Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur

SCIENTIFIC REPORT

2008 - 2013

Université Paris Sud bâtiment 508 - 91405 Orsay cedex

Foreword

This activity report covers the period from 2008 till mid 2013. Staff lists correspond to the permanent and temporary staffs which was present in the laboratory as of June 30st, 2013. Likewise the scientific publications correspond to this five and a half year period.

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Glossary

GRADUATE SCHOOLS

- EDIPS: ED427, Ecole Doctorale en Informatique de Paris-Sud (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 (Univ. Paris-Est and Marne-la-Vallée - UPEMLV)
- EDX: ED447, École Doctorale of École 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 (Pôle de compétitivité). 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: École Centrale de Marseille
- ECN: École Centrale de Nantes
- ECP: École Centrale de Paris
- ENPC: École National des Ponts et Chaussées
- ENS: École Normale Supérieure
- ENSAM: École Nationale Supérieure des Arts et Métiers
- ENSCI les Ateliers: Ecole Nationale Supérieure de Création Industrielle
- ENSIIE: École Nationale Supérieure d'Informatique pour l'Industrie et l'Entreprise
- ENSMA: École Nationale Supérieure de Mécanique et d'Aérotechnique, Poitiers
- ENSTA: École 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
- KIT: Karlsruher Institut für Technologie
- KTH: Kungliga Tekniska Högskolan, Royal Institute of Technology, Stockholm
- 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
- RTWH: Rheinisch-Westfaelische Technische Hochschule, Aachen
- Supelec: École 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 Diderot)
- UPEMLV: University Paris-Est Marne la Vallée
- UPMC: University Pierre & Marie Curie
- UPS: University Paul Sabatier Toulouse
- UPSay : University Paris-Saclay (IdEx)
- U-Psud: University Paris-Sud
- 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.
- 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: Senior Researcher
- 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: Permanent 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. Paris Diderot
- APC: AstroParticule et Cosmologie; UMR 7164 CNRS-CEA-Observatoire de Paris-Collège de France-Univ. Paris Diderot
- 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
- E3S: Equipe Supélec Sciences des Systèmes
- 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
- IBISC: Laboratoire d'Informatique, Biologie Intégrative et Systèmes Complexes; EA 4526, UEVE ENSIIE
- 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 l'UPMC, UMR 7606 CNRS-UPMC
- LIPN: Laboratoire d'Informatique de Paris- Nord, UMR 7030 CNRS-Univ. Paris Nord
- LISV: Laboratyoire d'Ingénierie des Systèmes de Verssaille; EA 4048, UVSQ

- 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
- LSV : Laboratoire Spécification et Vérification; UMR8643, ENS de Cachan
- 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
- PRISM: Laboratoire d'Informatique PRISM; UMR 8144 CNRS-UVSQ
- PROMES: Laboratoire Procédés, Matériaux et Energie Solaire: UPR CNRS 8521, UPVD
- SAMOVAR: Services répartis, Architectures, MOdélisation, Validation, Administration des Réseaux; UMR5157 CNRS-TELECOM SudParis
- 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, FRANÇOIS YVON, ANNE VILNAT, CHRISTIAN TENAUD

LIMSI is a CNRS laboratory associated (as well as co-located) with University Paris-Sud (U-PSUD); it is also associated with the University Pierre and Marie Curie (UPMC), through its historical links with UMPC mechanical engineering component. The laboratory was created in 1972 thanks to the efforts of Lucien Malavard, with an initial emphasis on numerical calculus for fluid mechanics, acoustics and signal processing. Research activities have progressively expanded to also include speech processing, infographics, then an increasing number of themes related to human-machine communication. A defining characteristic of the laboratory is thus its openness to a wide spectrum of research, ranging from thermodynamics to cognitive psychology, bridging across engineering and computer sciences. Research groups may be focused on diverse topics, they are nonetheless all engaged towards a shared goal: **to improve the well-being of man in his/her surrounding environment, both from material and immaterial aspects**. Our research thus strives at endowing society with better means of managing and using exponentially increasing streams of information, with more efficient and natural communication interfaces between humans and machines, with more efficient industrial design processes, with means of making the best use of available energy or natural resources, and with 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 disabled people.

Achieving these objectives requires developing the various basic 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, multilevel and multiphysics models, advanced dynamical systems, closed-loop control, in order to improve the predicting capabilities of the algorithms, either by taking into account new physical or social effects, model or parameter variability 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 resources such as annotated corpora or experimental databases.

The quality of our research can be measured in various ways, either along standard criteria evaluating the scientific production, or along criteria quantifying the relevance of our research with respect to our applied objectives. From this standpoint, since part of our research work aims to develop effective systems for large scale applications, LIMSI has established a long tradition of confronting its realizations with those produced by other teams across the world. This is particularly true for spoken language processing, where LIMSI has been involved in US/DARPA campaigns for more than 20 years on tasks of increasing complexity and has regularly been ranked amongst the very best over all these years. The laboratory has also been very active in initiating similar exercises in the domain of text language processing, either on Question Answering tasks, or more recently on Information Retrieval in the medical domain. Likewise, teams working on Fluid Mechanics have 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 specific configurations. This common practice of confronting algorithms to open challenges is another shared feature of LIMSI's teams.

As a multi-disciplinary laboratory, LIMSI is associated with four institutes of CNRS: primarily with the Institute for Information Sciences and Technologies and their interactions since the end of 2011, but also with the Institute for Engineering and Systems Sciences, the Institute for Humanities and Social Sciences, for its research in computational and corpus linguistics, and the Institute of Biological 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: section 07 dedicated to Information Sciences, section 10 devoted to Fluid Mechanics and Reactive Media, section 27 to Brain, Cognition and Behavior, and section 34 to Languages Sciences.

SCIENTIFIC ORGANIZATION

LIMSI is organized into two main scientific departments of uneven sizes: the department of Mechanics Energetics, and the department of Human-Machine Communication. The former is composed of 3 research

groups and corresponds approximately to 35 to 40% of our research forces; the latter is structured into 6 research groups and also comprises a transversal thematic action.

MECHANICS ENERGETICS (ME) DEPARTMENT

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 modeling 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 micro-meters 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 jointly develop 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.

COMPUTER GRAPHICS & THERMOAERAULIC ENGINEERING SUPPORT TEAM (CIGITA)

Our research in fluid mechanics and heat transfer heavily relies 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. 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 not only known algorithms and schemes but also new ones developed at LIMSI, and making efficient use of the available computing resources. The support team has been involved in the development of 4 numerical codes over the years, with a strong emphasis over the last 3 years on parallelization: CHORUS for compressible unsteady simulations with high order schemes, OLORIN for 3D unsteady flow (DNS or LES) either in the Boussinesq regime or under the low Mach flow approximation, BLUE devoted to two phase 3D incompressible flow developments, relying on the newest versions of the front tracking method with high performances on highly parallel supercomputers (Blue Gene Q in a PRACE project), and SUNFLUIDH for the simulation of unsteady flows under incompressibility and dilatability hypothesis including several levels of parallelization (domain decomposition, multithreading and GPU accelerator). Besides, the CIGITA support team also provides the researchers with hardware, including

both the administration and maintenance of individual computer equipment, and of the three clusters and a data storage server allowing for the development of parallelization of codes and algorithms.

Experimental support team

The experimental support team provides a support in the conception of set-ups for the experimental research activity carried out in the Mechanics-Energetics department, but also for the Human-machine communication department, notably in acoustics or virtual reality activities. Most of its current activities are related to fluid mechanics, with a recent emphasis 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. This team has been reinforced with the recent arrival of D. Caqueret (AI, CNRS).

Human-Machine Communication (CHM) Department

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 axes constitute the two main research fields of Human-Machine Communication Department.

Regarding interaction, research focuses both on the hardware aspects, with the development of new devices such as large tactile surfaces, haptic interfaces, and audio and/or visual reality augmenting tools for immersive interactions; and on software aspects: indeed, the machine may be represented as a conversational agent with which the user interacts, or as more complex embodied agents in immersive CAVE-like environments or as a robot. Studying human behavior in their interaction with these artificial environment is also critical for making these interactions as natural or as useful as possible. A particular field of interest, which gathers several groups, is the study and design of interaction devices and modalities in an artistic context.

Most information exchanged between humans is expressed by the means of language: either in the form of texts (for instance on newspapers' web sites) or recordings such as broadcast news or finalized conversations. But today's information is also more and more user-generated, and, arguably, less structured; the analysis, indexation and understanding of these various forms of "noisy" texts (forums, blogs and micro-blogs) and audio recordings (spontaneous conversations, recorded classes and talks, home-made videos) are less studied and pose new challenges, which need to be addressed, but also provide invaluable raw material for the in-vivo analysis of actual language use. Many other dimensions of language variation are also studied, alone or in combination: accentuated or emotive speech need to be characterized, transcribed and indexed, foreign texts need to be translated, technical texts in specialized domains (e.g. medical) need to be indexed or searched.

There are no clear cut boundaries between all these studies, and even if the department is primarily organized in groups, many projects actually gather researchers from these different groups.

Research axes

Research in the Human-Machine Communication Department addresses the different aspects of communication. This diversity begins with the medium used to communicate: from speech to writings, 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 classical WIMP interfaces (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) and paralinguistics (for research on social and affective dimension of spoken interactions) 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 for efficient algorithms to deal with communication constraints such as real time operation.

Research is primarily organized in six groups. 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 performed in these groups is strongly related to the activities of the Institute for Multimedia and Multimodal information (IMMI), an international CNRS laboratory hosted in our premises with the aim to develop and support LIMSI's collaborations with two German universities (RTWH in Aachen and KIT in Karlsruhe). The specificities of audio, speech and music are studied within the Audio & Acoustics group (AA), at the frontier between Human Language Technology and Interaction and between the two departments. The 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 behavior, 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 principal research 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 professional artists. The researchers involved in this theme are also members of one of the CHM groups. These collaborations between groups are very fruitful and enable to address a problem as a whole: taking into account both computer and human features for example.

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 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 originated in 2007 through the launch of the Digiteo research cluster (RTRA) in computer science, 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, including those already present and those who will join the Plateau in the near future. LIMSI has benefitted from important support from Digiteo, notably two chairs for visiting scholars: 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 at INRIA/Saclay. Digiteo has also supported two large equipment projects: SIMCOD, with support from CNRS, to install the large immersive facility EVE in the new building 512; a computing platform to support our activities in language science and technology, which require large computing resources and power to train the statistical models needed to perform tasks such as automatic speech recognition, multimedia indexation or automatic translation. Several collaborative research projects have also been funded and have helped to develop internal collaborations within Digiteo, often through joint supervision of PhD theses: over the last 5 years, a dozen PhD theses have been funded through Digiteo.

Digiteo has been instrumental in promoting 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 excellence laboratory (LabEx) DigiCosme, which focuses on 3 main key challenges for Computer and Information Sciences, one of them "DataSense" (Making sense out of massive data) being directly relevant for the activities of the Human-Machine Communication department.

The Mechanics-Energetics department is also part of a LabEx, LASIPS, which aims at forming a synergy between the classical engineering community, mechanics (both fluid and solid), 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 in 2012, and two of our proposals have been accepted, one with LGEP on MHD modeling, the other with ECP/EM2C on thermal transport at the nanoscale.

Since the founding of the IdEx 'Plateau de Saclay' early in 2012, LIMSI actively participates in the ongoing discussions regarding the future organization of the 'Université Paris-Saclay': the first steps have been to help shape the structure of the future doctoral programs in Information Technologies and in Mechanical Sciences; we have also been involved in the creation of two disciplinary departments, the Information Science and Technology department on the one hand, and the Mechanical Engineering department on the

other hand. These departments will organize the teaching and research in their respective disciplinary fields within the School of Engineering and Information Science and Technology.

INTERNAL ORGANIZATION

STAFF

As of the 30th of June 2013, LIMSI comprises:

- 32 CNRS researchers (of which two are emeritus): 15 Research Directors and 17 Research Associates ("Chargés de Recherche"), out of which 4 hold an HDR. These CNRS researchers are attached to their CoNRS evaluation section: 17 to section 07 "Information Sciences", 9 to section 10 "Fluid Mechanics and Reactive Media", 3 to section 34 "Language sciences", 2 to section 27 "Cognition, behavior, brain", 1 to section 9 "Structural and materials engineering, solid mechanics, biomechanics and acoustics".
- 48 Professors and Associate Professors (including one emeritus and one PRAG): 11 Professors, 37 Associate professors, of which 8 hold an HDR. Faculty members are affiliated to a number of CNU sections: 24 to section 27 "Computer Science", 2 to section 61 "Applied Computer Science, Automatics and Signal Processing", 16 to section 60 "Mechanics", 3 to section 62 "Energetics" and 3 to section 16 "Psychology". 32 of them are employed by U-PSUD, 9 by UPMC, and 7 by 6 other Universities or Engineering schools.
- 34 Support Staff (ITAs): 32 are employed by CNRS, 1 by U-PSUD and 1 by UPMC. 18 of these ITAs are in the Direction group and carry out general administrative or infrastructure and computer support for the entire laboratory; the remaining 16 work are more directly involved in research activities and are assigned either to research groups or to a department, distributing their activity over several groups.

In summary, a grand total of 80 CNRS researchers and academics are conducting their activity at LIMSI: 51 of them within the Human-Machine Communication department, and 29 within the Mechanics-Energetics department. 39 out of 80 hold an HDR. These numbers are remarkably stable with respect to the situation in 2007, with a very small increase of both CNRS researchers and university staff, which has benefited mostly to the CHM department. The number of habilitation (HDR) holders has also increased, as has the ratio between senior and junior researchers. This trend is not observed for the University staff and the balance between assistant professors and professors remains extremely unbalanced compared to the ratio of one professor for three assistant professors observed in most universities. As far as ITAs are concerned, a steady decrease (-5) is sadly observed.

In addition to the permanent staff, about 60 to 70 students are preparing a PhD degree at LIMSI, approximately 45 in the Human-Machine Communication department and 15 in the Mechanics-Energetics department. The number of post-doctoral interns is approximately 35. It has considerably increased over the last 4 to 5 years under the combined effect of ANR projects and of the Quaero program.

SUPPORT TEAMS

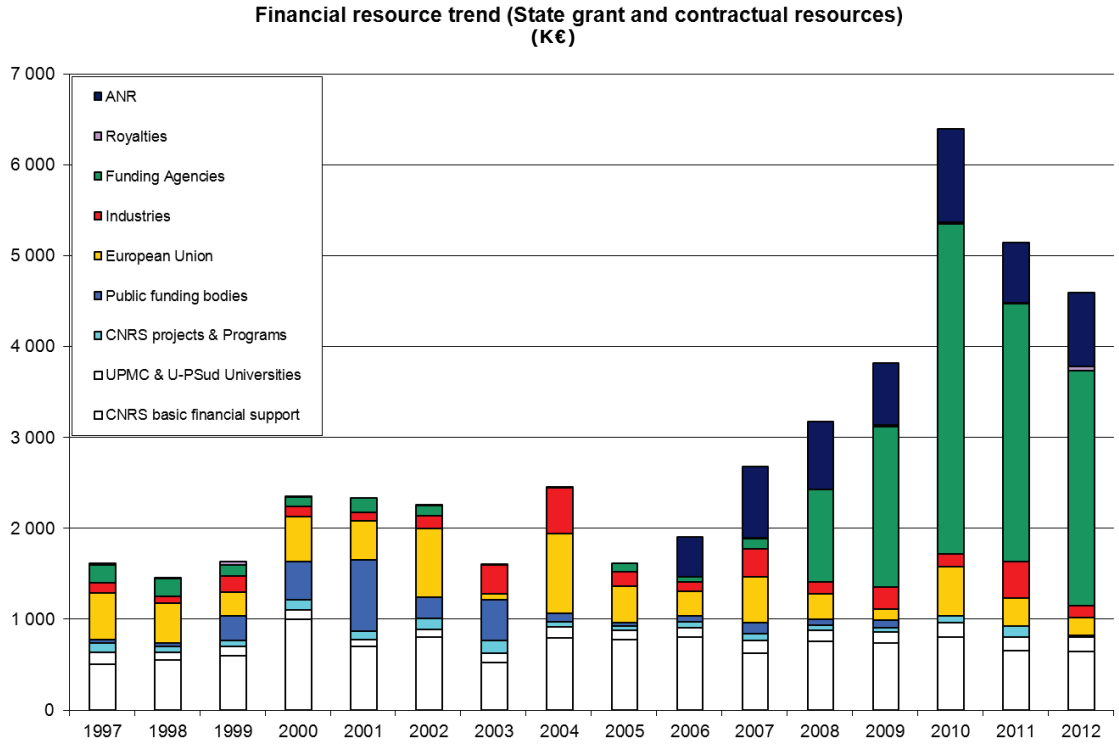
The research groups described above benefit from the active support of several technical and administrative staffs: about half of these support personnel is directly assigned to research groups (or departments); the activity of the other half is pooled for the benefit of the entire lab. These shared resources comprise the infrastructure cell, the computer support team, the documentation center, and the administration pool, which handles matters related to finance, management, contractual relationships and human resources. A complete organisational chart of the laboratory is given in appendix.

Support activities are facilitated by a number of in-house, as well as external, application and web services. The most notable applications concern staff management on the one-hand, and is especially useful to keep track of temporary staffs and interns; and publication management on the other hand, which enables to keep a precise count of the scientific production. Lists of personnel, PhDs and interns are given in appendix, as well as a complete listing of our publications.

FINANCIAL RESOURCES

The total funding budget of LIMSI amounts to 12.7 M€ in 2012, slightly above the average of the period 2008-2012 (12.5 M€). Approximately 9 M€ are direct funding from the State (corresponding to the salaries of the permanent staff and to State funding allocated by CNRS, U-PSUD and UPMC), and 3.7 M€ correspond to funding allocated to specific research projects by national or international financing

institutions (ANR, FUI, UE, etc.). The graph below displays the evolution of LIMSI's operating resources (including both contractual resources and State support) over the last 10 years and their breakdown by 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 grand financial resources.



Contractual resources available to research groups are extremely unbalanced: internal rules have thus been adopted and implemented to share a substantial part of these resources between groups. As a general policy, approximately 15% of each contract is collected by the laboratory. These shared financial resources are used to complement PhD grants, to finance missions and formations for PhD students and to fund small scale collaborative research programs within the laboratory. Approximately 8 to 10 projects are funded each year, after a public hearing and a discussion within the Laboratory Council.

GOVERNANCE AND INTERNAL ORGANIZATION

During the period, LIMSI has been headed by Patrick Le Quéré, also acting as the head of the 'Mechanics Energetics' department; Philippe Tarroux has been deputy director, head of the Human-Machine Department till the end of 2011. He has been replaced in this position in early 2012 by Anne Vilnat. After his nomination at the Ecole Polytechnique in the summer of 2012, P. Le Queré has been replaced by Christian Tenaud as the head of the Mechanics Energetics department. Starting July the first, 2013, a new management team is installed, headed by François Yvon (Director), with two deputy directors (A. Vilnat and C. Tenaud) heading their respective department, and an administrative officer in the person of Karine Bassoulet.

The management team has been working in close relationship with heads of scientific groups, holding meetings on a monthly basis. Likewise, the laboratory council, last elected in 2008, has been meeting eight to ten times a year, to discuss all subjects related to the scientific policy, to evaluate LIMSI internal scientific projects, but also to address administrative or other internal affairs. The lifetime of the council had to be extended in 2012 to sync with the new evaluation calendar of the laboratory; elections will be held in the fall of 2014. Department councils have also been installed in 2011 in each department, meeting on a per request basis. A statutory General Assembly is held in the first month of each year.

A scientific council (COS) gathers the more senior research staff (full professors, research directors, and other scientists holding an HDR). The COS has been summoned a handful of times during the period, notably for the designation of the new direction, and for the preparation of the prospective report.

Other ad-hoc commissions have been meeting on a per request basis to discuss general issues related to the premises, to the laboratory Web site or other Web services, to the computing resources, or to the general security conditions and regulations on site. One such commission specifically addresses issues related to doctoral studies.

Highlights

This section highlights a small numbers of activities which have been selected to cover a large spectrum of works and themes, from basic research to applications, from fluid mechanics to man-machine interactions.

Uncertainty Quantification

The most salient results during the period for the Uncertainty Quantification activity have been: (i) the development of stochastic reduced basis approaches for non-linear stochastic problems, (ii) the definition and implementation of a Roe-type flux Galerkin solver for stochastic hyperbolic systems, (iii) the improvement of non-intrusive methods by compressed-sensing and preconditioning approach.

Transition to turbulence

During the period, major advances in the fundamental understanding of subcritical transition to turbulence in wall-bounded flows were made, via the computation of exact coherent structures. These novel approaches obtained a large international recognition, as 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 two front covers of Journal of Fluid Mechanics (Y. Duguet, A.P. Willis, R.R. Kerswell, Slug genesis in cylindrical pipe flow, JFM, 663, 180-208, 2010, and T. Khapko, T. Kreilos, P. Schlatter, Y. Duguet, B. Eckhardt, D. S. Henningson, Localized edge states in the asymptotic suction boundary layer, Journal of Fluid Mechanics, 717, R6, 2013).

Quaero

LIMSI's contribution to the Quaero program (2008-2013) has been major: J.L. Gauvain has driven the Core Technical Activities of the project, encompassing 21 French and German partners with a total funding of about 35M Euros. The management effort included the organization of 11 bi-annual two-day workshops and the coordination of the writing of about 25 progress reports (each containing several hundred pages). Scientifically the program has supported more than 700 publications, dozens of PhD theses, and the production of several large scale speech and text corpora. The program had a very high impact on French research in all areas related to information retrieval for multimedia content. Both the TLP and the ILES group were involved in this program, advancing the state-of-the-art in several subdomains (speech transcription; speaker diarization; machine translation; named entity recognition; etc.).

Augmented and Virtual Reality

EVE, a large immersive environment was imagined, designed in the course of many years; it was finally installed in 2010. It has since enabled several major realizations: immersive applications (such as MalCoMIICs for immersive collaborations), platforms such as SMART-I² (multimodal perception) and MARC (design and animation of virtual agents, recently used in a collaboration involving the MIT MediaLab). EVE is also used and developed in close cooperation with LRI (Orsay) and CEA (Orsay) in the context the EquipEx Digiscope.

Art and Sciences

During the period, the transverse action VIDA (Virtuality, Interaction, Design, & Art), which orchestrates activities conducted in several groups (AMI, CPU, VENISE, AA, etc.), has flourished and engaged in many fruitful interactions with the arts and culture community: design of original cultural events such as "Genius Loci" (augmented reality of historical sites) and "Canal Haptique" (using haptic interactions to remotely convey emotions); design of multimodal human-computer interactions in arts ("Chorus Digitalis" or "Beautiful Beasts"); use of virtual materialities in artistic performances such as dance. These activities have given rise both to a large number of artistic performances and realizations, and to a rich scientific production.

STAFF (SUPPORT TEAMS)

PERMANENT STAFF

Last name	First name	Type of position	Employer	Group	HDR	Arrival date	Departure date
Barbet	Jean-Claude	Res. Eng.	CNRS	Direction		Hired as of 01/07/2009	
Bassoulet-Thomazeau	Karine	Res. Eng.	CNRS	Direction			
Bélizon	Guy	Technician	CNRS	Direction		Hired as of 01/05/2013	
Berezaie	Cristelle	Adm. Staff	CNRS	Direction			Left on 31/01/2010
Brilhac-Roserat	Magali	Ass. Eng.	CNRS	Direction			
Daly	Bénédicte	Adm. Staff	CNRS	Direction		Hired as of 01/12/2012	
Depauw	Annie	Technician	CNRS	Direction			
Desroches	Pascal	Technician	CNRS	Direction			
Durand	Pierre	Technician	CNRS	Direction			Retired on 30/04/2013
Hamon	Sébastien	Adm. Staff	CNRS	Direction		Hired as of 01/06/2009	Left on 01/04/2011
Lassalle	Olivier	Ass. Eng.	CNRS	Direction		Hired as of 01/05/2012	
Lerin	Daniel	Ass. Eng.	CNRS	Direction			Retired on 06/12/2010
Liège	Alexandre	Ass. Eng.	CNRS	Direction		Hired as of 01/12/2008	Left on 01/12/2011
Lollia	Isabelle	Adm. Staff	CNRS	Direction			
Merienne	Bernard	Res. Eng.	CNRS	Direction			Retired on 01/06/2009
Pageau-Maurice	Sophie	Adm. Staff	CNRS	Direction			
Pain	Nadine	Adm. Staff	CNRS	Direction			Retired on 30/04/2013
Piotelat	Elisabeth	Res. Eng.	CNRS	Direction			
Bourdin	Vincent	Res. Eng.	CNRS	Experimental Support team			
Caqueret	Dorine	Ass. Eng.	CNRS	Experimental Support team		Hired as of 01/01/2011	
Gautier	Vincent	Technician	UPMC	Experimental Support team			
Maire	Yves	Technician	Université Paris Sud	Experimental Support team			
Chergui	Jalel	Res. Eng.	CNRS	CIGITA			
Dang Anh	Tuan	Res. Eng.	CNRS	CIGITA			Retired on 04/07/2012
Fraigneau	Yann	Res. Eng.	CNRS	CIGITA			
Berthelin	Jean-Baptiste	CR	CNRS	DEPT			
Charrue	Martine	Adm. Staff	CNRS	DEPT			Retired on 31/07/2009
Hoint	Carole	Adm. Staff	CNRS	DEPT		Hired as of 14/03/2011	
Ronflé	Valérie	Adm. Staff	CNRS	DEPT			
Rostaing	Laurence	Adm. Staff	CNRS	DEPT		Hired as of 01/12/2008	
Sabah	Gérard	DR	CNRS	DEPT	HDR		Retired on 06/01/2013
Vérin - Chalumeau	Béatrice	Adm. Staff	CNRS	DEPT			Left on 31/08/2008

NON PERMANENT STAFF

Last name	First name	Group	Contract	Arrival date	Departure date
Diarra	Seydou	DEPT	CDD	01/02/2008	29/02/2008
Jousset	Michelle	DEPT	CDD	09/06/2008	31/12/2008
Azhar	Abderahman	GDIR	CDD	01/06/2011	15/09/2013
Bellande	David	GDIR	CDD	01/01/2013	31/10/2013
Falck	Mélanie	GDIR	CDD	01/02/2011	30/11/2012
Gobillard	Bertrand	GDIR	CDD	01/10/2008	01/04/2009
Jacquet	Christophe	GDIR	CDD	15/11/2010	31/12/2012
Meyer	Camille	GDIR	CDD	25/05/2009	31/01/2010
Moulonguet	Nicolas	GDIR	CDD	01/12/2007	30/04/2008
Picone	Marie	GDIR	CDD	03/11/2008	15/12/2009
Poirot	Romain	GDIR	CDD	01/10/2010	31/12/2013
Sineau	Olivier	GDIR	CDD	01/04/2010	15/10/2010
Solaz	Daniel	GDIR	CDD	01/01/2010	31/01/2010

BÉRENGÈRE PODVIN - 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 number flows). Associating the triptych modeling / simulation / experiment, the group seeks to achieve two main objectives. The first objective, a fundamental one, 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 with each other to validate modeling approaches and to characterize the dynamical behavior. The accuracy and efficiency of numerical tools designed in the group are constantly assessed through 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 in which specific and well-identified topics are developed:

High performance numerical methodologies: The objective of this theme is to increase the capabilities of the numerical simulations by developing reliable, efficient computational methods in order to (*i*) reproduce fundamental physical phenomena with a high degree of fidelity (*ii*) simulate realistic configurations of marked industrial interest involving complex geometries and/or multi-physics flows. The core issues associated with this theme deal with the resolution of partial differential equations describing fluid flow dynamics: they include the development of high order numerical schemes and sub-grid modeling for 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 fundamental physics of unsteady flows. It aims at a thorough description of the basic phenomena, which should lead to a better understanding, and meaningful analysis of the flow dynamics. This is achieved by combining efficient numerical simulations and innovative experimental methods with advanced dynamical analysis tools. Extraction of coherent structures, characterization of their dynamics, and determination of the unsteady velocity-pressure coupling are carried out for highly unsteady, largely separated flows.

Manipulation and flow control: This theme aims at bridging the gap between mathematical advances in control theory and realistic strategies for flow optimization, in a context of energy-saving applications (drag reduction, mixing enhancement or blockage within the fluid, energy transfer at the wall…). Fluid flow control involves several steps: 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. At different stages of the process, an effort is made to include realistic constraints into the design of the control tools.

Most of our research activities are funded through research grants, in particular by the Agence Nationale de la Recherche (ANR) and RTRA foundations; for instance the group had 4 ANR projects (one as leader) and 3 RTRA DIGITEO grants, as well as one European STREP project running during the period 2008—2013. Part of our work is carried out in collaboration with groups in laboratories belonging to CNRS or the

French Universities (Pprime Institute, Poitiers; EM2C/EC-Paris, Châtenay-Malabry; GEM, EC-Nantes; LMO, Université d'Orsay; Camille Jordan Institute, Université de Lyon; CERMICS/ENPC, Marne-La-Vallée; SATIE/ENS, Cachan; PMMH/ESPCI, Paris; LTPM, Grenoble; DynFluid/Arts & Métiers ParisTech, 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 ACTIVITIES

TOPIC 1: HIGH PERFORMANCE NUMERICAL METHODOLOGIES

*V. Daru, Y. Fraigneau, **O. Le Maître**, F. Lusseyran, L. Mathelin, L. Pastur,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 processes. In this context, we have 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 Multi Resolution 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, considering large simulation domains with conventional computing resources.

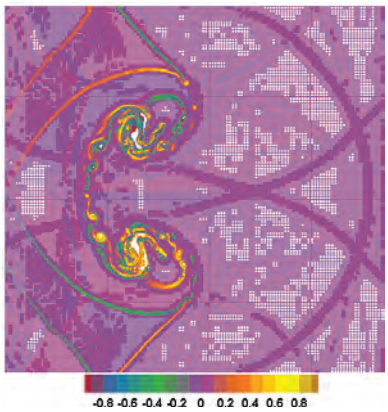


Illustration 1 – Interaction of a high density bubble with a Mach 2 steady shock wave at a dimensionless time t = 0.8: Vorticity contours colored onto the refined grid downstream of the interaction. Mesh is refined in the vicinity of wave patterns as well as regions exhibiting high vorticity.

In addition to our developments of high accurate approximations on Cartesian grids, we develop a new conservative coupling algorithm for fluid–structure interaction of deformable moving bodies with a compressible flow (PhD thesis of L. Monasse and A. Puscas, 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 flow 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 to be extended to three space dimensions. This was achieved 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. Special attention was given to geometrical considerations to ensure conservation and consistency of the numerical methods.

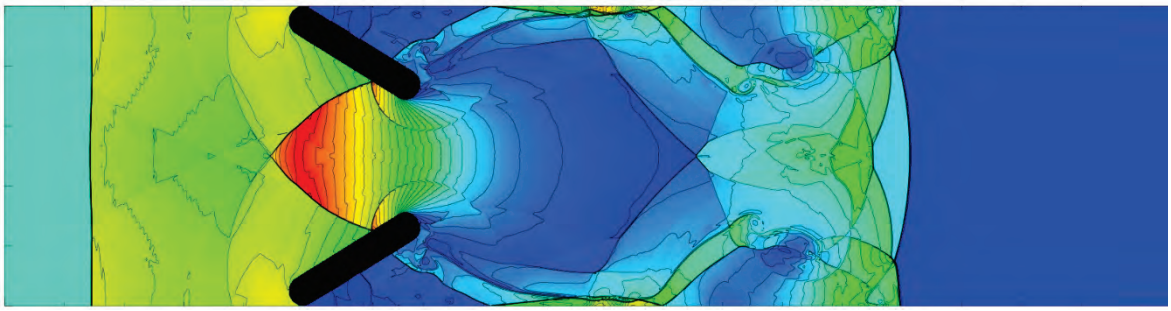


Illustration 2 - Wave patterns produced by the interaction of a strong shock wave with flapping doors: Density contours at time 0.375 s. L. Monasse, 2011 © collaborative work between CEA-DAM, CERMICS-ENPC, and LIMSI-CNRS.

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 LOW MACH LIQUID-GAS FLOWS *(V. Daru, O. Le Maître, with contributions of M.-C. Duluc (TSF group) and P. Le Quéré (CORO group)):*

The simulation of two-phase (liquid and gas) flows, with phase change, must account for the compressible nature and the equation of state of the gas phase. This yields severe constraints on the simulation time-step, which should be short enough to represent fast acoustic waves. Many two-phase flows are however controlled by heat transfer rather than by pressure waves, with a characteristic fluid velocity much smaller than the sound velocity. This situation allows for the Low Mach number compressible approximation where acoustic waves are removed, and thus significantly accelerating numerical simulations. An important effort was made in these last years to develop numerical methods adapted to two-phase flows, where the gas phase is characterized by a low Mach number and the liquid phase is treated as incompressible, i.e. with a divergence-free flow. This approach raises the problem of relating the pressure fields in the liquid phase and in the gas phase, because of the conceptually different nature of pressures in compressible and incompressible phases: a thermodynamic pressure can be defined only in the gas phase. This is the case for instance when several gas bubbles with different gas pressures are embedded in a liquid. The differences in pressure from one bubble to another induce forces on the liquid phase, resulting in a flow, while the fluid inertia induces alternated expansions and contractions of the bubbles. We solved this problem by splitting the pressure into thermodynamic and dynamic components and by extending the thermodynamic pressure field in the liquid to continuously connect the thermodynamic pressures in the different bubbles (Illustration 3). The method was validated and proved to be much more efficient compared to a classical single pressure field approach (Daru et al., JCP, 2010). The method was also extended for microfluidic simulations in the TSF group.

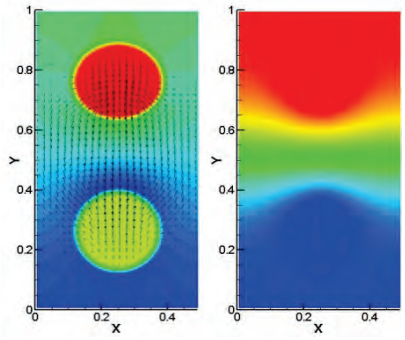


Illustration 3: Rectangular box with two air bubbles at different initial pressures inside water. Surface tension is taken into account.

Velocity field superimposed on the dynamic pressure field at time 1µs (left), extended thermodynamic pressure field (right).

Illustration 3: Rectangular box with two air bubbles at different initial pressures inside water. Surface tension is taken into account.

Velocity field superimposed on the dynamic pressure field at time 1µs (left), extended thermodynamic pressure field (right).

NUMERICAL METHODS FOR UNCERTAINTY QUANTIFICATION *(O. Le Maître, L. Mathelin, J. Pebel, A. Perrera, A. Tassi and J. Tryoen):*

We work on various Uncertainty Quantification problems, focusing on methodological and algorithmic developments. Our contributions principally rely on **probabilistic approaches for parametric uncertainties**, where uncertain model parameters are described by joint-probability distributions. The core of our research activities has been primarily organized around the forward propagation problem

where, given the model parameters distributions, the objective is to compute the distribution of the model solution or of some quantities of interest. Methods and algorithms we develop are tested and validated on various fluid flow models, including environmental flows (subsurface and run-off flows, infiltration), incompressible Navier-Stokes equations, free-surface flow (St Venant equations), Euler models, but also on reacting systems, reduced dynamical systems and conservation laws. For these different models, the uncertain parameters may account for incomplete knowledge of initial / boundary conditions, systems geometry and physical or model constants (scalars or field values) describing the properties of the media.

At LIMSI, spectral or functional expansions are mainly used to represent the model solution dependences, with respect to the uncertain parameters, as such representations offer rich characterizations of the model output uncertainty and provide a surrogate model which can be used for many subsequent purposes (calibration, identification, robust optimization, assimilation, variance decomposition,…). 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. As a result, straightforward functional expansions exhibit a computational cost that quickly grows with the number of uncertain parameters and the dimension of the representation basis, and most of our efforts over the last years has been dedicated to the development of **efficient approximation methods and dedicated algorithms** designed to maintain reasonable computational complexity. These efforts include the development of adaptive strategies at the stochastic level, reduced basis representations, improved sampling approaches, stochastic preconditioning, … some of these contributions being 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 4), and for up to 6 uncertain parameters [Tryoen *et al.*, 2011, Tryoen *et al.*, 2012].

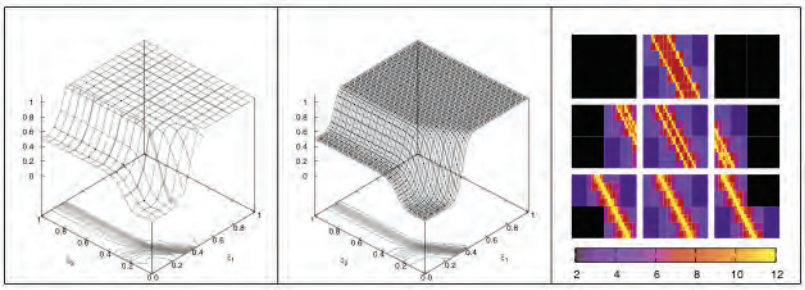


Illustration 4 - Stochastic Burger equation. Solutions at a point (x,t) as a function of 2 random parameters and for uniform resolution levels 2 and 4 (left plot). Color-coded adapted stochastic resolution for a traveling shock, as a function of time -top to bottom- and at 3 spatial locations -left to 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.*, 2013]. 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 concern the extension to unsteady [Mathelin *et al.*, 2009] and coupled problems.

Sparse approximations: efforts have also been made in efficiently using the available computational resources for approximating the solution of a CPU-intensive stochastic problem. For many problems encountered in practice, the solution exhibits a sparse representation in commonly used approximation bases. To exploit the sparse character, techniques inspired from the Compressed Sensing theory have been used in the uncertainty quantification context to focus the available information and resources to solely estimate the coefficients associated with the basis elements significantly contributing to the approximation. The method was applied in a non-intrusive context for estimating the solution of Shallow Water Equations with uncertain parameters. Significant savings in terms of number of necessary samples were achieved, hence decreasing the number of deterministic solutions to compute. An example involving 8 independent random parameters was considered and the method was shown to achieve similar accuracy (in L-2 norm) as sparse grid techniques while requiring about two orders of magnitude less samples.

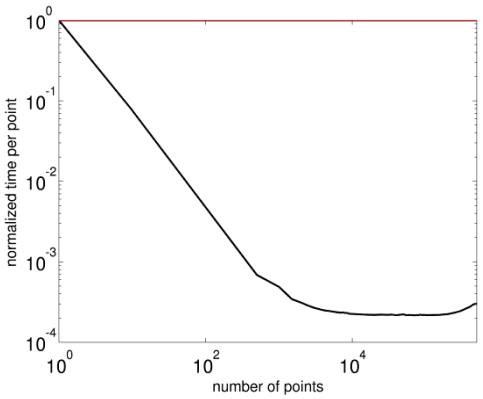
Stochastic preconditioning, asynchroneous integration and multiscale problems: uncertain models can exhibit complex dependences with respect to the random parameters, thus requiring high-order expansions when stochastic polynomial bases are used. This is typically the case when the characteristic time-scales 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 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 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 has been recently applied to the Navier-Stokes equations for uncertain unsteady flow around a cylinder with random fluid viscosity and inflow velocity [Schick, Heuveline and Le Maître, 2013]. The more complex situation of stiff systems with uncertain broad range of time-scales was 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 to reduce the polynomial degree of the approximation and to alleviating the severe constraint on the time-step required for stable explicit time-integration.

HIGH PERFORMANCE COMPUTING *(Y. FRAIGNEAU, O. LE MAÎTRE, F. LUSSEYRAN, L. PASTUR, C. TENAUD)*

The emergence of plateforms with hybrid GPU / CPU architectures has called for an adaptation of the computer codes to take full advantage of these new computational resources. In collaboration with M. Baboulin at LRI (Orsay), we have started a collaboration on the parallelization of the code Sunfluidh which solve the weakly compressible Navier-Stokes equations on structured grids. The parallelization involves a classical domain decomposition approach, with distribution over multiple CPU nodes, and multi-threaded local resolution with GPU-based acceleration. The progressive parallelization of the code components has already shown significant performance gains, the GPU acceleration being particularly promising. The project is supported by Digiteo through the funding of a PhD-thesis (Y. Wan, 2011-2014, Paris-Sud, co-advisors M. Baboulin (LRI) and O. Le Maître).

Detection and tracking of Lagrangian coherent structures require high computing performances. Following the Finite Time Lyapunov Exponents (FTLE) technique, divergence and contraction rates of the flow trajectories are determined in the frame of Florimond Guéniat PhD. However, the detection and tracking of these structures is a computationally demanding task, requiring the treatment of massive amounts of data. An optimized software, based on hybrid computer configuration (GPU / CPU), has been developed for FTLE calculation of 2D and 3D velocity fields. The optimization was done in two steps: (i) a vectorization step following the SIMD model which led to a reduction in the computing time of more than 3 decades (illustration 5-a), (ii) deporting map computations on a GPU chipset increase the efficiency by one decade (illustration 5-b). All the estimations are done using a laptop and the performances are largely increased when using dedicated hardware.

a



b

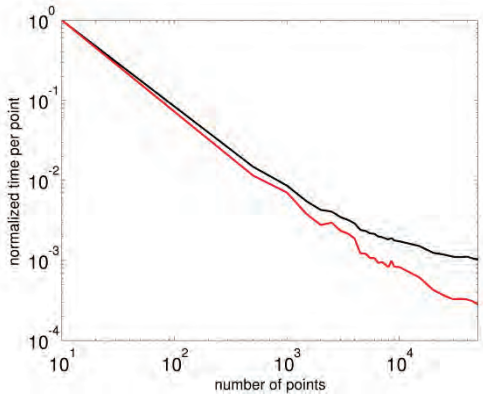


Illustration 5: (a) influence of an SIMD algorithm on intermediary-flow computations. (b) influence of a GPGPU treatment of interpolation.

TOPIC 2: UNSTEADY FLOWS

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

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 STICAM-Sud program, with A. Cammilleri (LFD, UBA), J. Carlier (FLUMINENCE, INRIA), E. Memin (FLUMINENCE, INRIA) and, G. Artana (LFD, UBA)):*

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 different projects (ANR DIB & CORMORED, DIGITEO Fluctus & Muse, PhD Thesis F. Guéniat) and supported by DGA & CNRS grants of two PhD Thesis of J. Balsey 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 (Illustration 6 -a). 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 achieved the parametric study of dynamics of bifurcations encountered in the inner flow, varying both the Reynolds number and the cavity aspect ratio, in the frame of two PhD Theses (J. Basley, C. Douay).
- Modal decompositions have also been employed to analyze and deduce the dynamics of the flow. Power spectral densities evolve with the control parameters. Regimes of shear layer oscillations were investigated through the spatial dynamics associated with the main frequencies of the flow. Hence, coherent structures in the permanent regime have been identified in velocity fields obtained through experimental measurements (PIV and time-resolved PIV) and direct numerical simulations, using proper orthogonal decomposition (POD), global Fourier modes or dynamic mode decomposition (DMD). Jérémy Basley's PhD thesis, defended in 2012, provides a thorough analysis of the coupling between shear-layer oscillations and the inner-flow. This includes drastic interactions with 3D structures deriving from centrifugal instabilities and characterized by frequencies down to 2 orders of magnitude smaller

(Illustration 6 -c). Part of this study was funded by an internal initiative financial support held by Nathalie Delprat & Luc Pastur and a CNRS & DGA doctoral scholarship.

- We have worked on detection and tracking of Eulerian and Lagrangian coherent structures, in the frame of projects DIGITEO Fluctus and ANR DIB, in collaboration with LRI (Orsay), Pprime (Poitiers) and PSA. 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 (LCS) that are surfaces embedded in the fluid through which the flow rate vanishes (Illustration 6 -b).

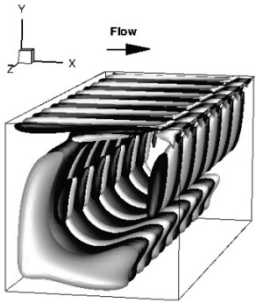


Illustration 6 a: Open cavity flow - Alley of Taylor-Görtler-like vortical structures resulting from centrifugal instability

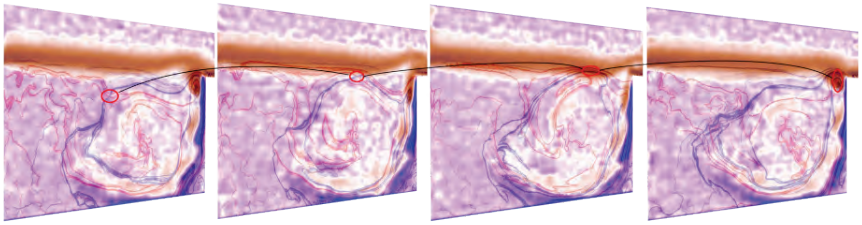


Illustration 6 b: Time-sequence of stable (blue) and unstable (red) lagrangian coherent structures identified from 2D-2C PIV (encircled is the saddle point at the intersection of both stable and unstable manifolds)

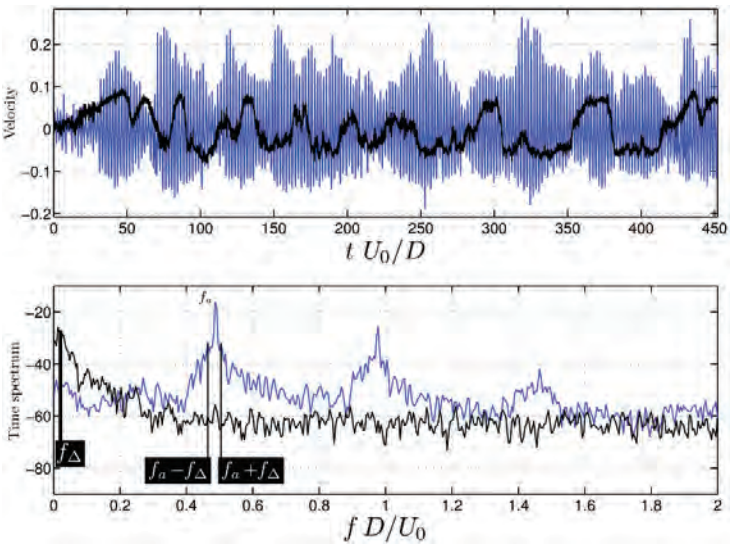
Illustration *6 c: Velocity fluctuations extracted from TR-PIV* datasets for L/D = 2.0, L/*θ0 = 82:*

top: Time-series

bottom: corresponding time spectrum (window averaged).

light blue: crosswise fluctuations v'/U0 extracted inside the shear,

black: streamwise fluctuations u'/U0 extracted inside the cavity,



c)

- 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 criteria, 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 negligible compared to dominant structures. As a consequence, reduced order models may blow up on finite time scales due to energy accumulation. Since spectral modes are associated with eigenvalues 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 applied with success to time-resolved PIV fields from a cylinder wake flow at a Reynolds number of 3900.

WALL PRESSURE FLUCTUATIONS AND COHERENT STRUCTURES (*P. Debesse, T. Faure, Y. Fraigneau, F. Lusseyran, L. Pastur, B. Podvin and C. Tenaud)*:

Mainly developed in the ANR project DIB[1] (2007-2011), this task aimed to a quantitative analysis of unsteady aerodynamic fields and their associated sound production mechanisms. Aerodynamic systems considered in this project 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 to the ANR DIB project dealt with: 1- the quantitative analysis of the main mechanisms involved in unsteady Aero-Acoustic flows, 2- the creation of both experimental and numerical (DNS of an open cavity and of a blunt flat plate (illustration 7 -a) databases, and 3- the development of analysis tools such as , for instance, *(i)* flow structures identification by FTLE computations (cf. Research Theme 1), *(ii)* the dynamic mode analysis of the forward-facing blunt flat plate flow that allows us to explain the connection between the steady field and the acoustic far field (illustration 7 -b), and *(iii)* the synchronized measures between wall pressure fluctuations and the velocity field in the open cavity at low Reynolds numbers.

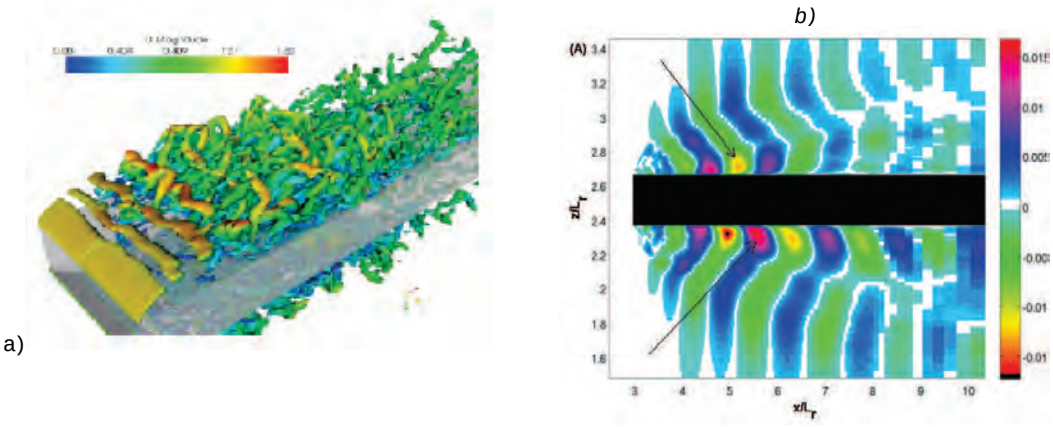
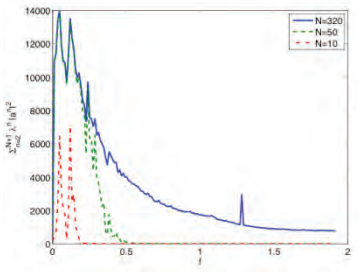


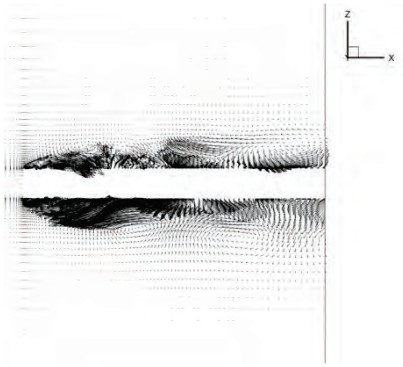
Illustration 7: Numerical predictions through Large-Eddy Simulation (LES) of the separated—reattached turbulent flow over a blunt at plate: a) Snapshot of an iso-surface of the Q criterion (Q=3) colored with the norm of the velocity b) Real-part of the dynamic mode associated with the 3rd main frequency f3 = 1693 Hz

Extensive POD analysis was carried out for the full 3-D velocity field as well as for the surface pressure on one side of the plate. POD analysis shows that outside the recirculation bubble, the most energetic motions consist of large-scale vortices shed downstream of the reattachment point (Illustration 8 a)). The spanwise extent of these vortices is of order the plate thickness H and their separation is about 1 to 2H. These motions are characterized by two frequencies fH/U0 = 0.04 and fH/U0 = 0.12, as can be seen in Illustration 8 b). The first frequency is associated with the flapping of the recirculation bubble and scales with the recirculation length, while the second frequency is associated with the shedding process and scales with the height of the bubble. A satisfactory agreement was reached with the results of Kiya and Sazaki (JFM 1985) and Trun's PhD thesis (2012). POD analysis of the surface pressure shows that the same frequencies can be identified on the surface (Illustration 9 a). In addition, it was found that that the pressure modes are quasi-invariant in the spanwise direction (Illustration 9 b). The vortical motions that can be deduced from the pressure modes are most intense in the reattachment region.

[1] *Dynamics, Unsteadiness and Noise around a blunt flat plate (Dynamique, Instationnarité et Bruit, DIB ANR Project, ANR- 07-BLAN-0177)*

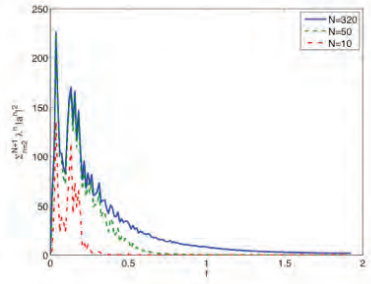
a)



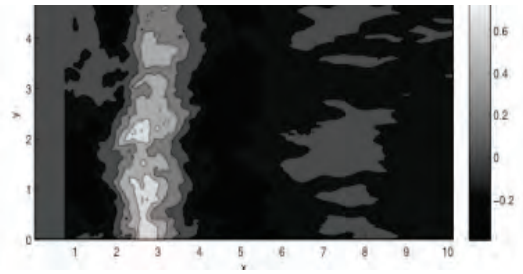


b)

Illustration 8 a) Spectral content of the first N POD fluctuating velocity modes for various truncations b) Most energetic fluctuating POD velocity mode



a)



b)

Illustration 9 a) Spectral content of the first N POD fluctuating pressure modes for various truncations b) Most energetic fluctuating POD pressure mode

Pulsating Jets and Voice Production *(D. Sciamarella and F. Lusseyran in collaboration with C. d'Alessandro (AA) and G. Artana, Univ. of Buenos-Aires through the LIA PMF with a master thesis (A. Centeno) and a thesis in co-tutorship (F. Tuerke)).*

Glottal flow is the air jet generated by a couple of 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 jet flows, and for the development of flow control applications based on bio-inspired devices. This work is developed in collaboration with the LFD, a partner laboratory of LIMSI in the Franco-Argentinian International Associated Laboratory in the Physics and Mechanics of Fluids (LIA PMF).

In 2011-2012, the focus was laid on the flow generated in a biomimetic channel, in which the larynx is represented with static geometries. The flow field was studied experimentally, with and without modulation, using the Stereo-PIV technique. Angel Centeno completed his diploma thesis with the characterization of a free jet with a glottal-like aspect ratio (Illustration 10-a). The principal finding of this thesis is the splitting-and-switch sequence observed for typical glottal flow rates. The customary presentation of bifurcation as a consequence of the axis switching phenomenon in elongated jets becomes questionable in view of our results. The glottal-like jet is shown to bifurcate in the vicinity of the jet exit with a mean field that bears the signature of vortex reconnection processes, known to be a potential source of intense sound generation. Axis-switching occurs further downstream, according to our theoretical self-similarity predictions (Illustration 10-b). The laboratory implementation of the pulsating case is achieved with a modulating flow system developed by Sciamarella and Artana. Acoustical experiments were performed with the flow modulating system connected to a Sondhi tube (a long tube with an anechoic termination). The method is shown to be sound for direct measurement of the glottal flow derivative. Florian Tuerke (PhD Student in a LIA PMF co-tutorship) started working on the linear instability analysis of an open single-cavity flow, in view of a study of the two facing cavities encountered in glottal flow production. A new perspective on non-harmonic mode coexistence, commonly found in the shear layer spectrum of open cavity flows, was obtained using the coincidence condition first proposed by Kulikowskii. This analysis seems to lead to the theoretical prediction of the discrete frequencies of the half-a-century-old semi-empirical formula by Rossiter (1964) (Illustration 10-c).

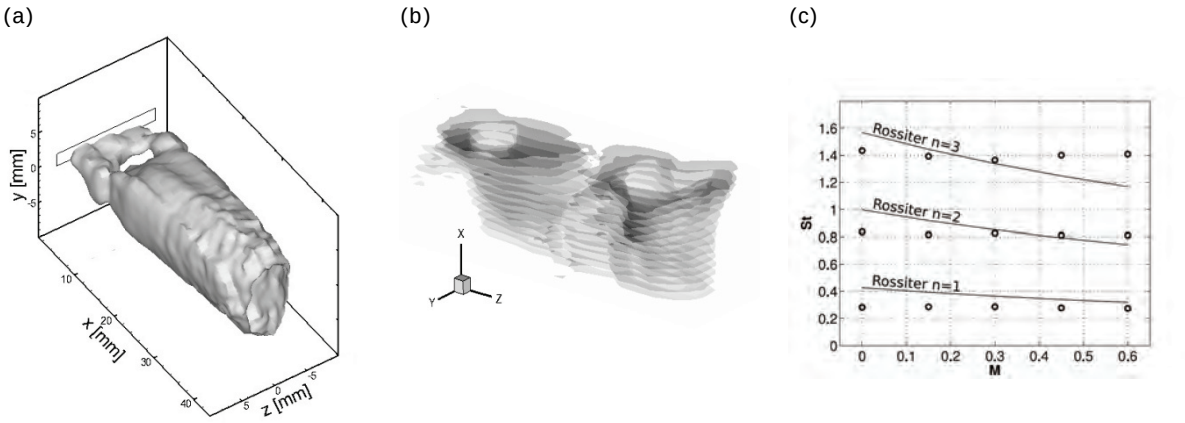


Illustration 10. a) Bifurcation and axis-switching in the biomimetic jet from 3D-PIV measurements; b) Focus on the bifurcation region (3 mm < x < 8 mm) showing piled-up slices of iso-velocity contours; c) Strouhal number as a function of the Mach number with the semi-empirical Rossiter formula (lines) and the compressible linear stability analysis in a finite domain (circles).

TOPIC 3: MANIPULATION AND FLOW CONTROL.

*B. Podvin, **L. Mathelin**, T. Faure, Y. Fraigneau, O. Le Maître, F. Lusseyran, L. Pastur, S. Pellerin 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.

(L. MATHELIN, T. ROUILLON, 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 11) to reduce the drag of an academic geometrical configuration. The geometry however represents a simplified rear part of a car (Illustration 11). 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. Up to 50 % reduction of the drag is here achieved by using a global optimization (Illustration 12).

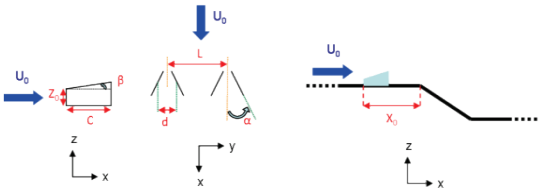


Illustration 11 - Vortex generator parameters and dihedron configuration

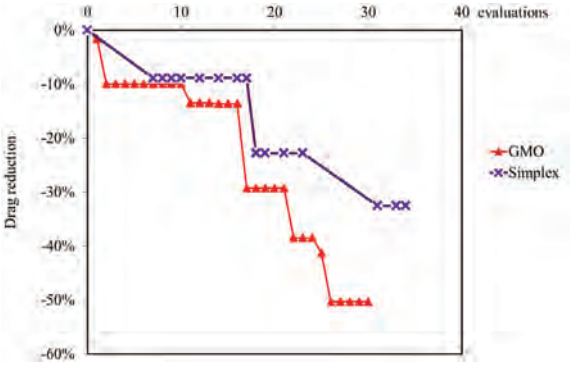


Illustration 12 - Drag reduction on a dihedron configuration representing the rear-part of a car: Comparison between a Simplex method and a global optimizer (the EGO method).

Manipulation of unsteady flow over a flat plate with a ramp – Preliminary results

(S. PELLERIN)

Reactive control constitutes another option to achieve drag reduction in aerodynamic applications such as the automobile industry. The idea is to use upstream wall actuation to modify vortex dynamics in the recirculation region. It requires a thorough understanding of the physics of unsteady separation and its induced drag, as well as of the action of wall generators. To this end we have developed a numerical simulation tool based on the velocity-vorticity formulation, which allows (i) accurate simulation of a given configuration (ii) direct manipulation of the flow through modification of the vorticity at the boundary. Only results for the reference flow are shown here.

The configuration chosen corresponds to the 3D unsteady, turbulent flow over a flat plate with a ramp with an angle of 42° and constitutes a benchmark case for the GDR "Contrôle des décollements". The Navier-Stokes equations are solved using the (v-ω) formulation for incompressible flows. LES is chosen for turbulence modeling, associated to the mixed-scale model (Loc et al., 2005). A penalization method is used for the solid zones. To force the vorticity vector to be zero inside the solid at each time step, it is imposed that $\partial\omega/\partial t = 0$. The grid is refined at the beginning of the ramp for the vertical direction y and corresponds to 5,1 million points. A turbulent boundary layer with a superposed white noise is applied at the inlet. Simulations are performed for a Reynolds number Re = 8.4 × 104, based on the upstream velocity U∞= 25.2 m/s-1, ramp height h and fluid viscosity νair.

Vortex structures with different scales are generated inside this unsteady turbulent flow (Illustration 13 a). The mean values are calculated and the mean separation zone length (l/h = 5.2) estimated is in agreement with a reference experiment (Kourta et al., 2011), which constituted a test case for the GDR "Contrôle des décollements". The turbulent kinetic energy k field shows zones with high intensity of turbulence (Illustration 13 b). In addition, the pressure coefficient Cp agrees with experimental data, in terms of values and evolution, particularly the constant level corresponding to the separation zone close to the wall. The theoretical slope of the turbulence cascade is also recovered on the energy spectra of velocity fields (Illustration 13 c).

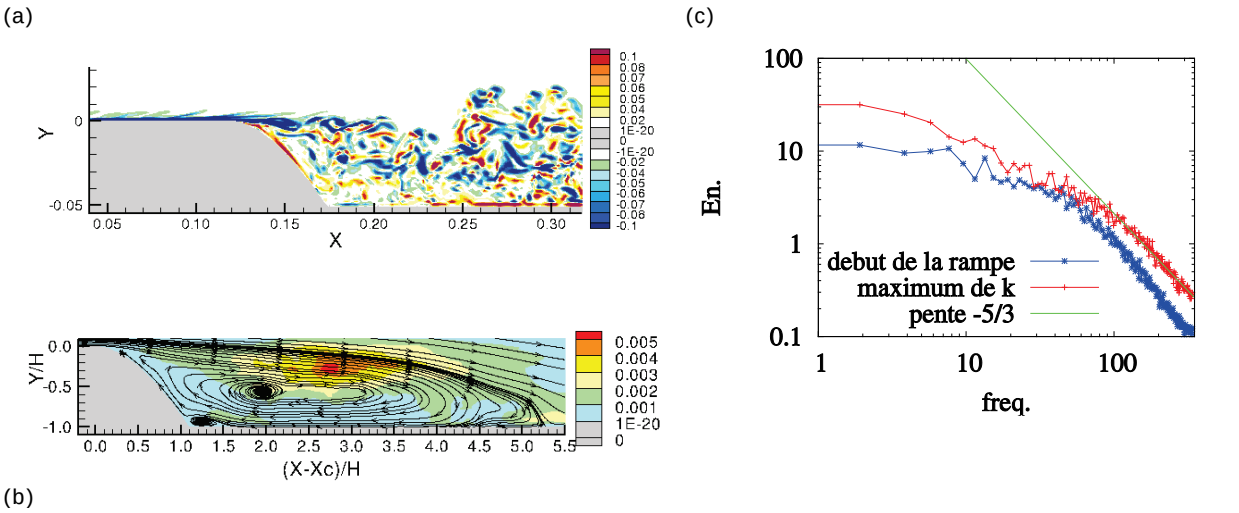


Illustration 13(a) Unsteady ω_z field; (b) mean fields: stream function and kinetic turbulent energy k; (x,y) median planes. (c) Energy spectra of $<v_x>$ inside the mean separation zone

POD-based synthetic conditions for the numerical simulation of turbulent channel flow

(B. PODVIN, Y. FRAIGNEAU)

Simulation of turbulent wall-bounded flows requires a high spatial resolution in the wall region, which limits the range of Reynolds which can be effectively reached by simulation. A possible solution would be to use an off-wall boundary condition to bypass the costly simulation of the inner wall region. Given the complexity of the flow dynamics in the wall region, such boundary conditions require to be fine-tuned to changing flow conditions, and need to incorporate substantial structural information. In previous work, we proposed a POD-based wall boundary condition. The condition consists of a three-component velocity field on an inner plane which is reconstructed at each instant from a combination of selected eigenfunctions. The coefficients of the combination are estimated from the simulation in the reduced domain using the threshold-based reconstruction method described in Podvin et al. (Journal of Fluids Engineering 2010). Tests were carried out for DNS at a low Reynolds number Re_τ = 180 (Podvin and Fraigneau, Journal of Turbulence 2011). Two different methods were used to obtain the temporal amplitudes of the eigenfunctions. The first approach consisted in integrating a low-dimensional model for the wall layer, independently from the simulation. The second one consisted in estimating the coefficients using information from the simulation. Tests were carried out for two plane heights y+ = 17 and y+ = 50 for a channel flow at a moderate Reynolds number Re_τ = 180. In both cases, we found some statistical agreement between the reduced simulation and the reference case above some readaptation height, which was approximately equal to the distance between the artificial boundary and the wall. However we observed that the flow adapted more quickly when outer layer information was used to recover the coefficients.

The study is now extended to LES at higher Reynolds numbers Re_τ = 295 and Re_τ = 590. The coefficients are reconstructed from outer layer information. Two versions of the reconstruction method are considered for the plane y+=50. In the first version (full reconstruction), both the phases and the moduli of the coefficients are allowed to vary. In the second version (phase reconstruction), only the phases are adjusted. We find that the latter method is associated with improved statistics (Illustration 14 a) and is relatively robust with respect to the reconstruction threshold (Illustration 14 b). However, it is sensitive to the details of the numerical simulation, unlike the former method, which is associated with less accurate statistics and is more dependent on the reconstruction threshold.

a b

Illustration 14 a- Mean velocity profile: comparison between the two reconstruction method b: phase reconstruction method for different thresholds.

Feedback flow control *(F. LUSSEYRAN, L. PASTUR, C. DOUAY, E. ATAM, L. MATHELIN)*

The main developments within the theme of control methodologies are focused on closed-loop control for fluid flows. Specifically, we use system identification techniques to quantitatively describe the transfer behavior of a physical system given its response to specific forcing data. Based on input and output signals, together with an underlying (commonly auto-regressive) model, an equivalent linear system is determined that best models the measured response behavior in a least-squares sense. This type of technique is particularly suited for flow systems that are receptive to (or plagued by) external noise. The system identification approach does not rely on the reconstruction of a state-vector, but recovers a functional relationship directly from the measurements. Together with a user-specified cost functional, an optimal control strategy can be derived, in effect, solely based on input-output information. This methodology is thus particularly appealing and experiment-compatible. We have then developed a model-free MPC (model predictive control) approach consisting of an underlying ARMAX template. This model is robust, applies to linear as well as nonlinear systems and can possibly be updated on-the-fly to account for changes in the system. The methodology was applied to the minimization of the drag of a circular cylinder in cross-flow in the laminar regime and a robust, closed-loop, LQG control was coupled with the ARMAX model. The drag is controlled through suction/blowing at the cylinder surface and is reduced significantly in the controlled system.

Illustration 15: view of a DBD plasma actuator

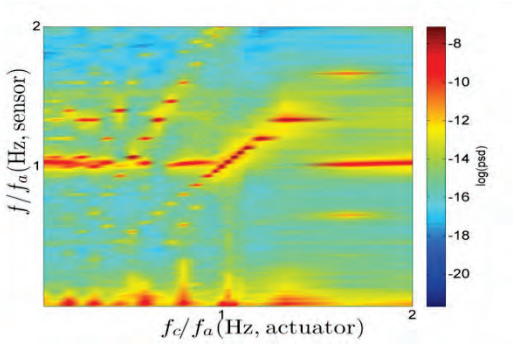


Illustration 16: spectral flow response measured at the sensor (vertical axis) vs forcing frequency fc at the actuator (horizontal axis). Spectral power is encoded from blue (small) to red (large). Response is the most energetic around the cavity natural frequency (fa ~15 Hz), even for fc/fa~1/2. Critical amplitudes for frequency locking provide Arnold tongues for the impinging shear layer.

In another effort, we intend to apply forcing and closed-loop control techniques to the self-sustained oscillations of an open cavity flow, at zero Mach number. Plasma DBD actuators (Illustration 15) have been implemented on the experimental setup, at the cavity leading edge. Unlike the typical search for efficiency in rapid flows, our DBD tuning goal aims at generating vanishing disturbances. As expected, beyond a critical forcing amplitude and forcing frequencies not too far from the natural dominant frequency of the shear layer, the shear layer oscillations lock on the forcing frequency (Illustration 16). More noticeably, the forcing of the shear-layer oscillations significantly affects the inner-flow organization, modifying the dynamical properties of spanwise instabilities. A reduced-order model for the cavity flow is developed in a joint work with the SATIE Lab (Cachan), in the framework of the COPERSFI DIGITEO project which supports the PhD Thesis of M. Rizi. The closed-loop control is applied in 2D direct numerical

simulations of the cavity flow (OLORIN code), with DBD actuators modeled as volumic forces and pressure sensors at the cavity trailing corner. The model is able to significantly reduce the amplitude of the shear-layer oscillations. Real-time delayed feedback control strategies have been tested on simple dynamical systems in the frame of the CORMORED ANR project (postdoctoral position of Th. Duriez- Illustration 17). Such strategies are to be extended to real flows.

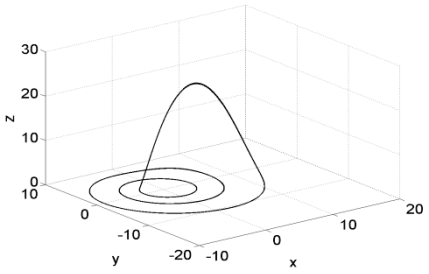


Illustration 17: period-two unstable orbit of the Rossler system controlled by real-time delayed feedback control

Highlights

Regarding developments on numerical methods for compressible flows and stiff gradient configurations, two remarkable results must be highlighted: (i) Coupling space Adaptive MultiResolution with a new resolution strategy based on time operator splitting leads to a novel approach that is very competitive considering 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. (ii) We developed a conservative coupling algorithm, based on an Embedded Boundary Method, between a compressible flow and a rigid body that is competitive with body-fitted methods and improves on previous results obtained with Immersed Boundary algorithms. 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.

The most salient results during the period for the Uncertainty Quantification activity have been: (*i*) the development of stochastic reduced basis approaches for non-linear stochastic problems, (*ii*) the definition and implementation of a Roe-type flux Galerkin solver for stochastic hyperbolic systems, (*iii*) the improvement of non-intrusive methods by compressed-sensing and preconditioning approach.

Concerning voice production, the glottal flow is a pulsating high aspect ratio jet, usually modeled as a mainly two-dimensional flow, even if its nature is three-dimensional. 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.High aspect ratios jets typically present an effect called axis switching. Moreover, 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. We then highlighted that the similarity properties are useful to predict the axis-switching phenomenon.

POD-based synthetic wall boundary conditions were used in a reduced simulation of a channel flow which excluded the wall region. It was found that the turbulent statistics of the reduced channel were in good agreement with those of a full channel flow. POD-based models could then be considered as an alternative approach to more classical wall models for the numerical simulation of turbulent wall-bounded 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

Last name	First name	Type of position	Employer	HDR	Arrival date	Departure date
Daru	Virginie	Ass.Prof.	ENSAM			
Faure	Thierry	Ass.Prof.	UPMC	HDR		Left on 01/09/2011
Guermond	Jean-Luc	DR	CNRS	HDR		
Le Maitre	Olivier	DR	CNRS	HDR		
Lusseyran	François	CR	CNRS	HDR		
Mathelin	Lionel	CR	CNRS			
Pastur	Luc	Ass.Prof.	Université Paris Sud			
Pellerin	Stéphanie	Ass.Prof.	Université Paris Sud			
Podvin	Bérengère	CR	CNRS	HDR		
Sciamarella	Denisse	CR	CNRS			
Tenaud	Christian	DR	CNRS	HDR		

NON PERMANENT STAFF

Last name	First name	Contract	Arrival date	Departure date
Abeguilé	Florian	Post-Doc	20/03/2006	19/03/2008
Basley	Jérémy	Post-Doc	01/09/2012	31/08/2013
Debesse	Philippe	CDD	01/01/2009	31/08/2011
Debesse	Philippe	CDD	01/03/2012	31/12/2012
Duriez	Thomas	CDD	01/07/2012	31/12/2012
Lorang Vo Dinh	Li	Post-Doc	01/04/2006	31/03/2008
Pebrel	Julien	Post-Doc	01/12/2009	30/11/2010
Pereira	Alberto	CDD	01/10/2009	30/09/2010
Reyt	Ida	Post-Doc	21/11/2012	30/09/2013
Rouillon	Thomas	CDD	15/02/2013	28/07/2013
Tassi	Pablo	CDD	30/11/2009	31/08/2010

PHD STUDENTS

Last name	First name	Thesis director	Arrival date	Date of defense
Basley	Jérémy	François Lusseyran	01/10/2008	19/10/2012
Debesse	Philippe	Maurice Xavier François	01/10/2004	05/12/2008
Monasse	Laurent	Christian Tenaud	01/10/2008	10/10/2011
Rouillon	Thomas	Christian Tenaud	18/11/2009	20/12/2012
Tryoen	Julie	Olivier Le Maitre	01/10/2008	21/11/2011
Douay	Christelle	François Lusseyran	01/10/2010	
Gueniat	Florimond	François Lusseyran	01/10/2010	
Pinto	Joao	Christian Tenaud	01/10/2008	
Puscas	Maria Adela	Christian Tenaud	13/10/2011	
Rizi	Mohamed-Yazid	Hisham Abou-Kandil	01/09/2011	
Tuerke	Florian	François Lusseyran	10/12/2012	

INTERNSHIPS

Last name	First name	Arrival date	Date of departure	Prepared degree	School / University
Lebrequer	Marc	03/03/08	04/07/08	3ème année Ingénieur	ENSAM Paris
Meyniel	Steven	28/04/08	31/07/08	Master M1 Mécanique	Université Paris Sud
Gueniat	Florimond	04/05/09	24/07/09	Master M1 Mécanique	Université Paris Sud

Sahal	Makram	04/05/09	17/07/09	Master M1 Mécanique	Université Paris Sud
Pillon	Muriel	04/05/09	17/07/09	Master M1 Mécanique	Université Paris Sud
Mochki	Sépass	04/05/09	24/07/09	Master SDI MIS ATIAM	Université Paris Sud
Thach	Hélène	04/05/09	24/07/09	Master 1	Université Paris Sud
Gueniat	Florimond	01/03/10	30/06/10	M2R	Université Paris Sud
Thach	Hélène	01/03/10	09/07/10	Master 2	Université Paris Sud
Douay	Christelle	01/03/10	31/07/10	Master 2	Université Paris Sud
Gandikota	Gurunath	06/03/10	30/06/10	3ème Année Ingénieur	ENSAM Paris
Chibane	Wassila	01/05/10	31/07/10	M1	UPMC
Laurens	Samuel	01/03/11	30/06/11	3ème Année Ingénieur	ENSAM Paris
Gabriel	Damien	04/04/11	01/07/11	M1	Université Paris Sud
Duhem	Erik	18/04/11	22/07/11	M1	Université Paris Sud
Biolchini	Romain	10/04/12	10/07/12	M1 Physique	Université Paris Sud

INDICATORS OF SCIENTIFIC NOTORIETY

PRIZES AND AWARDS

- The article by L. Monasse, V. Daru, C. Mariotti, S. Piperno & C. Tenaud (2012), published in the Journal of Computational Physics. 231(7): 2977-2994, has been cited as one of the top 25 hottest articles.

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

- C. Tenaud is a member of the Comité National Français de Mécanique, interface between IUTAM and the French Community of Mechanics.
- 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 atUPMC, 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.
- (Ecole d'été du Non-Linéaire) at Peyresq.
- D. Sciamarella, Organizer of the Inaugural colloquium of the International Associated Laboratory Physics and Fluid Mechanics (LIA PMF) ; March 8-10th 2010, Buenos Aires, Argentine
- D. Sciamarella, Organizer of the Opening Conference of the Virtual Net « Raíces » in Fluids of the Mincyt Program (Argentine); October 10th, 2010, Buenos Aires, Argentine
- D. Sciamarella, Organizer of the 2013 SticAmSud Workshop “Physics-Based Modeling Voice Production”
- C. Tenaud is a member of the French Scientific Committee of ICTAM 2012 (Beijing) selecting the French papers.

- C. Tenaud is a member of the Scientific Committee of the 3rd International Conference of Turbulence and Interactions (ITI) 2012.

INVITED LECTURES, TALKS OR SEMINARS

KEYNOTE SPEAKER AT INTERNATIONAL CONFERENCES

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

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.
- C. Tenaud at the CANUM'2012, Superbesse, mai 2012.

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, An adaptive multiresolution technique for unsteady compressible flow simulations. Invited talk at the Coimbra University, Portugal, janvier 2009.
- 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 schoolSeptember 7-11 2009, Orsay, France.

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

- 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), GDR 3058 Thermoacoustics (V. Daru).
- 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 commitees

National committees (CoNRS, CNU, CCSU…)

- S. Pellerin (since 2008) and V. Daru (since 2011) are members of the 60th section of the CNU.
- F. Lusseyran is member of the CCSU 60-61-62 of the Paris-Sud University (since 2011).
- 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: Expert scientifique du Fonds Québécois de la Recherche sur la Nature et les Technologies (2010) - programme établissement de nouveaux chercheurs 2011-2012
- C. Tenaud is an expert of the Research National Agency (ANR).

Member of the administration or advisory board

- C. Tenaud is a member of the Scientific Committee of the LabEx LaSIPS.

Member of selection juries

- We participated in several CCSE for different Schools or Universities: Paris-Sud University, Pierre & Marie Curie University, 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) de l'Université Pierre & Marie Curie, Paris.
- O. Le Maître is scientific consultant at the CEA/DEN/DM2S.
- F. Lusseyran is member of selection committee (CDS) in 2009 at the École Centrale de Lyon and the Toulouse University, and in 2009, 2010, and 2012 at the Orléans University.

Teaching activities and duties in relation to research

- T. Faure is responsible of the Tutorial platform of Fluid Mechanics, UPMC, Paris
- Researches and Associate Professors teach in several Masters: Sciences De l'Ingénieur of l'UPMC, Paris (B. Podvin), Dynamique des Fluides et des Transferts, co-habilité UPMC and U-PSUD (F. Lusseyran), Mécanique énergétique of Nancy University, Fluides Atmosphères et Plasmas of Orléans University (F. Lusseyran), as well as in Numerical Analysis and Computational Methods of ENPC, Paris (O. Le Maître)

Dissemination and vulgarization

- We participate at the « Fête de la science » 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. Sciamarella. Communication Video. Ciclo de Videoentrevistas, Facultad de Ingeniería de la UBA.

- The group regularly hosts interns at the undergraduate and graduate level.
- D. Sciamarella. Co-organizer of World Voice Day 2013 avec J. Sundberg.

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 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).

CONTRACTS TABLE FOR AERO GROUP

Contracts on public fundings

	Acronym	Funding agency/ Partner	Program	General Coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
ANR Basic Science & JCJC	CALINS	ANR	Blanc	Tenaud Christian	Tenaud Christian	05/12/2005	04/06/2009	99 422
	HiSpeed PIV	ANR	Blanc	Moisy Frédéric (FAST)	Pastur Luc	08/11/2006	07/05/2010	122 400
	RS-PEGASE	ANR	Blanc	Ferriere Alain (PROMES)	Sergent Anne	22/12/2006	21/12/2009	58 884
	DIB 2007	ANR	Blanc	Borée Jacques (PPRIME)	Lusseyran François	01/12/2007	30/11/2011	150 000
	CORMORED	ANR	Blanc	Mathelin Lionel	Mathelin Lionel	01/01/2009	31/12/2012	127 000
	TYCHE	ANR	Blanc	Le Maitre Olivier	Le Maitre Olivier	01/12/2010	30/11/2013	65 936
	Cool Jazz	ANR	Blanc	Lesshafft Lutz (LADHYX)	Lusseyran François	01/01/2013	31/12/2015	73 417
	ASRMEI	ANR	JCJC	Le Maitre Olivier	Le Maitre Olivier	01/01/2009	31/12/2011	114 407
ANR with industrial partners	CoRSAIRe	ANR	ARA MDMSA	Bourdot Patrick	Bourdot Patrick	06/05/2006	05/11/2009	131 700
Research collaborations	IFS	CEA-ENPC		Daru Virginie	Daru Virginie	01/10/2008	30/09/2011	-
	POPAART	CNRS- MAE		Sciamarella Denisse	Sciamarella Denisse	01/01/2005	31/12/2008	6 600
	STIC-AmSud	CNRS	Programme STICAmSud	Donzeau-Gouge Véronique (CNRS)	Sciamarella Denisse	01/01/2007	31/12/2009	5 000
	MoMaS-PC	CNRS	Programme interdisc. PACEN	Le Maitre Olivier	Le Maitre Olivier	01/01/2008	31/12/2011	41 800
	PEPS SHS-ST2I 2008	CNRS	PEPS	Jacquemin Christian	Jacquemin Christian	01/04/2008	31/12/2008	10 000
	MoMas	CNRS	Programme interdisc. PACEN	Allaire Grégoire (CMAP)	Le Maitre Olivier	01/01/2010	31/12/2010	6 432
	LIA	CNRS		Romat Hubert (PPRIME)	Sciamarella Denisse	01/01/2010	NC	5 850
	PQI Parallèle	Digiteo	Projet Emergent	Martinez Jean-Marc (CEA)	Le Maitre Olivier	01/10/2007	30/09/2009	1 655
	FLUCTUS	Digiteo	Projet Emergent	Pastur Luc	Pastur Luc	01/09/2010	31/08/2013	112 788
	MUSE	Digiteo	Projet Emergent	Massot Marc (EM2C)	Tenaud Christian	01/10/2010	30/09/2013	83 500
	COPERSFI	Digiteo		Mathelin Lionel	Mathelin Lionel	01/09/2011	31/10/2014	-
	CALIFHA	Digiteo		Baboulin Marc (LRI)	Le Maitre Olivier	01/10/2011	30/09/2014	-
	UQ-Hyperbolique	ENPC		Le Maitre Olivier	Le Maitre Olivier	01/10/2008	31/12/2011	-
	Tuyères	Université d'Evry Val d'Essonne		Tenaud Christian	Tenaud Christian	29/11/2011	28/11/2013	-
		UniverSud Paris	PRES	Mathelin Lionel	Mathelin Lionel	11/02/2008	30/09/2009	7 500
UE contract	WALLTURB	EU	STREP	Stanislas Michel (LML)	Podvin Berengere	01/04/2005	30/06/2009	134 000
Partnership	DRI Pologne	CNRS / Académie polonaise des sciences (PAN)		Le Quéré Patrick	Le Quéré Patrick	01/01/2001	31/12/2008	15 900
	CNRS/ASB	CNRS - Académie des sciences Bulgare		Tabakova Sonia (ASB, Bulgaria)	Daru Virginie	17/02/2010	31/12/2011	2 000

Industrial contracts, contracts on private fundings...								
	Acronym	Funding agency/ Partner	Program	General Coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
Research collaborations	PEA CACV	ONERA		Tenaud Christian	Tenaud Christian	15/03/2005	20/08/2008	67 500
	Coalescence	Saint Gobain Recherche		Juric Damir	Juric Damir	23/01/2009	22/01/2010	20 000
	Optimisation VG	PCA		Tenaud Christian	Tenaud Christian	16/11/2009	15/11/2012	25 000
	Advection chaotique	EADS		Duguet Yohann	Duguet Yohann	15/12/2011	31/12/2015	132 000
	Optimisation Forme	PCA		Tenaud Christian	Tenaud Christian	15/02/2013	15/06/2013	20 044

Patents, software registrations, licence agreements...					
Technology Transfer	Patent	LIMSI Author	Co-authors	Date	
	Airflow pulsating system	Sciamarella Denisse	Artana Guillermo	01/06/2012	patent not filed due to a close patent
	Software registrations (APP)	LIMSI Author	Co-authors	Date	
	CHORUS compressible high order unsteady simulation	Fraigneau Yann	Daru Virginie, Tenaud Christian	01/04/2010	
	MR Chorus Compressible High-ORder Unsteady Simulation using MultiResolution approach for adaptive mesh refinement	Tenaud Christian	_	01/06/2010	
	OLORIN Software for simulation of unsteady incompressible or low-compressible flows (low Mach number hypothesis) with 2D and 3D capabilities.	Fraigneau Yann	Le Quéré Patrick, Sergent Anne, Podvin Bérengère	01/09/2010	
	Licence agreement	Resp. for LIMSI	Licensee	Date	
	CHORUS compressible high order unsteady simulation	Fraigneau Yann	CEA	01/11/2010	

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CORO
COnvection and ROtation

CAROLINE NORE

INTRODUCTION

The CORO group investigates the dynamics of various internal or external fluid flows using numerical simulation 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 on 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 their numerical simulation requires the use of Large Eddy Simulation approaches. These models have been validated against Direct Numerical Simulations. On the fundamental side, we investigate the influence of the coupling between Boussinesq-type 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; the study of the three-dimensional instabilities of helical vortices is a prerequisite for control strategies. 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 into magnetic energy, has been demonstrated numerically in wave-like flows and in different configurations inside 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 ACTIVITIES

TOPIC 1: CONVECTION

***A. Sergent**, D. Băltean-Carlès, P. Le Quéré, L. Martin Witkowski, C. Weisman. PhD students: Z.L. Gao, C. Garnier, L. Ma, L. Oteski, H.L. Tran. In collaboration with J. Chergui (CIGITA), V. Daru (AERO), Y. Fraigneau (CIGITA) and B. Podvin (AERO)*

We study four fundamental models of buoyant convection flows: Rayleigh-Bénard convection, differentially heated convection, buoyant jet in a confined cavity and chimney flows. Instabilities are investigated as the governing parameters are varied, and new bifurcation scenarios emerge when other forcing terms such as rotation and radiation are added. Higher values of the parameters require the use of accurate numerical methods and turbulence closure models as well as challenging numerical simulations. Thermal convection coupled with acoustic effects is analyzed numerically with an emphasis on instabilities and acoustic streaming in standing-wave thermoacoustic engines.

BUOYANT 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 parameter space [Reynolds number (defined by the angular velocity of the disks), Rayleigh number]. 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 these bifurcations. 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). The bifurcation diagram has been obtained using a Newton method coupled with arc-length continuation, a very effective yet costly method when the flow is three-dimensional. Reduced order modeling technique has been developed in order to predict these bifurcations at much smaller cost (typically keeping less than 50 degrees of freedom).

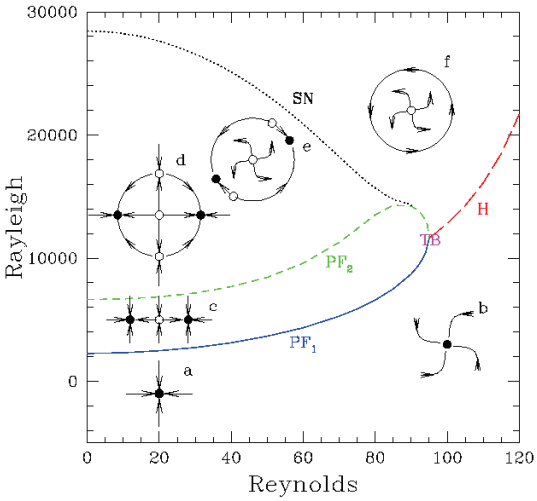

Illustration 1: bifurcation diagrams and phase portraits for counter-rotating Rayleigh-Bénard convection in a cylindrical cavity (Prandtl number unity, geometrical aspect ratio unity).

The discretized partial differential equations are reduced to several coupled ordinary differential equations in the following way. Few selected eigenvectors of the linearized Navier-Stokes equations are computed via the Newton-Arnoldi method, on which a Galerkin projection of the Navier-Stokes equations 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. Applied to this particular configuration, the reduced order model captures most of the complex behavior of the flow.

BIFURCATIONS, MIXING, TRANSITION AND TURBULENCE IN DIFFERENTIALLY HEATED FLOWS

The onset of chaos in the flow of air inside a vertical differentially heated channel as the Rayleigh number is increased is studied numerically (Ph.D thesis of Z. Gao) using a spectral DNS code developed at LIMSI. The first instability is a supercritical circle pitchfork bifurcation leading to steady 2D co-rotating rolls. A Ginzburg-Landau equation is derived analytically for the flow around this first bifurcation. In two dimensions, rolls become unstable via a Hopf bifurcation. As Ra is further increased, the flow becomes quasi-periodic then temporally chaotic for a limited range of Rayleigh numbers, beyond which the flow returns to a steady state through a spatial modulation instability.

In three dimensions, the rolls instead undergo another pitchfork bifurcation to 3D structures, which consist of transverse rolls connected by counter-rotating vorticity braids (see figure). The flow becomes then time-dependent through a Hopf bifurcation, energy being exchanged between the rolls and the braids. Chaotic behavior subsequently occurs through two competing routes: a sequence of period-doubling bifurcations leading to intermittency or a spatial pattern modulation reminiscent of the Eckhaus instability (collab. B. Podvin, P. Le Quéré and A. Sergent at LIMSI, S. Xin at CETHIL and L. Tuckerman at PMMH).

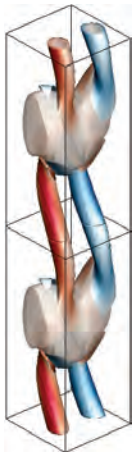

Illustration 2: flow inside an air-filled differentially heated channel at Ra=11500 (Criterion-Q isocontour colored by the vertical vorticity showing transverse rolls connected by counter-rotating vorticity braids).

The route to chaos is also investigated numerically inside a closed differentially heated air-filled cavity with a finite height-to-width ratio of two. Confinement implies a recirculating flow, and the presence of a stratified core supports internal oscillations of the flow. As the Rayleigh number is increased, a sequence of oscillatory bifurcations leads to quasi-periodic regimes interspersed with synchronization windows where the dynamics is periodic, and eventually the flow becomes chaotic. The dynamics of passive Lagrangian tracers is investigated numerically in order to quantify chaotic mixing inside the same cavity flow, with an emphasis on the time-periodic regime. Large chaotic mixing zones are predicted by the computation of Melnikov functions associated with homoclinic/heteroclinic trajectories of the base flow. Transition towards complete mixing occurs through resonance of Kolmogorov-Arnold-Moser tori, which demonstrates that the first oscillatory regime of the flow is sufficient to induce complete two-dimensional mixing within the whole cavity (PhD thesis of L. Oteski funded by the EADS foundation).

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 (Ra) between 10^7 and 10^{10}. For all values of Ra, a primary large scale circulation (LSC) state with four rolls emerges from noise. This state is metastable on very long time periods ($\propto 10^4$ convective time units, c.t.u.) and undergoes a sudden transition without any external input towards a secondary LSC. During the transition (~100 c.t.u), a sharp reorientation of the rolls axis leads to the transitory appearance of an orthogonal roll. The spontaneously selected size of the rolls increases with Ra. Using proper orthogonal decomposition (POD), we confirm the existence of an LSC consisting of quasi-stationary cross-stream rolls (y-rolls) which are aligned with the short direction of the box. The existence of a secondary flow is shown, which consists of horizontal rolls (z-rolls) surrounding the core of the cavity and orthogonal to the cross-stream rolls (see figure below). The amplitude of these longitudinal rolls oscillates on a time scale of 50 c.t.u. Integration of a simplified dynamical model with stationary y-rolls leads to an oscillation of the z-rolls, which supports the idea that the oscillation of the secondary rolls is determined by the primary flow structure.

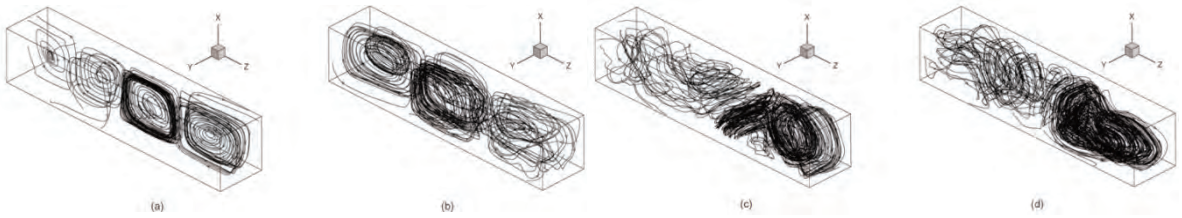

Illustration 3: streamlines in turbulent Rayleigh-Bénard convection at Ra = 6×10^8. (a) POD mode n = 1. (b) POD mode n = 2. (c) POD mode n = 3. (d) POD mode n = 4.

BUOYANT CONVECTION COUPLED WITH RADIATION

The well-documented discrepancy between numerical and experimental estimates of the thermal stratification in high-Ra air-filled differentially heated cavities has motivated a joint research program to integrate both wall and medium radiation into physical models 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 solve the stratification paradox, we have first established reference solutions by means of three-dimensional (3D) spectral direct numerical simulations of a buoyancy-driven flow ($Ra_H=1.5\times10^9$) for two configurations: an idealized cavity (perfectly adiabatic cavity, PAC) and an Intermediate Realistic Cavity (IRC) based on experimental temperature distributions (Salat, 2004) at the top and bottom walls. Using a LES approach, it was proven that the complete set of experimental temperature distributions at the walls (Full Realistic Cavity) is needed to recover full agreement between numerical and experimental results. In particular, thermal boundary conditions at the front and rear walls are crucial for a good agreement. Finally a 3D numerical code coupling convection, conduction and wall radiation has been developed, and is able to reproduce the experimental temperature distribution inside the cavity.

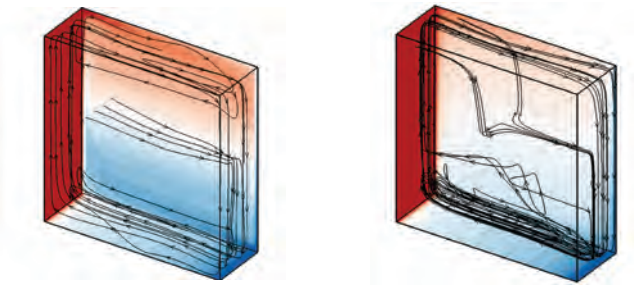

Illustration 4: influence of the thermal boundary conditions on the flow structure in an air-filled differentially heated cavity at $Ra=1.5\ 10^9$. Streamlines of the time-averaged flow. Left: IRC (Intermediate Realistic Cavity with adiabatic front and rear walls), right: FRC (Full Realistic Cavity with full experimental temperature distributions at wall).

BUOYANT CONVECTION MODELING: CHIMNEY AND BUOYANT JET

For buoyant flows in open or semi-infinite configurations, prescription of the appropriate boundary conditions on the frontiers of the computational domain is a key issue for the relevance and the accuracy of numerical simulations. This issue has been the subject of numerous studies, which have generally focused 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 less 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. A vertical channel (chimney) is considered as a prototype configuration of such flows. A benchmark organized within the French thermal science community (SFT) has revealed a significant scatter amongst numerical 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 combined linearly with additional conditions or by imposing directly pressure through dedicated boundary conditions. However no clear conclusion can be established from comparisons with experimental results (PhD thesis of C. Garnier).

Knowledge of the dispersion and mixing mechanisms of hydrogen in confined air-filled cavities at low Mach number is an important safety issue for all hydrogen-based systems, since fire or explosion may result from specific concentration distributions. 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 performed using helium as a light gas. Coexistence within the cavity of pure helium and pure air regions causes significant variations of the fluid properties (non-Boussinesq effects) which make numerical convergence difficult. A 2D unsteady numerical model has been developed (PhD thesis of H.L. Tran) for binary mixtures. The model was validated by comparison with experimental results of laminar starting plumes of glycerol-water solution. It is currently applied in the case of a benchmark configuration simulating hydrogen leakage in a cavity (collab. P. Le Quéré and A. Sergent with G. Bernard-Michel at CEA)

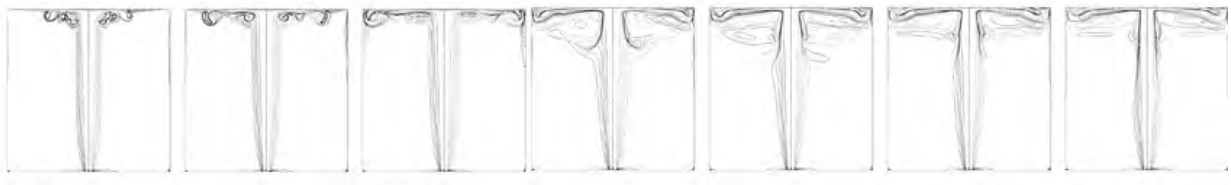

Illustration 5: time evolution of vorticity isocontours of a buoyant jet of a helium-air mixture at $Gr=9.3x10^9$ and $Ri=262$ (respectively at convective time=10, 20, 30, 46, 93, 139 and 260).

THERMAL CONVECTION AND THERMOACOUSTICS

Standing wave thermoacoustic engines consist of a resonating tube, closed at one end, with a load at the other end, inside which heat exchangers and a stack made of parallel plates are placed. One heat exchanger is connected to a hot source, the other to a cold source. The combined effect of pressure fluctuations and oscillating heat exchange in the boundary layers near the stack plates provide a heat engine effect. A multiple scale analysis allows for the global compressible flow problem to be reduced to a dynamically incompressible problem in the active cell, with boundary conditions obtained from linear acoustics in the resonator, providing a proper asymptotic approximation in the low Mach number limit, under the assumption that the flow sweeps a length comparable with the stack length (collab. D. Băltean-Carlès, P. Le Quéré, C. Weisman with L. Bauwens, University of Calgary). Direct numerical simulations of the flow in the active cell, coupled with an exact solution of one-dimensional acoustics in the resonators, are performed using a two-dimensional, time-dependent finite volume code. If 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 regime (Algerian thesis of O. Hireche). The influence of the load model on the wave

saturation is studied, yielding a specific load range for saturation at levels comparable with experiments (Ph.D. thesis of L. Ma). The critical temperature for the complete simplified engine is studied as a function of the load and of the position of the active cell inside the resonator. Due to the temperature difference between the hot and cold heat exchangers, a longitudinal temperature/density gradient exists, which associated to the acceleration of the oscillating flow results in a strong instability, present only during part of the cycle. The vortex dynamics associated with cavities and step-like cross-section changes also show interesting features, notably interplays between temperature gradients and accelerations.

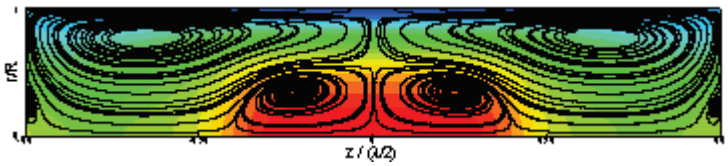

Illustration 6: acoustic streaming in a closed two-dimensional channel: streamlines and isotherms of the associated mean temperature field (upper half of the domain)

Rayleigh streaming refers to the second order mean velocity that is generated by viscous effects related with the interaction of an acoustic wave with a solid surface. In thermoacoustic devices, acoustic streaming results in a convected heat flow that can reduce the total efficiency. Because the power density of a thermoacoustic device is roughly proportional to the square of the acoustic pressure amplitude, the study of high acoustic amplitude phenomena is important for the field of thermoacoustics.

The streaming flow can be linear (slow streaming) or nonlinear (fast streaming) and the two regimes are characterized with a non-dimensional number Re_{NL} that quantifies the influence of fluid inertia on acoustic streaming. Numerical simulations of compressible Navier-Stokes equations in closed waveguides are performed, using high resolution finite difference schemes developed at LIMSI (collab. D. Bălțean-Carlès, V. Daru and C. Weisman). Two geometries are investigated: closed two-dimensional channels and cylindrical axisymmetric waveguides. A plane standing wave is excited inside the guide and the associated acoustic streaming is investigated by averaging the solution over the fundamental acoustic period. As expected, the streaming velocity agrees reasonably well with the slow streaming theory for small Re_{NL}, but deviates significantly from predictions for fast streaming, when Re_{NL} >1. The numerical results are compared with experimental results obtained by LDV (collab. I. Reyt, H. Bailliet, J.-C. Valière from Institut Pprime, Poitiers). Both experimental and numerical results show that the centers of the outer streaming cells are pushed towards the acoustic velocity nodes until counter-rotating additional vortices are generated near the acoustic velocity antinodes. The evolution of the mean temperature field within the resonator is also investigated in order to understand the coupling with the streaming flow. When increasing Re_{NL} the mean temperature field becomes two-dimensional as a consequence of the balance between heat convection through acoustic streaming and heat conduction.

TOPIC 2: FREE SURFACE FLOWS

C. Dang Vu- Delcarte, C.T. Pham, *G. Labrosse, L. Martin Witkowski. PhD students and Post-docs fellows: L. Kahouadji, B. Trouette*

Thermal and/or 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 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

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 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).

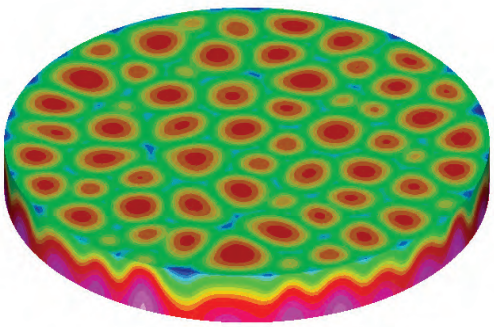

Illustration 7: Rayleigh-Bénard-Marangoni convection:
temperature field (warm fluid in red, cold fluid in blue, Ra=150, Ma=1950, Pr=12, Bi=0.2).

Producing a high-quality crystal is often done with a floating-zone technique. 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 destabilization. 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). In the case of non-rotating rod, it has been shown that the discrete Chebychev Gauss-Radau version of the polar–diffusion operator, when associated to Neumann boundary conditions, displays complex eigenvalues which is a violation of the original continuous problem (collab. C. Dang-Vu Delcarte, G. Labrosse and B. Trouette).

SOLUTAL CONVECTION

During the drying of plane layers of polymer solutions, four mechanisms, based on buoyancy or surface tension, of thermal or solutal origin, can give rise to convective flow. This problem is studied numerically, by 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. In this transient problem, when linear stability analysis indicates the presence of several instability mechanisms, it is necessary to invoke nonlinear arguments to establish the leading mechanism. (collab. C. Dang Vu-Delcarte and B. Trouette with E. Chénier at MSME, F. Doumenc and B. Guerrier at FAST).

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 hydrodynamic 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 together with the dynamics of an evaporating wetting droplet, which 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 theoretically and 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, *Y. Duguet, L. Martin Witkowski, P. Le Quéré, O. Daube, PhD students: B. Piton, C. Selçuk*

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 trailing helical vortices which have been experimentally shown to be prone to several instability processes. In order to characterize such helical vortex systems, an original code HELIX has been recently developed at LIMSI, which enforces the helical symmetry into the incompressible Navier-Stokes equations (collab. I. Delbende and O. Daube at LIMSI, M. Rossi at d'Alembert, UPMC). 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 rotating states in the viscous framework with one or several helical vortices. The problem of the merging dynamics of two helical vortices has been investigated (PhD thesis of B. Piton): four different mechanisms have been identified when the helical pitch and the Reynolds number are varied. A 4-year ANR grant (HELIX) has been obtained to study the three-dimensional instabilities in such helical vortex systems (Ph. D thesis of S. C. Selçuk), together with IRPHE (Marseille, Th. Leweke), in collaboration with the worldwide leader team on the subject at DTU Copenhagen (J. Sorensen, V. Okulov).

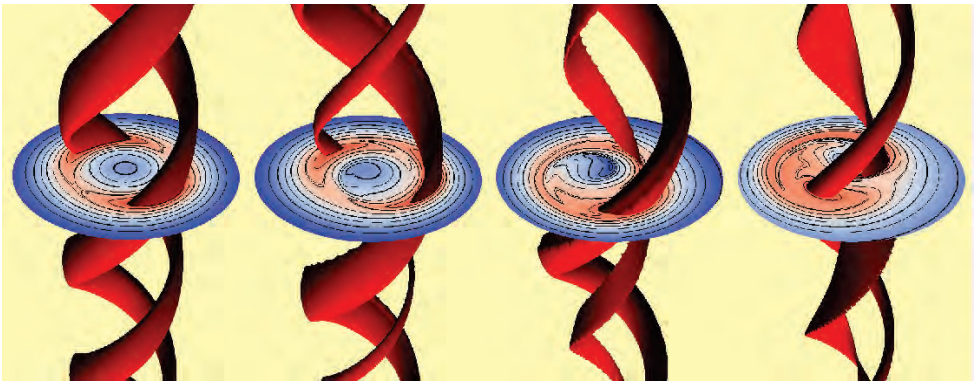

Illustration 8: temporal evolution of two helical vortices at low pitch before merging. Isocontours of helical vorticity in the 2D computational domain and corresponding 3D vortex structure.

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 PhD 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)

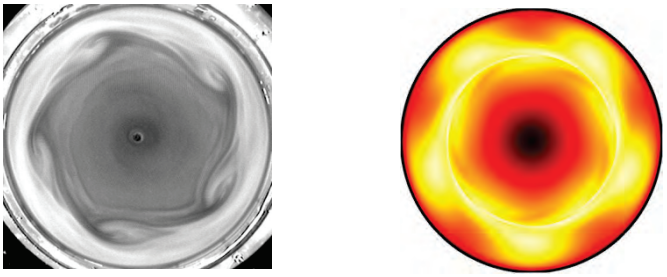

Illustration 9: flow structure at a Reynolds number slightly above the first instability threshold. An azimuthal mode 5 is dominant in the experiment conducted at IRPHE (left) and reproduced via a linear stability analysis (right).

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, as is the case for most canonical shear flows in the presence of solid boundaries. Two different approaches are considered, both relying on extensive spectral direct numerical simulations. The first approach, inspired by the theory of dynamical systems, relies on the identification of edge states, i.e. relative attractors sitting on the phase-space separatrix between the basins of attraction of the laminar and the turbulent state, respectively. These self-sustained coherent states appear to be invariably localized in space. Transition occurs through their spatial expansion. They have been identified so far in cylindrical pipe flow, in plane Couette flow (pCf), as well as in boundary layer flows with or without wall suction. Intensive work is carried out in order to identify the exact mechanisms responsible for the existence of such localized equilibrium solutions, as well as their relevance to experimental observations.

The second approach revolves around the spatio-temporal intermittency characterizing the onset of turbulence, and the possible formation of large-scale laminar-turbulent patterns. Recent progress has been made for the explanation of the mechanisms at play during the formation of such large-scale structures such as oblique turbulent stripes in pCf. It is based on a scale separation between small-scale motion and large scales associated with the viscous diffusion at the laminar-turbulent interfaces. Coupling with additional damping forces such as cyclonic rotation, stable stratification or an external magnetic field results in an increasing scale separation. An experimental set-up for pCf has been recently developed at ENSTA (Palaiseau) in collaboration with R. Monchaux, which will allow testing of these theoretical predictions. A statistical approach to spatio-temporal intermittency is also currently being developed for boundary layer flows. This demanding numerical work forms the basis of a regular collaboration between Y. Duguet at LIMSI and the team of D. Henningson at KTH (Stockholm, Sweden) and B. Eckhardt at Philipps-Universität Marburg (Germany).

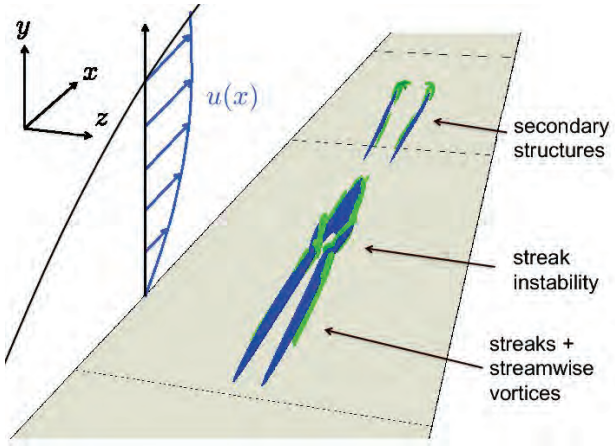

Illustration 10: isosurfaces of streamwise vorticity (blue) and vortical intensity (λ_2 criterion, green) for a snapshot of the edge state in a spatially developing boundary layer flow.

TOPIC 4: MAGNETOHYDRODYNAMICS (MHD)

C. Nore, *W. Herreman, PhD students and Post-docs fellows L. Cappanera, F. Luddens, A Ribeiro, H. Zaidi*

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, and 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 2002, 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 (PhD thesis of L. Cappanera, in relation with the DRESDYN facility currently built in Dresden, Germany, F. Stefani et al.) and dynamo action in a Couette-Taylor set-up (experiment in New Mexico, USA, S.A. Colgate et al.).

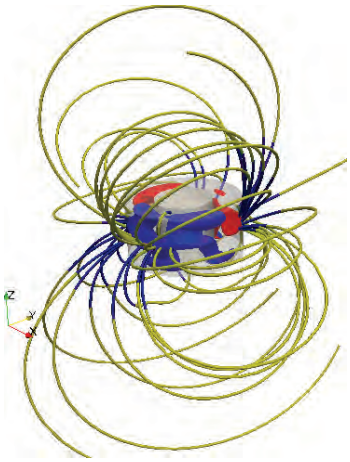

Illustration 11: nonlinear dynamo in a Couette-Taylor set-up: isosurface of magnetic energy in the conducting fluid (colored by the azimuthal component) and magnetic field lines in the vacuum (positive vertical component in yellow, negative in blue).

DYNAMO DRIVEN BY LAGRANGIAN MEAN FLOW

Many geophysically relevant flows are a superposition of a mean zonal flow (Jupiter's bands) and wavelike perturbation flows. Combining theoretical arguments with direct numerical simulations, we have succeeded to show how this type of flows may generate magnetic fields (may drive dynamos) through the Lagrangian mean flow, i.e. the mean flow followed by fluid particles.

The first part of this study has focused on the case in which mean flow is absent. The Lagrangian mean flow is then the well-known Stokes drift flow. We show that this drift drives the same dynamo as the initial wave-like flow and relate this result to formerly existing models in dynamo theory (collab. W. Herreman at LIMSI and P. Lesaffre at LRA-ENS).

In the second part of the study (W. Herreman), we include mean flow effects. The Lagrangian mean flow is more complex to evaluate, but we can still say that it controls dynamo action. We relate this result to

one of the first models of dynamo theory, namely Braginsky's model for weakly axisymmetric dynamo action.

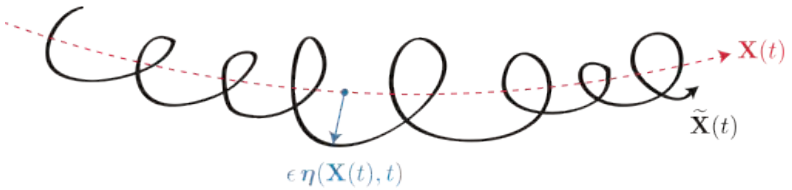

Illustration 12: the Lagrangian mean flow defines the guiding center (red) of fluid particles trajectories (black). We have shown that this flow controls dynamo.

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.
- Progress in the simulations of the dynamo effect attested by the selection for Research Highlights in Physics of Fluids (C. Nore, J. L. Guermond, R. Laguerre, J. Léorat, and F. Luddens, Nonlinear dynamo in a short Taylor--Couette setup, Physics of Fluids, 24 (2012)).
- 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 two front covers of Journal of Fluid Mechanics (Y. Duguet, A.P. Willis, R.R. Kerswell, Slug genesis in cylindrical pipe flow, JFM, 663, 180-208, 2010, and T. Khapko, T. Kreilos, P. Schlatter, Y. Duguet, B. Eckhardt, D. S. Henningson, Localized edge states in the asymptotic suction boundary layer, Journal of Fluid Mechanics, 717, R6, 2013).
- 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.
- Development of a Low Mach number model for the analysis of idealized thermoacoustic engines, with associated numerical solution (O. Hireche, C. Weisman, D. Baltean-Carlès, P. Le Quéré, L. Bauwens, J. Acoust. Soc. Am. 128 (6), 2010).

STAFF

PERMANENT STAFF

Last name	First name	Type of position	Employer	HDR	Arrival date	Departure date
Baltean	Diana	Ass.Prof.	UPMC			
Dang Vu	Claudine	Prof. (Emeritus)	Université Paris Sud	HDR		
Daube	Olivier	Prof. (Emeritus)	Université d'Evry	HDR		Retired on 30/09/2009
Delbende	Ivan	Ass.Prof.	UPMC	HDR		
Duguet	Yohann	CR	CNRS		Hired as of 01/10/2009	
Herreman	Wietze	Ass.Prof.	Université Paris Sud		Hired as of 01/09/2010	
Labrosse	Gérard	Prof.	Université Paris Sud	HDR		Retired on 31/08/2011
Le Quéré	Patrick	DR	CNRS	HDR		

Martin Witkowski	Laurent	Ass.Prof.	UPMC			
Nore	Caroline	Prof.	Université Paris Sud	HDR		
Pham	Chi-Tuong	Ass.Prof.	Université Paris Sud		Hired as of 01/09/2008	
Sergent	Anne	Ass.Prof.	UPMC			
Weisman	Catherine	Ass.Prof.	UPMC			

NON PERMANENT STAFF

Last name	First name	Contract	Arrival date	Departure date
Anwar Fahad	Syed	Post-Doc	01/06/2009	31/05/2010
Kahouadji	Lyes	Post-Doc	25/10/2011	31/08/2012
Luddens	Francky	Post-Doc	01/09/2012	30/08/2013
Roussel	Olivier	CDD	01/06/2013	01/08/2014
Tran	Huong-Lan	Post-Doc	04/11/2009	31/12/2013
Trouette	Benoit	Post-Doc	10/12/2010	31/08/2011
Zaïdi	Houda	Post-Doc	01/01/2013	31/12/2013

PHD STUDENTS

Last name	First name	Thesis director	Arrival date	Date of defense
Hireche	Omar	Maurice - Xavier François	01/10/2007	31/10/2010
Kahouadji	Lyes	Patrick Le Quéré	01/10/2007	24/10/2011
Luddens	Francky	Caroline Nore	01/09/2009	06/12/2012
Piton	Benjamin	Patrick Le Quéré	01/10/2008	20/10/2011
Redondo	Alexis	Gerard Labrosse	01/09/2004	03/11/2008
Ribeiro	Adolfo	Caroline Nore	01/10/2006	30/07/2010
Trouette	Benoit	Claudine Dang Vu	01/10/2007	09/12/2010
Cadet	Laurent	Patrice Joubert	01/10/2012	
Cappanera	Loïc	Caroline Nore	01/10/2012	
Gao	Zhenlan	Bérengère Podvin	01/12/2010	
Garnier	Charles	Patrick Le Quéré	01/09/2011	
Ma	Lin	Patrick Le Quéré	01/10/2011	
Oteski	Ludomir	Patrick Le Quéré	01/10/2011	
Selcuk	Can	Ivan Delbende	01/01/2013	
Tran	Huong-Lan	Patrick Le Quéré	07/12/2009	

INTERNSHIPS

Last name	First name	Arrival date	Departure date	Prepared degree	School / University
Menanteau	Sébastien	17/03/08	05/09/08	Master 2	École des Mines de Douai
Naldi	Grégory	05/05/08	20/07/08	Master M1 Mécanique	Université Paris Sud
Moonsamy	Yoan	05/05/08	30/07/08	Master 1	Université Paris Sud
Luddens	Francky	03/02/09	30/06/09	Master 2	Université Paris Sud
Sodjavi	Kodjoui	15/03/09	31/08/09	Master 2	UPMC
Lafdhal Ahmed	Mohamed	04/05/09	17/07/09	M1	Université Paris Sud
Sari	Elhadi	04/05/09	17/07/09	M1	Université Paris Sud
Aktas	Djeylan	02/06/09	17/07/09	Magistère Master 1	Université Paris Sud
Nguyen	Anh Vu	22/06/09	15/09/09	M1	UPMC
Ma	Lin	01/05/10	31/07/10	M1	UPMC
Oteski	Ludomir	03/05/10	31/07/10	M1 Physique	Université Paris Sud
Ma	Lin	01/03/11	31/08/11	Master 2 SDI	UPMC
Deguillard	Estelle	07/03/11	07/07/11	Master 2	Université Paris Sud
Oteski	Ludomir	07/03/11	07/07/11	M2 DFE	Université Paris Sud
Farhaoui	Asma	01/04/11	30/06/11	M1 Physique	Université Paris Sud

Salamé	Rani	26/04/11	25/07/11	M1	UPMC
Cadet	Laurent	05/03/12	05/09/12	Master Mécanique des Fluides	ENSAM
Oukacine	Marina	19/03/12	13/07/12	Master Sciences de l'ingénieur	UPMC
Cappanera	Loïc	02/04/12	31/07/12	M2	Université Paris Sud
Farhaoui	Asma	02/04/12	31/08/12	M2 Physique Appliquée	Université Paris Sud
Pelissier	Etienne	14/05/12	31/08/12	Master Sciences de l'ingénieur	UPMC
Faugaret	Antoine	15/05/13	31/08/13	Master 1	UPMC
Shao	Yinlong	20/05/13	12/07/13	M1	Université Paris Sud
Erdogan	Eser	23/05/13	20/07/13	M1 Physique	Université Paris Sud

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.
- C.-T. Pham is Editor of the Comptes-Rendus des Rencontres du Non-Linéaire.

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).
- Y. Duguet co-organized the session on "Subcritical transition in shear flows" of the 5th International Symposium on Bifurcations and shear flows" held in Haifa, Israel, July, 8-11th, 2013.
- 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).
- C.-T. Pham co-organized the Rencontres du Non-Linéaire 2013 (Université Paris-Diderot) and is member of the scientific committee of the Rencontres du Non-Linéaire.
- P. Le Quéré and A. Sergent were members of the organizing committee (LIMSI) of the 11ème école thématique de Mécanique des Fluides Numérique MFN 2009 on the topic « Transferts en écoulements dominés par la Convection » held in Oléron, June 7-13 2009.
- D. Baltean-Carlès, 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.
- A. Sergent was a member of the organizing committee (LIMSI) of the 13ème école thématique de Mécanique des Fluides Numériques MFN2013 on the topic « Outils et méthodes multi-échelles» held at Porquerolles, June 2-8 2013.
- 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).
- A. 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.
- D. Baltean-Carlès tought a lab class on a thermoacoustic prime-mover prototype at 1st School in Thermoacoustics (CNRS), Roscoff, France, 2010.
- D. Baltean-Carlès gave a lecture on "Concept and theory of thermoacoustics", Internship in Thermoacoustics (FPO/SFV/IPN), France, 2009, 2010.

INVITED TALK (NATIONAL OR INTERNATIONAL)

- D. Baltean, PIV contribution for measuring acoustic and streaming flow in thermoacoustic systems, using phase average dynamics, Acoustic'08 meeting (ASA), Paris, June 29-July 4, 2008.
- 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.
- I. Delbende, Dynamics of helical vortices, Séminaire du FDY-TUD, Darmstadt, Allemagne, 2013.
- Y. Duguet, Oblique spots in transitional flows, School of Applied Mathematics and Statistics, University of Sheffield, United Kingdom, 2013.
- Y. Duguet, Oblique spots in transitional flows, School of Mathematics, University Bristol, United Kingdom, 2013.
- Y. Duguet, Oblique spots in transitional flow,
- Fachbereich Physik, Phillips Universität Marburg, Marburg, Germany, 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.
- W. Herreman, The role of mean fluid particle motion in kinematic dynamo action at high Rm, Institut for geophysik, ETH Zurich, Suisse, mars 2013.
- W. Herreman, Stokes drift dynamos, ENS Lyon, France, octobre 2012.

- 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.
- C. Nore, Dynamo action in finite cylinders, Institut for geophysik, ETH Zurich, Suisse, mars 2012.
- 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, École Polytechnique, Palaiseau) and G. Kawahara (Université d'Osaka, Japan).
- C. Weisman and D. Baltean-Carlès participate 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, 8885 € in 2012, 9705 € in 2013 for covering travel and sustenance of the Algerian partners in France: Omar Hireche, Kheira Nehar Belaid (2012, 2013), Sid Ali Litim (2010,2011), Miloud Abidat).
- P. Le Quéré is member of the Scientific 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).
- D. Baltean was member of CCSU 60 of UPMC (2004-2011).

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

- 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 University.
- Y. Duguet was member of 3 Comités de Sélection Maîtres de conférences at Université Marne-La-Vallée in May 2011 and May 2012.
- C. Nore was member of Comité de Sélection Maître de Conférences-Chaire CNU 34/60, May 2011, Nice.
- C. Nore was member of Comité de Sélection Maître de Conférences CNU 60 at ENS Cachan, May 2012, Paris.
- C. Nore was president of Comité de Sélection Maître de Conférences CNU 60 in May 2013, Paris-Sud University (poste 4143).
- C. Dang Vu-Delcarte and C. Nore were members of Comité de Sélection Professeur des Universités CNU 60 at Paris-Sud University, May 2012.
- C.-T. Pham was member of Comité de Sélection Maître de Conférences CNU 60 in May 2013, Paris-Sud Sud University (poste 4142).
- C.-T. Pham and A. Sergent were members of Comité de Sélection Maître de Conférences CNU 60 in May 2013, Paris-Sud University (poste 4143).
- C.-T. Pham was member of Comité de Sélection Maître de Conférences CNU 34 in May 2013, UPMC (poste 1361).
- L. Martin Witkowski was member of Comité de Sélection Maîtres de Conférences CNU 60/62 at Université d'Evry Val d'Essonne, May 2010.
- A. Sergent was member of Comité de Sélection Maître de Conférences CNU 60 at UPMC, May 2012.
- A. Sergent was member of Comité de Sélection Maîtres de Conférences CNU 60/62 at Université d'Evry Val d'Essonne, May 2013.
- A. Sergent was member of Comité de Sélection Maîtres de Conférences CNU 60/62 at Université de Poitiers, May 2013.

TEACHING ACTIVITIES AND DUTIES IN RELATION TO RESEARCH

- C. Dang Vu-Delcarte was co-director of the Master Physique Appliquée et Mécanique (Master PAM) of University Paris-Sud and of the Speciality M2 DFE Dynamique des Fluides et Energétique until 2012.
- C. Nore is co-director of the Master Physique Appliquée et Mécanique (Master PAM) of University Paris-Sud.
- C. Nore teaches a course on MagnetoHydroDynamics (M2, DFE, Master PAM, Paris Sud University).
- C.-T. Pham teaches a course on Hamiltonian Mechanics (M1, Master PAM, Paris Sud University).
- C.-T. Pham (course head) teaches courses on Numerical Methods for CFD, Finite Element Methods, Programming and Code Development (M2 DFE, Master PAM, Paris Sud University).
- D. Baltean-Carlès teached (with C. Morin, MCF-UPMC) a course on « Energy and environmental impact» (M1, Master SDI, EE --MF2A, UPMC) (2009-2011).
- D. Baltean-Carlès teached (with A. Mongruel, MCF-UPMC) a course on « *Suspensions and two-phase media*» (M2, Master SDI, MF2A, UPMC) (2012-2013).
- 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 « Renewable Energies and Energetic Efficiency» (M2, Masters PIE and DFE, Paris-Sud University).
- W. Herreman (course head) teaches a course on « Numerical methods for fluid mechanics » (M1, Master PAM, Paris Sud 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).
- C. Nore was co-director of the École Doctorale Matière Condensée et Interfaces, co-habilitée Paris Diderot, Paris-Sud, ESPCI, ENS (director: Thomas Coudreau, professeur Paris 7), 2005-2009.

DISSEMINATION AND VULGARIZATION

- D. Baltean-Carlès was supervisor of classe préparatoire students (TIPE).
- I. Delbende is supervisor of classe préparatoire students (TIPE).

RESEARCH CONVENTIONS AND CONTRACTS

ACADEMIC PARTNERSHIPS

The code HELIX has been developed in collaboration with d'Alembert, UPMC. A licence application is about to be submitted which co-inventors are I. Delbende, M. Rossi and O. Daube. Moreover, a licence agreement for the use of the code has been negociated in 2013 for 2 years with M. Oberlack, FDY-TUD, Darmstadt, Germany.

VALORIZATION

A simulation platform OLORIN has been developed by CIGITA team on the basis of the know-how in numerical algorithms for incompressible and low-mach number flows. A licence application is in progress with co-inventors Y. Fraigneau, P. Le Quéré, A. Sergent and B. Podvin.

INDUSTRIAL RELATIONSHIPS

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

TABLE OF CONTRACTS FOR CORO GROUP

Contracts on public fundings

	Acronym	Funding agency/ Partner	Program	General coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
ANR Basic Science & JCJC	HiSpeed PIV	ANR	Blanc	Moisy Frédéric (FAST)	Pastur Luc	08/11/2006	07/05/2010	122 400
	RS-PEGASE	ANR	Blanc	Ferriere Alain (PROMES)	Sergent Anne	22/12/2006	21/12/2009	58 884
	PLASBorDDIAM	ANR	Blanc	Gicquel Alix (LSMP)	Le Quéré Patrick	01/09/2011	31/08/2015	115 544
	HELIX	ANR	Blanc	Leweke Thomas (IRPHE)	Delbende Ivan	01/01/2013	31/12/2016	141 681
Research collaborations	BQR 2008	Université Pierre et Marie Curie	BQR	Baltean Diana	Baltean Diana	01/01/2008	31/12/2008	15 000
	Coopération avec la Chine	CNRS		Le Quéré Patrick	Le Quéré Patrick	01/01/2010	31/12/2010	4 400
	SAKURA 2011	Programme Hubert Curien	PHC - SAKURA	Maneville Paul (Ladhyx)	Duguet Yohann	01/01/2011	31/12/2012	0
	Fer-VKS	LaSIPS		Nore Caroline	Nore Caroline	13/04/2011	31/12/2012	58 000
	BQR 2013	Université Pierre et Marie Curie	BQR	Martin Witkowski Laurent	Martin Witkowski Laurent	01/03/2013	31/12/2013	1 900
	Tassili	Ministère des affaires étrangères et européennes		Baltean Diana	Baltean Diana	01/03/2013	15/01/2014	1 845
UE contract	WALLTURB	EU	STREP	Stanislas Michel (LML)	Podvin Bérengere	01/04/2005	30/06/2009	134 000
Partnership	DRI Pologne	CNRS / Académie polonaise des sciences (PAN)		Le Quéré Patrick	Le Quéré Patrick	01/01/2001	31/12/2008	15 900
	CMCU	CMCU		Le Quéré Patrick	Le Quéré Patrick	01/04/2006	31/12/2008	17 089
Research support	COCORACOPHA	CNRS	Programme interdisciplinaire Energie	Le Quéré Patrick	Le Quéré Patrick	01/07/2007	31/12/2009	38 600
	FED EM2C-TMC	ECP		Anouar Soufiani (EM2C)	Le Quéré Patrick	01/07/2008	30/06/2009	35 000
	IUF	IUF		Nore Caroline	Nore Caroline	01/09/2008	31/08/2013	71 143
	FED EM2C-TMC	ECP		Anouar Soufiani (EM2C)	Le Quéré Patrick	01/05/2009	30/04/2010	16 722
	COCORAPHA 2	CNRS	Programme interdisciplinaire Energie	Xin Shihe (CETHIL)	Sergent Anne	01/01/2010	31/12/2012	8 000
	Energie	CNRS	Programme interdisciplinaire Energie	Le Quéré Patrick	Le Quéré Patrick	01/01/2010	31/12/2011	39 000
	GAMELAN	CEA		Le Quéré Patrick	Le Quéré Patrick	01/07/2011	31/07/2014	45 000
		Fondation EADS	Bourse de thèse	Duguet Yohann	Duguet Yohann	15/12/2011	31/12/2015	132 000

industrial contracts, contracts on private fundings...

	Acronym	Funding agency/Partner	Program	General coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
Prestation of services	Numerical simulation	ONERA		Le Quéré Patrick	Le Quéré Patrick	01/08/2008	30/06/2009	20 000

Patents, software registrations, licence agreements...					
	Software registrations (APP)	LIMSI author	Co-authors	Date	Comment
Valorisation	SUNFLUIDH Software for simulation of 3D unsteady incompressible or dilatable flows (low Mach number hypothesis) and extended to reactive flows, more specially for specific ionized gas applications.	Fraigneau Yann	–	01/05/2013	
	OLORIN Software for simulation of unsteady incompressible or low-compressible flows (low Mach number hypothesis) with 2D and 3D capabilities.	Fraigneau Yann	Le Quéré Patrick, Sergent Anne, Podvin Bérengère	01/09/2010	
	Licence agreements	Resp. for LIMSI	Licensee	Date	Comment
	SUNFLUIDH_EDU	Martin Witkowski Laurent	Université Pierre et Marie Curie	01/12/2012	Student version of SUNFLUIDH
	HELIX	Delbende Ivan	TU Darmstadt (All.)	01/02/2013	

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TSF
Solid-Fluid Transfer

MICHEL PONS

INTRODUCTION

The specificity of the *Solid-Fluid Transfer group* relies in its know-how in *Heat transfer* and *Energetics*. Another characteristic is that almost any member of the group is or was an experimentalist, or, if not, closely works with experimentalists. In the broad field of *Heat transfer* and *Energetics*, which is constantly revisited by new experimental techniques (e.g. optical velocimetry), new materials, or new challenges (e.g. micro- and nano-scales), the *Solid-Fluid Transfer group* explores four domains: (1) two-phase flows, (2) oscillating flows, (3) heat transfer from solid to superfluid helium, and (4) 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, our experimental skills are:

- 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;

Considering numerical simulations, some of us develop numerical codes with advanced numerical techniques; most of us mainly use numerical codes and contribute partially to their development. Globally speaking, the numerical skills developed in the group are:

- HPC and massively parallel Divergence-free two-phase flows with front-tracking for studying Faraday waves and related issues (massively parallel computing);
- Flows combining a Low-Mach-number region with an incompressible one, including front-tracking, for two-phase flows at microscale (accurate numerical scheme);
- Flows with microfluidic suspensions (asymptotic expansions, perturbation methods);
- Incompressible flows in open domains for natural convection in buildings (adapted boundary conditions);
- Second law analyses of processes, especially of solar-powered ones and those for refrigeration.

Our common purpose is to correctly simulate and finely understand the basic phenomena involved in complex or innovative transfer problems. Beyond fundamental knowledge, we are interested in improving the efficiency of transfer processes, *e.g.* via intensification of heat-transfer, separation, energetic efficiency, or reduction of irreversibilities. We thus address issues related to thermal- or energy-engineering, and we try to build bridges between theoretical investigations and applications. We are involved in various applications such as heat-transfers at nano-scales, solar air-conditioning, design of superconducting cavities of particle accelerators, or emergency-cooling of nuclear reactors.

It must be also said that the skills listed above have often been 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 and P. Le Quéré (AERO group) for numerical simulation of two-phase flows, Y. Fraigneau (CIGITA) for implementing pressure-driven boundary conditions on open domains.

In short, the *Solid-Fluid Transfer group* currently consists of two CNRS researchers, one professor, six assistant professors, one research engineer (only half-time for the group), and five PhD students. We collaborate with various French laboratories, namely FAST, IPNO, PMMH, CEA/IRFU, CEA/LITEN, EM2C, Pprime, LAUM, PIMENT, IEF, LGEP, LadHyX, IRSTEA, and foreign institutions like Hongik Univ. (South Korea), Univ. Chile, ETH (Zürich, Switzerland), Univ. Houari Boumediene (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 ACTIVITIES

TOPIC 1: TWO-PHASE FLOWS, DYNAMICS AND TRANSFERS

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

In the broad field of two-phase flows, LIMSI claims 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. Microscale phenomena are thus approached with analytical or asymptotic methods. At usual scales, the fluid and the interface have similar sizes. Moreover, the interface can take special shapes, like in *Faraday waves* for instance. For such cases, we follow the evolution of the interface shape with the *Front-tracking* technique. *Faraday waves* are very interesting theoretically while being useful for checking the validity of our numerical schemes by comparing our results to experimental data. A significant effort was made in these last years in parallelizing the numerical code handling gas phases with constant and uniform density, a task achieved with the significant contribution of J. Chergui (CIGITA). We also remember that LIMSI's long term goal is to accurately simulate liquid-vapor flows involving phase change, heat transfer and convection. In this third kind of issues, bubbles may grow by evaporation, detach, shrink, coalesce, etc., so that the effects of gas-phase compressibility must be taken into account. By using the *Low Mach number* approach, compressibility effects were included into our numerical codes while still ensuring mass conservation. We could thus study the dynamics of vapor bubbles in microscale geometries. Obviously, there is still much to do, for instance describing the dynamics of the contact line with solid surfaces when relevant, or including the heat and mass transfers related to 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 much smaller than 1 and the dynamics of solid suspensions is mainly ruled by hydrodynamic interactions with walls. Small inertial effects in the fluid (of the order of Re^2) produce differential lift forces on the particles, thus inducing particle separation. Those lift 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 that we use 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). We have also established solutions (at the order of *Re*) in creeping flows for various combinations of walls and particles. The case of spherical particles in a Poiseuille flow along a solid plane walls was solved with an analytical method, see Illustration 1, and results were effectively used for optimizing separation techniques in analytical chemistry (Pasol *et al.* 2011).

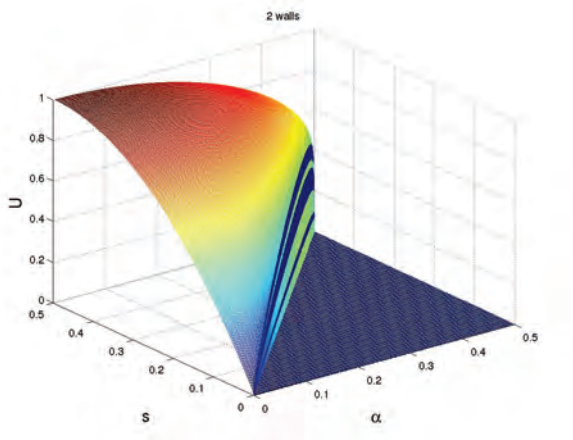


Illustration 1: Velocity of a freely moving sphere carried by a Poiseuille flow (normalized by the maximum Poiseuille flow velocity) as a function of the dimensionless sphere radius α and the dimensionless sphere center position s. The Stokes equations for the creeping flow were solved by the multipole method which is very accurate (Pasol et al., 2011).

That basic case was extended to more and more complex shapes of the particles and the walls: e.g. ellipsoids settling in a cubic container -solved by the boundary integral method (Hedhili *et al. CMES* 2011)-

or spherocylinders (trunk of a cylinder and two hemispherical caps) as used in biological applications. The multipole method, where the spherocylinders were modeled as assemblies of interpenetrating spheres, again lead to excellent agreements with experiments (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 the Stokes flow close to a porous membrane, relies on the fundamental solution where singularities are located outside of the flow field. In a first step, no-slip conditions were assumed along the porous wall (Debbech *et al.* 2010). The more elaborate Beavers and Joseph slip-conditions were used in following works. The case of several particles in a viscous flow near a porous wall was treated, first by a perturbation method developed at the 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. The special case of a single 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 in 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).

In the case of severe accidents, Pressurized Water Reactors are sprayed with water droplets. Nuclear engineering thus needs to better know the dynamics and thermal effects of droplets. We studied how the two water droplets coalesce during their fall from the injection nozzles which are located at the top of the containment vessel. We have shown that the various collision regimes, 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; for instance icing of aircrafts due to impinging supercooled water drops is likely to cause severe accidents. We calculated freezing of supercooled drops in airflows with the method of matched asymptotic expansions based on the Stefan number (Tabakova *et al.* 2010) and found that 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 the second order, accounting for the presence of the free surface (Tabakova *et al.* 2011). The results agree well with recent experimental observations using rapid video pictures of drops in icing wind tunnels (Mongruel *et al.* 2011).

F. Feuillebois, now retired, was honored by an international symposium dedicated to his 65th birthday.

LARGE SCALE LIQUID-GAS INTERFACE WITH INCOMPRESSIBLE GAS PHASE – PARALLEL DNS IN 3 DIMENSIONS

One trump of LIMSI's in the field of numerical simulations of two-phase flows is the *Front-tracking* technique. We apply this technique to flows where the gas phase is either incompressible or weakly compressible.

D. Juric, J. Chergui (CIGITA LIMSI) and S. Shin (Hongik Univ.) have developed the high performance, parallel code BLUE. BLUE is based on a high fidelity hybrid Front-Tracking/Level-Set algorithm for the Lagrangian tracking of arbitrarily deformable phase interfaces and a precise treatment of surface tension forces, interface advection and mass conservation. BLUE couples an implicit, 3D incompressible Navier-Stokes solver with multigrid pressure solution to the Lagrangian tracking method for implementation on large-scale parallel computing architectures. Validation tests have been performed on LIMSI's parallel cluster (196 cores). On massively parallel machines (IBM BlueGene/Q machines), BLUE has shown excellent scalability performance up to 8192 processors at IDRIS, see Illustration 2, and up to 16384 processors at the Julich Supercomputing Center in Germany (ranked world's fifth fastest supercomputer).

The modular program structure allows for the application of the code to a wide variety of physical scenarios: free surface instabilities, flow of bubbles or drops with coalescence and breakup, droplet impact or flow around immersed solid objects for microchannel flows for example. We focus our studies on physical phenomena of large spatio-temporal extent where high performance is indispensable. One example is the canonical phenomenon of a high impact water droplet splash onto a film of water (see Illustration 3). Other projects involve recent experiments by J. Rajchenbach (Univ. Nice) of highly nonlinear Faraday waves which show five-petaled localized patterns that have never been observed previously. Simulations by A. Ebo Adou have reproduced the experimental pentagonal pattern in this regime. 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 and L. Tuckerman (PMMH-ESPCI, Paris) is aimed at characterizing the instability threshold of this rotating Faraday experiment. N. Périnet (Univ. Chile) is conducting simulations using BLUE on an IBM iDataplex cluster at Univ. Chile in a study of the dynamics and interactions of solitons in a hydrodynamic channel. The PhD work of B. Xu (LIMSI and FAST) on simulation and scaling of two-phase microfluidic flows is inspired by the recent discovery by T. Cubaud (Stony Brook Univ., New York) of a remarkable new

class of two-phase flow morphologies involving thin miscible and immiscible viscous threads in microfluidic devices.

Our program on the study of the dynamics of free surfaces, films and general fluid-fluid interfaces can find applications in a wide variety of situations such as free-surface waves and turbulence, jets, bubbles and drops. The engineering applications range from microfluidics (e.g. micro-encapsulation) to marine engineering (ocean waves, hull drag reduction by bubble injection) and chemical or bio-engineering processes at scales in between. The code BLUE can be adapted to problems involving phase change or flame fronts.

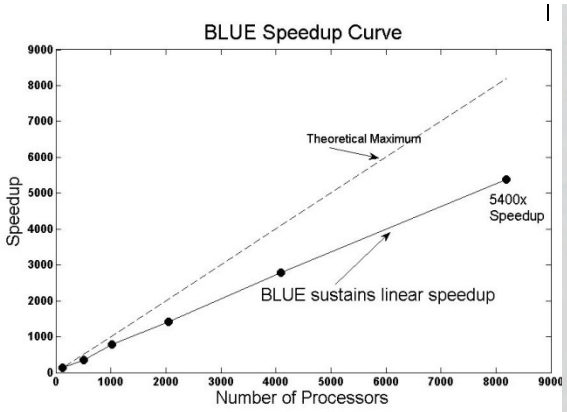


Illustration 2: BLUE's performance increase with number of cores: linear speedup up to 8192 processors on the IBM Bluegene at IDRIS, Orsay

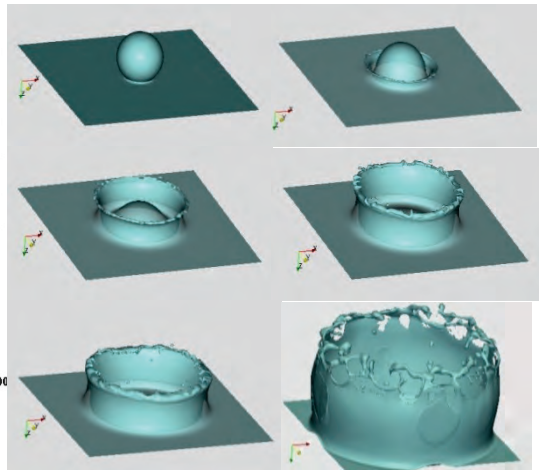


Illustration 3: A water drop splashes onto a free-surface of water Sequence of 6 snapshots. Parallel 3D simulation on 4096 cores at JSC, Germany.

MICROFLUIDICS WITH A COMPRESSIBLE GAS PHASE

Two-phase flows involving phase change cannot be completely simulated without accounting for the equation of state of the gas phase and the compressible nature. However, when the fluid velocity is much slower than the sound speed, *e.g.* in configurations which are mainly controlled by heat transfer, significant reduction in CPU time can be achieved thanks to the *Low Mach Number* approximation. V. Daru (AERO group) developed efficient numerical schemes where one phase follows the Low Mach Number approximation and the other one is divergence-free. The concept of a dual fluid (one phase weakly compressible, one phase incompressible) is valid as demonstrated by 1D test-cases involving liquid-vapor phase change[2] and fast interface dynamics (Duluc *et al*. *Microfluidics & Nanofluidics* 2009). However, two issues were to be addressed before simulating 2D or 3D configurations. First, the thermodynamic pressure in the gas phase must be connected to the pressure field in the liquid phase although the latter is defined up to an additive constant. For instance, consider a contiguous liquid phase, not submitted to gravity, containing several gas bubbles where the gas pressure takes different values from one bubble to the next. The forces exerted by the bubbles on the liquid generate motion in the liquid phase, then the fluid inertia induces alternate expansions and contractions of the bubbles. The solution developed by V. Daru in the AERO group ensures continuity of the total pressure field by introducing the *extended pressure field* in the algorithm (Daru *et al. JCP*, 2010). See more numerical details in the section of the AERO group.

The second concern is exact mass preservation by the front-tracking algorithm when the flow is divergence-free on one side only of the interface. This is a crucial, delicate and very demanding issue. G. Prigent's made great progress on this point during his PhD thesis. He rigorously verified each step of the numerical scheme, and then replaced the smooth Heaviside function used in the front-tracking technique by a sharp stepwise one. Discrepancies in the mass and energy balances were reduced down to acceptable values while the algorithm is robust and rapid. Now, our code can be used for simulating isobaric flows where a gas bubble expands or contracts, as well as isochoric flows, where the thermodynamic pressure in the bubble may fluctuate. A new test-case at low velocity has been elaborated where a gaseous bubble is transported by water across a non-isothermal micro-channel (Prigent et al. ASME 2012), see Illustration 4. The stepwise temperature change on the walls induces a delayed pressure

[2] 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.

increase in the bubble, as represented in Illustration 5. Because of such compressibility effects, gas bubbles could be used as actuators in microfluidic applications.

It can also be seen that any new version of our numerical codes is validated by comparison with either analytical solutions, numerical solutions given by other physically relevant models, data derived from linear stability analyses, or 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.

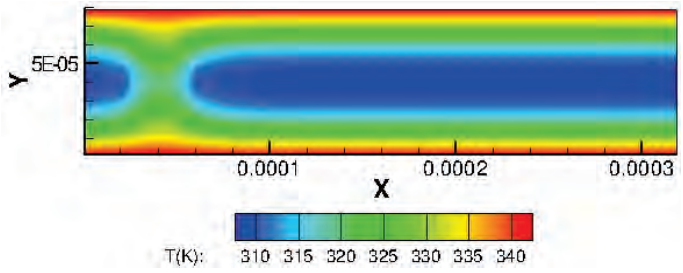


Illustration 4: An isochoric air bubble flows through a water filled micro-channel : the stepwise temperature change is supplied at the walls. The picture shows alteration of the temperature field induced by the bubble crossing.

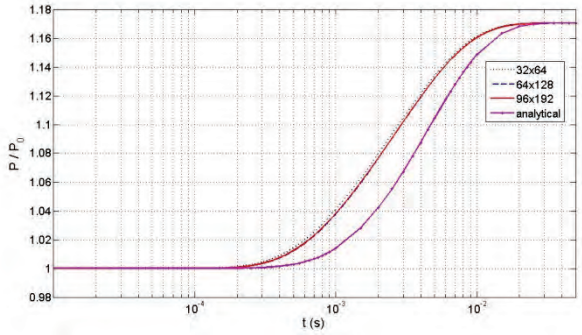


Illustration 5: Pressure change undergone by an air-filled bubble flowing in a micro-channel filled with water, the wall temperature of which is a stepwise function. Grid-convergence and comparison with the analytical solution of heat-diffusion only.

TOPIC 2: OSCILLATING FLOWS, DYNAMICS AND TRANSFERS

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

In LIMSI, a research activity that involves people of different groups is called *transverse*, and when it is perennial enough then it appears in the organizational chart as a *Transverse Action*. So it is for the Transverse Action *Thermoacoustics-Cryogenics*, to which people of the three groups contribute. It was decided to present the numerical activities based on the Navier-Stokes equations in the CORO group, while the TSF group rather deals with experimental investigations on a full-size machine.

Like many other laboratories involved in thermoacoustics, LIMSI focuses attention on the acoustic streaming, both experimentally and numerically. As explained before, only the former aspect is presented here-under. Acoustic streaming is the generic name of secondary flows (their velocity is one order of magnitude less than the acoustic velocity) which are generated within acoustic waves developed in 3D geometries with no-slip conditions at the walls, such as thermoacoustic stacks, acoustic loops of Stirling-type thermoacoustic machines, or simple resonator tubes. The acoustic streaming does not consume much acoustic energy but it induces enthalpy transfers which are very unfavorable to the efficiency of thermoacoustic machines. That phenomenon thus deserves deep studies. With the precious help of F. Lusseyran (AERO group), several experimental techniques have been developed in the *Solid-Fluid Transfer* group : characterization of the secondary velocity field, either by Particle Image Velocimetry (PIV) or by Laser Doppler Velocimetry (LDV), characterization of the secondary pressure field related to the secondary flow.

The LIMSI's thermoacoustic prime mover consists of a linear resonator coupled to an annular loop (4.25m long Stirling-type engine with progressive waves at 22Hz in nitrogen gas at pressures up to 30bars), cf. Illustration 6. It is equipped with piezoelectric pressure sensors and with a Laser Doppler Velocimetry (LDV) apparatus, see Illustration 7. Analysis of the experimental pressure profiles demonstrates that the acoustic field can be correctly described by a linear model, see Illustration 8 (Kouidri *et al. CFA* 2010, *ASME-ATI-UIT* 2010; Paridaens *et al. CFM* 2011, *ASME* 2011). It can also be deduced that both Mach number M and nonlinear Reynolds number Re_{NL} are low [$Re_{NL} = (M.R/\delta_v)^2$, where R the radius of the

resonator and δ_v the thickness of the viscous boundary layer]. Further analysis then leads to the secondary pressure field and shows that the acoustic streaming flow is of the *slow-type* (*linear* regime). We have then developed an analytical mode based on successive approximations and asymptotic developments (Paridaens *et al*. *Acoustics* 2012). The calculated velocity profiles compare favorably with the experimental data of the axial acoustic velocity U_{a1} and of the second order velocity U_m (acoustic streaming) despite deviations in the vicinity of the wall, see Illustration 9.

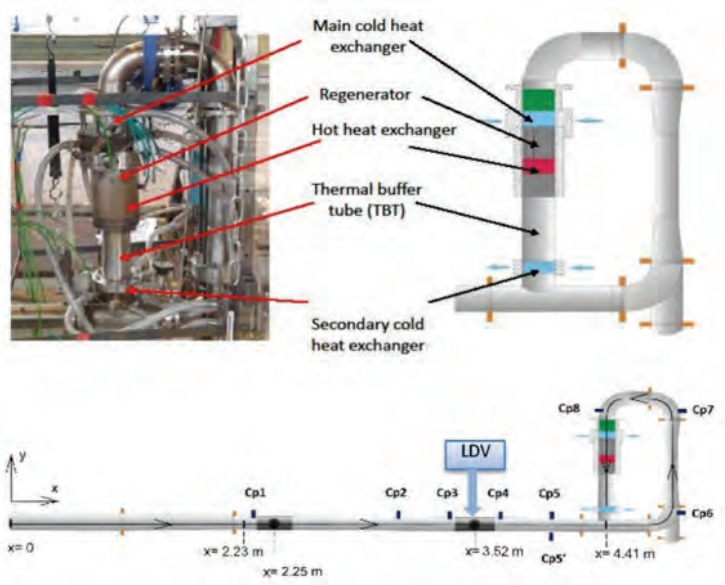


Illustration 6: LIMSI's Thermoacoustic prime mover.

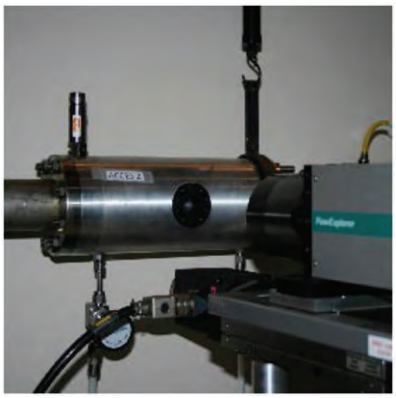


Illustration 7: The LDV equipment and the measurement window implemented on the resonator. The position is indicated in Illustration 6.

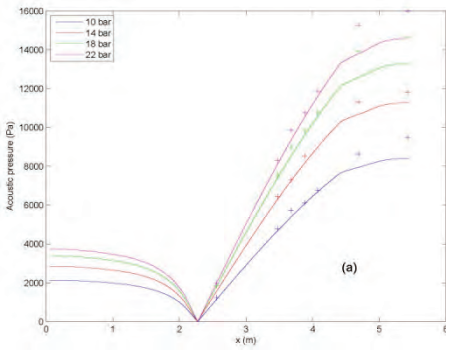
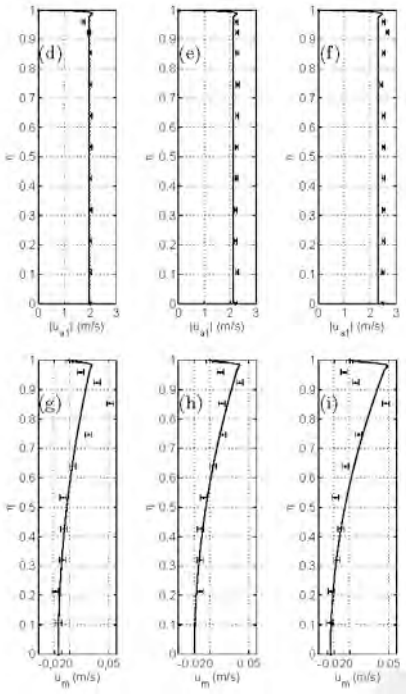


Illustration 8: Experimental and numerical values (resp. dots and lines) of the acoustic part of the pressure field along the resonator and loop; the positions of the piezoelectric sensors are given in Illustration 6.



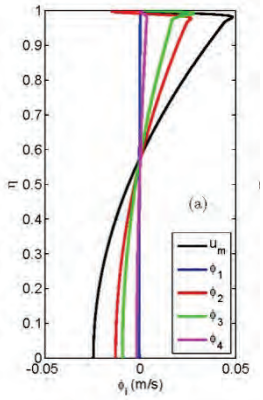


Illustration 10: The various contributions (ϕ_j) for the case (i) of Illustration 9.

Illustration 9: Velocity profiles of the first and second orders (vs. radial position, resp. above and under): measured and calculated data for three heating power-rates (resp. 165, 190, and 210W) with a mean pressure of 10 bars.

Moreover, the model evidences various contributions to the generation of the acoustic streaming: the viscous stress (ϕ_1), the Reynolds stress (ϕ_2 and ϕ_3) and the acoustic flow (ϕ_4). Illustration 10 shows the respective contributions for one experimental configuration. The collaboration with Pprime (Poitiers) in the framework of the GdR 3058 *Thermoacoustique* (Task *Investigation of streaming flows by laser metrology*) was very useful for sharing skills and comparing the results of LDV measurements.

TOPIC 3: HEAT TRANSFER FROM SOLID TO SUPERFLUID HELIUM

J. Amrit, *A. Ramière, V. Radha Krishnan, Q. Li*

This theme focuses research on heat-transfer at cryogenic interfaces and heat-transport in micro/nano-structures. Three issues are investigated simultaneously, namely (1) the thermal boundary Kapitza resistance at Silicon crystal/superfluid Helium interfaces, (2) the thermo-magnetic stability of superconducting cavities (SC) for particle accelerators and (3) the thermal transport in nanowires and micro/nano-junctions. Our studies mainly rely on experiments conducted at low temperatures, which are complemented with theoretical and numerical work. The underlying physical phenomena of interest are the scattering of energy carriers (phonons) at interfaces and boundaries, and the resulting dissipation.

The thermal boundary resistance (Kapitza resistance, *i.e.* a finite temperature jump at interfaces) is studied in collaboration with IPNO (Orsay). We measured the resistance between a highly polished single-crystal Silicon (111) and superfluid Helium at temperatures as low as 0.4-2.1K. This premiere was possible thanks to the unique cell geometry designed for our experiments (Amrit & Thermeau *J. Phys.* 2009). Analysis of the results evidenced a transition in the transmission process: due to the nanometer size of surface roughness, scattering changes from diffuse to specular when temperature decreases. It was the first time that this transition was described (Amrit *Phys. Rev. B* 2010). Current studies investigate the thermal boundary resistance as a function of the acoustic impedance (density x speed-of-sound) of superfluid helium. The measurements are conducted from atmospheric pressure to 23 bars. The resulting change by 80% in the acoustic impedance induces a change of 7% only in the thermal boundary resistance; see Illustration 11 (Ramière *et al.* 2012 and 2013[3]). These results confirm that tailoring of interface transmission requires a control of the interface roughness. Current experiments examine the transition in the thermal boundary resistance at the Si/He interface upon solidification of superfluid Helium.

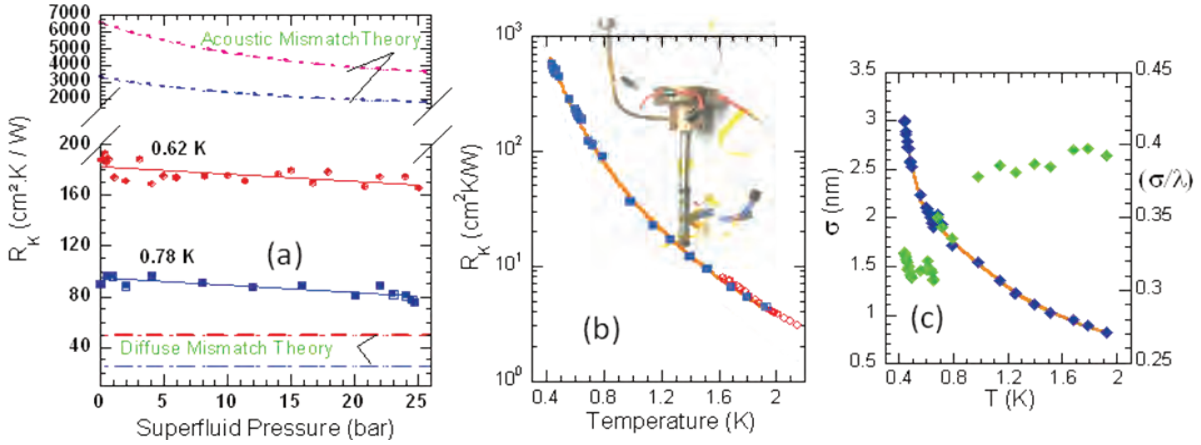


Illustration 11: (a) Kapitza resistance at the Si/He interface as a function of pressure at two temperatures. (b) Kapitza resistance at the interface Si/He under atmospheric pressure as a function of temperature and the experimental cell (insert). (c) Nanometer scale surface roughness (squares) required to interpret data and roughness-to-wavelength ratio (diamonds) characterizing the nature of scattering.

The studies on the thermal stability of superconducting cavities (SC) of particle accelerators are conducted in collaboration with C.-Z. Antoine (CEA/Saclay/Irfu). We measured the Kapitza resistance between Niobium single crystals and superfluid He. The samples were supplied by the *Fermi National Accelerator Laboratory* (Illinois USA) and were characterized at ICMO (Orsay). The data, that complement our previous measurements and numerical simulations on polycrystalline Niobium (Amrit & Li 2008), were recently used for the first time in view of a novel design for accelerator cavities made of Nb single crystals (Amrit and Antoine 2010). The data also gave access to the influence of surface defects on the Kapitza resistance (Amrit & Ramière 2013 idem). All these results constitute a benchmark for the conception of SC. Current numerical simulations focus on the occurrence of hotspots on SC during their operation.

Studies on the thermal transport in nanowires and micro/nano-junctions have been conducted in a joint research collaboration with S. Volz (EM2C, École Centrale Paris) for over six years. In 2010 we extended

[3] J. Amrit & A. Ramiere, Kapitza resistance between superfluid helium and solid: role of the boundary, submitted to *Low Temperature Physics* (English translation of *Fizika Nizkikh Temperatur*) and accepted (2013).

our partnership to F. Parrain (IEF Orsay) and O. Bourgeois (Institut Louis Néel, Grenoble). These two collaborators take in charge the fabrication of samples (MEMS devices) and detectors (nanofilms). Venkatesh Radha Krishnan, financed by a one-year post-doctorate grant of the PRES UniverSud, investigated the electronic ballistic heat transport in metallic nanowires and the role of the thermal boundary resistance between the nanowire and its substrates, as a function of the nanowire diameter (Venkatesh *et al.* 2011). Currently and as part of the PhD work of A. Ramière, thermal transport in the ballistic regime across micro junctions is studied. The aim is to demonstrate new physical laws describing the energy dissipation in micro- or nano-electronic systems at ambient temperatures. Experiments are done at low temperatures (below 2K) where the ballistic regime is fully established. Monte Carlo simulations for thermal transport at micro-scales are also performed[4], see Illustration 12. This work is supported by the LabEx LaSIPS, Paris-Saclay.

Simultaneously, we also examine the effects of turbulence on the heat transfer coefficient in a cryogenic heat exchanger, which was specially designed and built for this study (Amrit *et al. EJP* 2012). Current and future research shall focus on thermal phenomena at micro/nano-scale related to surface roughness and size (geometry) change, an issue which is very active internationally.

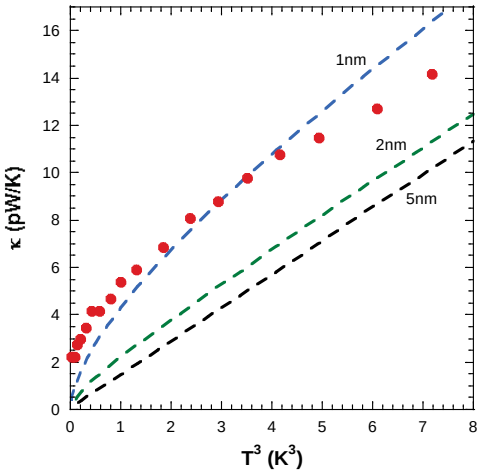


*Illustration 12: Thermal conductance in mesoscopic silicon ribbons at low temperatures, our Monte Carlo simulations for different values of the surface roughness (dashed lines) and the experimental results of Héron et al. (Nano Letters, **9**, 1861, 2009) (dots). Note the departure from the behaviour in T^3.*

TOPIC 4 : APPLIED CONVECTIVE TRANSFERS

***M. Pons**, V. Bourdin, M.-C. Duluc, M. Jarrahi, G. Defresne, M. Firdaouss, E. Tapachès, S. Wullens, M. Chhay*

The applications of convective transfers we are interested in are connected to some issues related with energy concerns. For instance, we study the effect of heat-flux modulation on external free convection because we expect the heat-transfer to be intensified, or we study natural ventilation of buildings because we expect energy savings via a reduced use of air-conditioners. Lastly, the *TSF* group contributes to the general effort for promoting renewable energies, namely solar energy : solar air-conditioning, concentrated solar power in tropical islands, and low concentration for photovoltaic panels.

ENHANCEMENT OF EXTERNAL FREE CONVECTION

Free convection around a line source has been investigated for long in our group : a horizontal metallic wire immersed in a pool of fluid was submitted to a stepwise electrical heating. Heat-flux modulation may result in non-linear effects or thermo-convective instabilities, thus leading to enhancement in heat-transfer. M.C. Duluc and M. Jarrahi (who recently joined LIMSI as an assistant professor in the IUT d'Orsay) build a new experimental set-up for studying the fundaments of those interactions. The wire can now be heated with a modulated power-rate. After validation of the instrumentation and experimental procedures, measurement campaigns have now started, see Illustration 13. Moreover PIV measurements planned in a second step will give insight on the flow patterns around the wire and will permit comparison with numerical simulations. The long term concern is about the most efficient geometries and modulations for heat-transfer intensification.

[4] A. Ramière, J. Amrit & S. Volz, Role of boundary roughness on heat transport in mesoscopic silicon ribbons at low temperatures, *Nanoenergy Letters* (submitted in 2013).

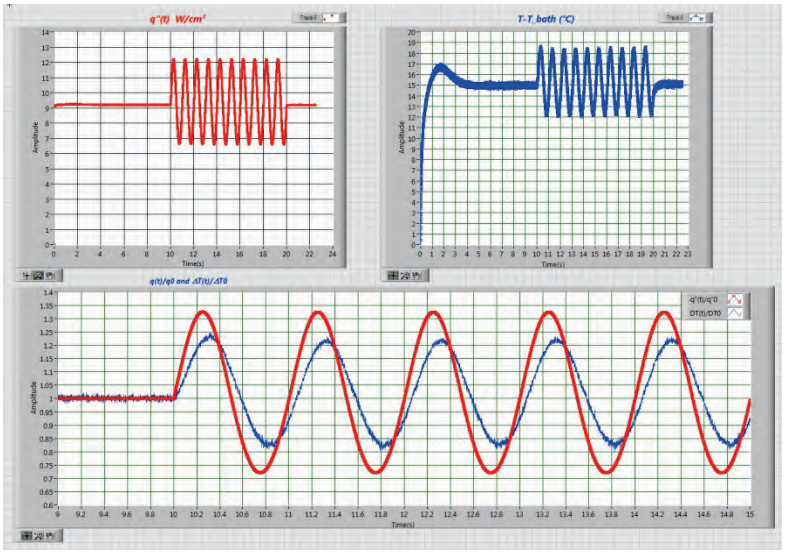


Illustration 13: Temperature response of the wire (top right frame) when submitted to a sinusoidal modulation of the heat flux (top left frame). In the lower frame, the non-dimensional signals are superimposed in order to evidence the gain and the phase shift.

NATURAL VENTILATION IN BUILDINGS

The wide development of air-conditioning raises serious energy issues. Nocturnal ventilation offers *free-cooling* at night, and thus can reduce the use of air-conditioners. The design of an efficient ventilation system requires reliable numerical simulations of air flows in buildings but such simulations are very challenging, because the effective Reynolds and Rayleigh numbers are very large, because the real houses or flats are geometrically complex, and because simulations must be done over very long periods. We entered the subject via the *ADNBATI* project (Amélioration de la Description Numérique du BÂTI, Programme *Energie* of CNRS) in collaboration with PIMENT (Univ. La Réunion) and LOCIE-INES. The first purpose was to compare the various methods currently used for computing the heat-transfer induced by natural convection in a room with two opposite openings. The results demonstrated the need of advanced CFD computations, see Illustration 14 (Pons *et al*. *ACOMEN Conf.* 2011). However, a real building involves many coupled phenomena such as solar fluxes, wind fluctuations, radiation, conduction and inertia in the walls, humid air, composite materials, without forgetting the interactions with the occupants. During his post-doc co-financed by LIMSI and LOCIE-INES, M. Chhay evaluated the possibilities of addressing such issues with multi-level simulation (Pons *et al*. *SFT Conf.* 2011). However, the rapid development of HPC made us turn toward coupling CFD and zonal models onto a co-simulation platform. The fluid convection is handled by CFD while wide-range interactions and slow phenomena are handled by the zonal models presently used by the consultants in building energetics engineering. S. Wullens, PhD student co-directed with E. Wurtz (formerly LOCIE, currently CEA-INES) and financed by the *4C* ANR project (coordinated by PIMENT) began in 2010 implementation of pressure-based boundary-conditions for open domains into one LIMSI's code (OLORIN). He first investigated the ADNBATI case (single room with two openings), so confirming the results obtained by PIMENT, see Illustration 15 and (Wullens et al. *SFT* 2013). He also validated his work with the data of the "vertical chimney" benchmark conducted by Chenier et al. in the framework the French community on Thermal Sciences (SFT), see the section *Buoyant convection modeling, Topic 1* in *CORO* group. He is now implementing the coupling of the CFD code with a multizone model (Modelica framework, CEA-INES) onto a test platform using the 'cloud' recently opened by CNRS. The purpose is to simulate the behavior of a simple whole building in transient conditions. This will be a significant contribution to an on-coming co-simulation platform devoted to building simulations.

A significant feature of the natural flow in the ADNBATI room is the presence of two large recirculation cells that occupy almost all the volume, see Illustration 15. In collaboration with M. Hasnaoui (Univ. Marrakech), M. Firdaouss conducted a more academic study: 2D square cavity heated from below, with a model based on the stream function-vorticity formulation. The configuration with two horizontal cells is intrinsic to that configuration, see the BHF case in Illustration 16. This study also showed that the two-cell flow unfortunately reduces heat-transfer compared to other configurations (Raji *et al*. 2012). Investigation must be continued toward other aspect ratios and larger values of *Ra*.

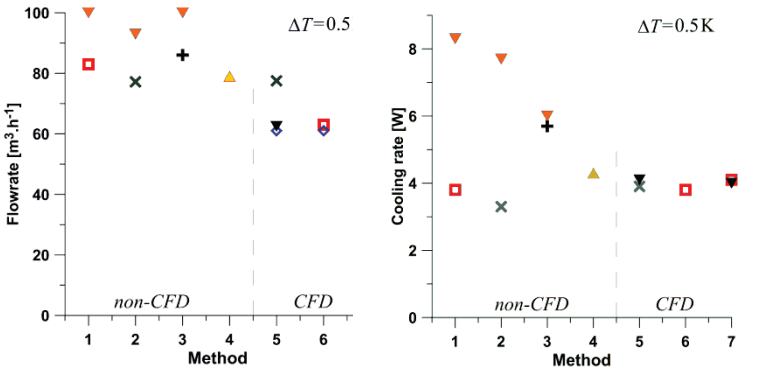


Illustration 14: ADNBATI benchmark: comparison of the results given by the seven investigated methods for the average ventilation flow-rate (left) and average heat-transfer (right). Method #1: analytical formulae; #2: nodal models; #3: TRNSYS-CONTAM; #4: zonal model; #5: under-resolved CFD laminar; #6: under-resolved CFD turbulent; #7: Direct Numerical Simulation.

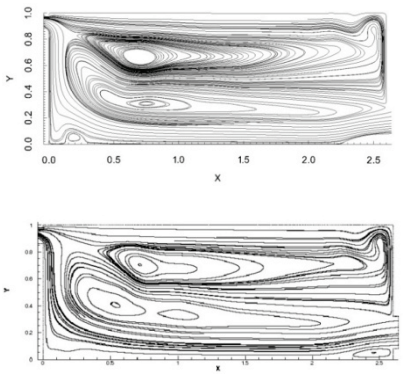


Illustration 15: ADNBATI with Ra=10^7; Streamlines calculated by DNS#7 in LIMSI (top) and PIMENT (bottom). Air enters the room at the bottom right and leaves it at the top left.

SOLAR ENERGY

Historically, some members of the *TSF* group were involved in solar-powered refrigeration. It was then logical for M. Pons to contribute to the ANR project *Orasol*, the aim of which was 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). The thermodynamic approach is based on non-dimensional energy- and mass-fluxes in order to describe the energetic behavior of the units, from incident solar energy to cold production. The analysis included the heat rejected to the atmosphere, the electricity consumed by auxiliaries, and the water consumption when relevant. Thanks to that analysis, comparison between the performance recorded during two years gives comprehensive insight on various features such as possible degradation of performance, or quantitative differences between continuous cycles (liquid sorption or rotary desiccant wheel) and discontinuous ones (solid sorption). Special attention was devoted to statistics on the actual electricity consumption of the tested solar air-conditioners. This point is usually neglected in the literature although its reduction is expected to be the main environmental benefit of that technique. The *Orasol* study demonstrates that the initial design of the system through which heat is rejected to the atmosphere is extremely important (Pons et al. *Energy* 2012). The exergy analysis of solar-powered was also developed in the framework of the *Orasol* project. As a first step, was established the method for evaluating the exergy content of solar radiation at the terrestrial level (Pons *ECOS Conf.* 2008 & 2011) or when the ambient temperature changes (Pons *IJoT* 2009). Applying then that method to actual data collected in Odeillo (PROMES) and in La Réunion (PIMENT) gives access to the exergy losses which are specific to given uses of solar energy : with flat-plate collectors (without concentration) or with huge fields of heliostats (quasi-infinite concentration), for producing heat, possibly converted into electricity, or for photovoltaic conversion (Pons *Renewable Energy* 2012).

From the *Orasol* study, it sounded logical to extend our interest in solar energy in two directions. Both are related to relatively low concentration, which is intermediate between no-concentration and infinite concentration. The first study involves photovoltaic conversion and is conducted in strong collaboration with LGEP (Orsay, LabEx LaSIPS). Since 2011, V. Bourdin (TSF group), A. Migan and J.P. Kleider (LGEP) investigate the benefit of using simple mirrors for enhancing the electricity produced by photovoltaic panels. Two experimental campaigns have been conducted in summers 2012 and 2013, see the experimental field Illustration 17. Compared to reference panels, the panels equipped with mirrors exhibit experimental performance (under nominal insolation) enhanced by 18% for poly-crystalline cells and by 29% for amorphous cells. Such a result is very encouraging, and current studies focus on thermal effects and mirror optimization. The second concern is production of electricity by an Organic Rankine Cycle powered a Fresnel-type concentrating solar collector. This is an extension of our collaboration with PIMENT. Indeed, due to a specific energetic context (significant cost of the fuel imported for producing electricity), a tropical island like La Réunion is interested in Organic Rankine Cycle (ORC) powered by Concentrated Solar Power (CSP). The PhD thesis started in 2012 (E. Tapachés, in co-direction with F. Lucas at PIMENT) first developed an efficient algorithm for using the Monte-Carlo software EDSTAR that calculate the flux absorbed in the visible wavelengths after reflection on various surfaces (mirrors, like in

the former case, and possible secondary reflector). On both studies, we are now working on coupling the radiative fluxes (short and long wavelengths) and the convective-conductive transfers. This will open the way for later optimization.

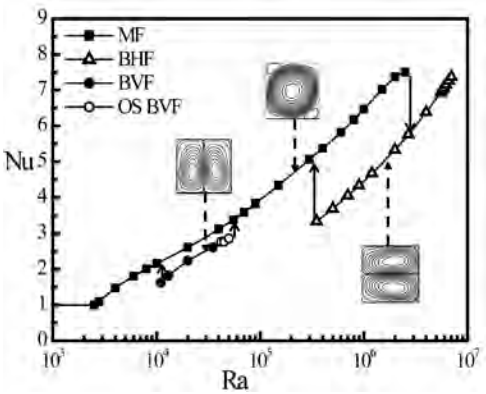


Illustration 16: Flow-pattern phase-diagram in 2D square cavity heated from below. The mono-cellular flow pattern (MF, closed *squares), which is the fundamental mode for this geometry, may exist up to Ra=2.5x10^6. Beyond this value, only the horizontal two-cell flow (BHF, open triangles) exists. Note that the transition between the MF and BHF flows displays an hysteresis. Also note the low Nusselt numbers for the BHF flow.*

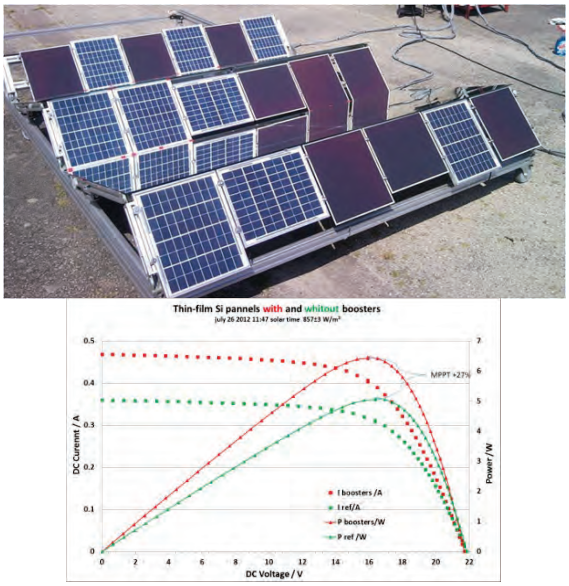


Illustration 17: The photovoltaic panels of the second and third rows are equipped with mirrors (top). Current-tension curves showing the performance increase induced by the mirrors (bottom solid lines).

Highlights

- Development of a massively parallel numerical code for incompressible two-phase flows using the front tracking technique (BLUE).
- Pentagonal quasi-crystal pattern for Faraday waves calculated for the first time, in good agreement with experimental observations, thanks to BLUE. Moreover, calculation of an exotic regime of hexagonal patterns in Faraday waves (heteroclinic cycle alternating between quasi-hexagonal and beaded stripe patterns)
- For the first time, measurements of the Kapitza resistance between a single-crystal of Silicon and superfluid Helium at temperatures as low as 0.4K, and also with a pressure of the superfluid Helium ranging from Standard Vapor Pressure to 25 bars (various temperatures).
- Excellent agreement between numerical simulations and experiments for the jet occurring after the fall of a liquid drop on a solid surface.
- International symposium organized in honor of François Feuillebois' 65th birthday : 'Microparticles in Stokes Flows', Warsaw, August 2011 (URL : http ://microparticles2011.ippt.gov.pl/).
- Numerical methods for simulating discontinuous compressible gas phase enclosed in a liquid volume (with AERO group).
- Development of pressure controlled boundary conditions for open domains (with CORO group).

STAFF

PERMANENT STAFF

Last name	First name	Position	Employer	HDR	Arrival date	Departure date
Amrit	Jay	Ass.Prof.	Université Paris Sud	HDR		
Bisch	Daniele	Ass. Eng.	CNRS			Retired on 06/10/2008
Defresne	Gérard	Ass .Prof.	Université Paris Sud			
Duluc	Marie-Christine	Ass.Prof.	CNAM	HDR		
Feuillebois	François	DR	CNRS	HDR	Hired as of 01/01/2010	Retired on 01/09/2011
Firdaouss	Mouaouia	Ass.Prof.	UPMC			
François	Maurice - Xavier	Prof. (Emeritus)	UPMC	HDR		Retired on 31/12/2011
Grenier	Nicolas	Ass.Prof.	Université Paris Sud		Hired as of 01/09/2013	
Jarrahi	Mojtaba	Ass.Prof.	Université Paris Sud		Hired as of 01/09/2012	
Jebali Jerbi	Fathi	Ass.Prof.	UPMC			
Juric	Damir	CR	CNRS	HDR		
Kouidri	Smaïne	Prof.	UPMC	HDR		
Pons	Michel	DR	CNRS	HDR		

NON PERMANENT STAFF

Last name	First name	Contract	Arrival date	Departure date
Chhay	Marx	CDD	01/09/2009	31/08/2010
Kahouadji	Lyes	Post-Doc	01/10/2012	31/12/2012
Khabthani	Sondes	Post-Doc	26/04/2010	06/05/2010
Krishnan	Radha	Post-Doc	10/09/2008	09/09/2009

PHD STUDENTS

Last name	First name	Thesis director	Arrival date	Date of defense
Betrancourt	Adrien	Maurice Xavier François	01/09/2004	15/07/2008
Paridaens	Richard	Smaïne Kouidri	15/09/2009	29/05/2013
Perinet	Nicolas	Laurette Tuckerman	01/10/2007	17/12/2010
Prigent	Guillaume	Patrick Le Quéré	01/10/2009	24/01/2013
Ebo Adou	Ali-Higo	Damir Juric	01/10/2012	
Ramière	Aymeric	Jairaj Amrit	01/10/2011	
Tapachès	Emeric	Michel Pons	18/06/2012	
Wullens	Sébastien	Michel Pons	01/09/2010	
Xu	Bingrui	Neil Ribes	01/10/2012	

INTERNSHIPS

Last name	First name	Arrival date	Departure date	Prepared degree	School / University
Moriot	Jérémy	01/04/08	29/06/08	Master 1	Université Paris Sud
Yan	Xiaoxing	15/11/08	26/06/09	3ème Année Ingénieur	ENSAM
Ndongo Fokoua	Georges	09/03/09	09/09/09	Master 2	UPMC
Sun	Wei	08/04/09	29/06/09	Master 2	UPMC
Ricard	Vincent	09/12/09	25/06/10	3ème Année Ingénieur	ENSAM
Wullens	Sébastien	15/02/10	21/08/10	Master 2	UPMC
El Gendi	Mahmoud	08/04/10	31/07/10	Master M2	Université Haute Alsace
Fath Allah	Amir	19/04/10	19/07/10	M1	Université Paris Sud
Belhassein	Betty	10/05/10	30/07/10	Master 1	UPMC

Ricard	Vincent	01/07/10	31/08/10	4ème Année Ingénieur	INSA Lyon
Canterino	Simon	20/10/10	30/06/11	3ème Année Ingénieur	ENSAM
Ramière	Aymeric	01/04/11	30/09/11	M2	Université Paris Sud
Saldana Ortiz	Francisco	04/01/12	30/06/12	3ème Année Ingénieur	ENSAM
Lieu	Alice	02/05/12	31/08/12	Master	UPMC

INDICATORS OF SCIENTIFIC NOTORIETY

EDITORIAL BOARD APPOINTMENT

- 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 (ACADEMIC)

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 first summer school on *Thermoacoustics*, endorsed by CNRS, held in Roscoff, May 30-June 4, 2010 (42 participants).
- Scientific committees :
  - S. Kouidri for the *26th IAHR Symposium on Hydraulic Machinery and Systems* (Beijing China, August 19–23, 2012).
  - S. Kouidri for the of the 5th International Symposium on Fluid Machinery and Fluids Engineering (Jeju, Korea October, 24-27 2012).
  - M. Pons for the conferences of IBPSA-France (Int. Building Performance Simulation and Analysis) and for the first Spring-school *SIMUREX* (as President) endorsed by CNRS (IES Cargèse, April 18-24, 2010).

INVITED LECTURES, TALKS OR SEMINARS

KEYNOTE SPEAKER AT AN INTERNATIONAL CONFERENCE

- 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.

TUTORIAL AT WORKSHOPS OR CONFERENCES OR SUMMER SCHOOLS

- 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.
- 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.
- 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 TALK (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,* an 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.
- M. Pons, *Second-law analysis of adsorption cycles*, invited lecture at Kyushu University (Fukuoka, Japan) Dept Mechanics Energetics (January 22-24, 2013).

PARTICIPATION IN EXPERTISE AND ADMINISTRATION OF RESEARCH

INTERNATIONAL OR NATIONAL SCIENTIFIC NETWORKING

INTERNATIONAL NETWORKS

- PICS French-Polish cooperative agreement between CNRS and IPPT, Polish Academy of Sciences, on Hydrodynamic interactions in suspensions (2009-2011) : F. Feuillebois.
- Cooperative agreement N° 23897 between CNRS and Bulgarian Academy of Sciences, on Freezing of a flowing liquid film and application to icing (2010-2011) : F. Feuillebois.
- French-Algerian collaboration in the CMEP program 10MDU809 (P. Le Quéré director) on *A numerical and experimental study of thermoacoustic systems* (2010-2014), within the framework of the Hubert Curien Tassili program : D. Baltean-Carlès.

NATIONAL NETWORKS OR WORKING GROUPS

- Fédération *TM&*C (Transferts de Masse et de Chaleur Ile-de-France) : J. Amrit, M. Pons
- European GdRe Thermal Nanosciences and Nanoengineering (S. Volz EM2C) : J. Amrit.
- GdR CNRS No 2503 Nanothermique (2006-2010) : J. Amrit.
- PRES-Universud : J. Amrit.
- GdR CNRS No 3058 *Thermoacoustique* : D. Baltean-Carlès, F. Jebali Jerbi, S. Kouidri, and M. Pons.

PARTICIPATION IN EVALUATION OR EXPERTISE COMMITTEES

NATIONAL COMMITTEES (CONRS, CNU, CCSU…)

- CCSU 60-61-62 of Univ. Paris-Sud : J. Amrit (2009-2013) and M. Pons (2013).
- CCSU 60 of UPMC 2008-2011 : D. Baltean and M. Pons.
- 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

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

MEMBER OF SELECTION JURIES

- Juries of HDR thesis defenses (2 x M. Pons)
- Juries of the Agrégation Mécanique (M.-C. Duluc from 2009 to 2013)
- Juries of PhD thesis defenses (2 x D. Baltean-Carlès; 1 x M.-C. Duluc; 10 x S. Kouidri; 1 x J. Amrit; 6 x M. Pons)
- Selection juries of U-PSUD, IUT-Cachan, IUT Orsay, IUT –Evry : J. Amrit

TEACHING ACTIVITIES AND DUTIES IN RELATION TO RESEARCH

UNIVERSITY PARIS-SUD

- Master PAM (DFE + PIE) : Coordination of the module Énergies Renouvelables et Efficacité Énergétique plus course in Énergie Solaire, V. Bourdin.
- Master DFE : Ventilation et Composants (in Thermique du Bâtiment), M. Pons.

UNIVERSITY PIERRE ET MARIE CURIE

- Master Mechanics : Suspensions and two-phase media, F. Feuillebois.
- Master SDI (EE + MF2A) : Energy and environmental impact, D. Baltean-Carlès (2009-2011).
- Master Mécanique des Fluides : (i) Flows in Natural Media; (ii) Numerical Methods in Fluid Mechanics, M. Firdaouss.
- Master Mécanique des Fluides : (i) Internal Flow in Turbomachinery; (ii) Aeroacoustics and Noise Pollution (in common with Arts & Métiers Paristech), S. Kouidri.
- Master OMEBA : Solar-Powered Refrigeration, M. Pons.

UNIVERSITY PARIS-DIDEROT

- Master Ingénierie et Physique des Énergies : (i) Forced convection; (ii) Pool boiling, M.-C. Duluc.
- Master Ingénierie et Physique des Énergies : (i) Desiccant cooling; (ii) Radiative Heat Transfer; (iii) Natural Convection, M. Pons.

FOREIGN UNIVERSITIES

- École Polytechnique de Tunisie (La Marsa, Tunisia) - Master Engineering Mathematics : Modeling of *effective properties of heterogeneous random media*, F. Feuillebois.

RESEARCH CONVENTIONS AND CONTRACTS

ACADEMIC PARTNERSHIPS

- LabEx LaSIPS, Project ERéThiques-Jonctions, 2012 : J. Amrit.
- Institut Physique Nucléaire d'Orsay (J.-P. Thermeau, F. Chatelet, F. Dubois), Résistance de Kapitza
- CEA, Irfu/Saclay (C. Z. Antoine), Cavités supraconductrices.
- IEF, Orsay (F. Parrain, A. Bosseboeuf), Fabrication des dispositifs de type MEMS.
- Institut Néel, Grenoble (. Bourgeois), nanofabrication depuis 2010.
- École Centrale de Paris, EM2C (S. Volz), *nanothermique*, depuis 2006.

INDUSTRIAL RELATIONSHIPS

- IRSN (Saclay), 2010-2011, Supervision of a PhD thesis, F. Feuillebois.
- Saint-Gobain Recherche, 2009-2010, Simulation of two-phase flows, D. Juric.
- CEA, 2010, Building Simulation and Analysis program, M. Pons.
- ALTRAN RESEARCH (informally), 2012, Optical and thermal model for simulation of PV panel, V. Bourdin.

TABLE OF CONTRACTS FOR TSF GROUP

Contracts on public fundings								
	Acronym	Funding agency/ partner	Program	General coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
ANR with industrial partners	ORASOL	ANR	PREBAT	Lucas Franck (PIMENT)	Pons Michel	17/04/2007	17/01/2011	45 320
Research collaborations	CLIMB	CEA		Gmar Mehdi (CEA)	Pons Michel	01/01/2010	31/12/2010	8 000
	ADN-BATI	CNRS	Programme interdisciplinaire Energie	Pons Michel	Pons Michel	01/01/2009	30/04/2010	7 500
	GAT Habitat	CNRS	Programme interdisciplinaire Energie	Peuportier Bruno (CEP Mines ParisTech)	Pons Michel	01/06/2010	31/12/2011	13 000
	FormHydable	CNRS	PEPS	Pons Michel	Pons Michel	01/06/2013	31/12/2013	7 500
	Kaptiza	IPNO		Amrit Jairaj	Amrit Jairaj	01/04/2009	30/09/2015	-
		IRSN	Encadrement de thèse	Feuillebois François	Feuillebois François	17/11/2008	16/11/2011	60 000
	Eréthiques-Jonctions	LaSIPS		Amrit Jairaj	Amrit Jairaj	13/04/2011	31/12/2013	38 000
	Irréversibilités dessicantes	Université La Rochelle		Pons Michel	Pons Michel	09/08/2007	08/08/2010	-
	PRES-2008	UniverSud Paris	PRES	Amrit Jairaj	Amrit Jairaj	11/02/2008	11/02/2009	50 000
	PRES-2011	UniverSud Paris	PRES	Amrit Jairaj	Amrit Jairaj	01/04/2011	30/09/2011	2 500
Partnership	DRI Pologne	CNRS / Académie polonaise des sciences (PAN)		Le Quéré Patrick	Le Quéré Patrick	01/01/2001	31/12/2008	15 900
		CNRS	Partenariat IPPT Pologne	Feuillebois François	Feuillebois François	01/01/2010	31/12/2011	10 000
Research support	FED EM2C-TMC	ECP		Anouar Soufiani (EM2C)	Le Quéré Patrick	01/05/2009	30/04/2010	16 722

Industrial contracts, contracts on private fundings…								
	Acronym	Funding agency/ Partner	Program	General Coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
Non disclosure agreement		Air Liquide		Pons Michel	Pons Michel	01/03/3013	28/02/2014	-
		AQUA OMNES		Pons Michel	Pons Michel	12/12/2008	11/12/2009	-
Research collaborations	Coalescence	Saint Gobain Recherche		Juric Damir	Juric Damir	23/01/2009	22/01/2010	20 000

Patents, software registrations, licence agreements…					
	Patent - Software registration (APP)	LIMSI authors	co-author	Date	comment
Technology transfer	Blue : Prediction of incompressible two-phase flows from data characterizing the flow configuration	Juric Damir Chergui Jalel	_	01/10/2012	Patentability under review, sofware registration (APP)

SCIENTIFIC PUBLICATIONS

DOCTORAL THESES AND HDR

1. Debesse, P., *Vers une mesure du vent thermoacoustique* 2008, thèse de l'UPMC/LIMSI. Soutenue à Orsay, France, le 5 décembre 2008, 228 p.
2. Duluc, M.-C., *Contribution à l'étude des transferts en écoulements avec et sans changement de phase*, 2009, HdR Université Pierre et Marie Curie, soutenue à Orsay, France, le 26 janvier 2009.
3. Paridaens, R., Analyse et caractérisation des écoulements redressés dans un moteur thermoacoustique annulaire 2013, thèse de l'UPMC. Soutenue à Orsay, France, le 29 mai 2013, 152 p.
4. Périnet, N., *Simulation numérique des ondes de Faraday* 2010, thèse de l'Université Pierre et Marie Curie. Soutenue à Paris, France, le 17 décembre 2010, 129 p.
5. Prigent, G., *Modélisation et simulation numérique d'écoulements diphasiques pour la microfluidique* 2013, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 24 janvier 2013, 141p p.

ARTICLES IN PEER REVIEWED SCIENTIFIC JOURNALS

1. 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.

2. 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.
3. Amrit, J., C. Douay, F. Dubois, and G. Defresne, *Cryogenic heat exchanger with turbulent flows.* European Journal of Physics, 2012. **33**: pp.189-198.
4. Amrit, J. and Q. Li, Simulation of the impact of the Kapitza resistance at grain-grain interfaces on niobium S.C. cavities. Advances in Cryogenic Engineering, 2008. pp.135-142.
5. Amrit, J. and J.-P. Thermeau, *Measurements of the Kapitza resistance between Silicon and Helium from 0.4 K to 2.1 K.* Journal of Physics: Conference Series, 2009. **150**: pp.032002_1-032002_3.
6. Daru, V., D. Baltean, C. Weisman, P. Debesse, and G. Gandikota, *Two-dimensional numerical simulations of nonlinear acoustic streaming in standing waves.* Wave Motion, 2013. **50** (5): pp.955-963.
7. 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.
8. 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.
9. Duluc, M.-C., O. Le Maitre, V. Daru, and P. Le Quéré, *Numerical study of liquid inclusion oscillations inside a closed 1D microchannel filled with gas.* Microfluidics and Nanofluidics, 2009. **6** (2): pp.163-177.
10. Duluc, M.-C., B. Stutz, and M. Lallemand, *Boiling incipience in liquid nitrogen induced by a step change in heat flux.* International Journal of Heat and Mass Transfer, 2008. **51** (7-8): pp.1738-1750.
11. Duluc, M.-C., S. Xin, F. Lusseyran, and P. Le Quéré, Numerical and experimental investigation of laminar free convection around a thin wire : long time scalings and assessment of numerical approach. International Journal of Heat and Fluid Flow, 2008. **29** (4): pp.1125-1138.
12. Fedala, D., S. Kouidri, and R. Rey, *Numerical study of time domain analogy applied to noise prediction from rotating blades.* Journal of Sound and Vibration, 2009. **321** (3-5): pp.662-679.
13. Feuillebois, F., M. Bazant, and O. Vinogradova, *Transverse flow in thin superhydrophobic channels.* Physical Review E, 2010. **82** (5): pp.055301_1-055301-4.
14. 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.
15. Feuillebois, F., S. Khabthani, A. Sellier, and L. Elasmi, *Motion of a solid particle in a shear flow along a porous slab.* Journal of Fluid Mechanics, 2012. **713**: pp.271-306.
16. 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.
17. Fischer, 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.
18. 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.
19. 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.
20. 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.
21. Hurault, J., S. Kouidri, and F. Bakir, *Experimental investigations on the wall pressure measurement on the blade of axial flow fans.* Experimental Thermal and Fluid Science, 2012. **40**: pp.29-37.
22. 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.
23. Jebali Jerbi, F., G. Huelsz, and S. Kouidri, *Acoustic velocity measurements in resonators of thermoacoustic systems using hot-wire anemometry.* Flow Measurement and Instrumentation, 2013. **32**: pp.41-50.
24. 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.
25. Momen, G., G. Hermosilla, A. Michau, M. Pons, M. Firdaouss, and K. Hassouni, *Hydrogen storage in an activated carbon bed: effect of energy release on storage capacity of the tank.* International Journal of Hydrogen Energy, 2009. **34** (9): pp.3799 - 3809.
26. Momen, G., G. Hermosilla, A. Michau, M. Pons, M. Firdaouss, P. Marty, and K. Hassouni, *Experimental and numerical investigation of the thermal effects during hydrogen charging in packed bed storage tank.* International Journal of Heat and Mass Transfer, 2009. **52** (5-6): pp.1495-1503.
27. 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.
28. 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.

29. Osorio, M., A. Betrancourt, M.X. François, J. Veira, and F. Vidal, *A superconducting fault current limiter integrated in the cold heat exchanger of a thermoacoustic refrigerator.* Superconductor Science and Technology, 2008. **21** (9): pp.095013_1-095013_7.
30. 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.
31. Périnet, N., D. Juric, and L. Tuckerman, *Numerical simulation of Faraday waves.* Journal of Fluid Mechanics, 2009. **635**: pp.126.
32. Périnet, N., D. Juric, and L. Tuckerman, *Alternating hexagonal and striped patterns in Faraday surface waves.* Physical Review Letters, 2012. **109**: pp.164501.
33. Périnet, N., D. Juric, and L. Tuckerman, *Exotic behaviour of hexagons in Faraday waves.* Revista Cubana de Fisica, 2012. **29** (1E): pp.6-8.
34. Pons, M., Transition from single-to multi-cell natural convection of air in cavities with an aspect ratio of 20: a thermodynamic approach. International Journal of Thermodynamics, 2008. **11** (2): pp.71-79.
35. Pons, M., *On the reference state for exergy when ambient temperature fluctuates.* International Journal of Thermodynamics, 2009. **12** (3): pp.113-121.
36. Pons, M., Exergy analysis of solar collectors, from incident radiation to dissipation. Renewable Energy, 2012. **47**: pp.194-202.
37. Pons, M., G. Anies, F. Boudehenn, P. Bourdoukan, J. Castaing-Lasvignottes, G. Evola, A. Le Denn, N. Le Pierres, O. Marc, N. Mazet, D. Stitou, and F. Lucas, *Performance comparison of six solar-powered air-conditioners operated in five places.* Energy, 2012. **46** (1): pp.471-483.
38. 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.
39. Raji, A., M. Hasnaoui, M. Firdaouss, and C. Ouardi, *Natural convection heat transfer enhancement in a square cavity periodically cooled from above.* Numerical Heat Transfer A, 2013. **63** (7): pp.511-533.
40. Ramière, A., J. Amrit, and S. Volz, *Pressure dependence of the thermal contact resistance at the Si/He interface.* Journal of Physics: Conference Series, 2012. **395**: pp.012110_1-012110_4.
41. Shin, S. and D. Juric, *Simulation of droplet impact on a solid surface using the level contour reconstruction method.* Journal of Mechanical Science and Technology, 2009. **23** (9): pp.2434-2443.
42. Shin, S. and D. Juric, A hybrid interface method for three-dimensional multiphase flows based on front tracking and level set techniques. International Journal for Numerical Methods in Fluids, 2009. **60** (7): pp.753-778.
43. 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.
44. Tabakova, S., F. Feuillebois, A. Mongruel, V. Daru, and S. Radev, *First stages of drop impact on a dry surface: asymptotic model.* Zeitschrift für Angewandte Mathematik und Physik (ZAMP), 2012. **63**: pp.313-330.
45. 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.
46. Yahiaoui, G. and F. Feuillebois, *Lift on a sphere moving near a wall in a parabolic flow.* Journal of Fluid Mechanics, 2010. **662**: pp.447-474.

BOOKS & CHAPTERS IN BOOKS

1. Feuillebois, F., *The quiz*, in *Journal of Physics: Conference Series, vol. 392*, I. O. P. Science, Editor. 2012, DOI : 10.1088/1742-6596/392/1/011002. pp. 011002_1-011002_2.
2. 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. Eds Christov, Eds. 2011, American Institute of Physics Conference Proceedings, vol. 1404. pp. 340-351.
3. Feuillebois, F., N. Ghalya, A. Sellier, and L. Elasmi, *Influence of wall slip in dilute suspensions*, in *Journal of Physics: Conference Series, vol. 392*, I. O. P. Science, Editor. 2012, DOI : 10.1088/1742-6596/392/1/012012. pp. 012012_1-012012_19.
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ILES
Information, Written and Signed Language

PIERRE ZWEIGENBAUM - ANNE VILNAT

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 section for *spoken language* processing). ILES was created in 2008 by merging the former LIR (Language, Information, Representation) group and the GESTE "thematic action", the rationale being that sign language processing and written language processing share a substantial subset of methods and goals.

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 design 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 from 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 modelling work and methods to **generate realistic signed productions** (*aka* virtual signer videos: see *Sign Language Modelling and Processing*).

Natural language processing relies on algorithms and knowledge about language, e.g., morphology, lexicon, syntax, semantics, pragmatics, or 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 designing 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 Speech Processing group TLP, while retaining its specificity. Corpora and Representations are a common topic which spans both groups and on which we have strong collaborations. Multilingualism is at the heart of the Machine Translation activity led by TLP; 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 and a project on medical abstract translation. Information Extraction and Question Answering are also research topics in Speech Understanding, and we also collaborate with S. Rosset and other 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; additional ILES contributors to each topic are listed (see *with the participation of*); and a semi-colon separates permanent staff from PhD students and post-docs.

RESEARCH ACTIVITIES

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, V. Moriceau, 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 representation 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. They are instrumental in designing evaluation campaigns, which nowadays play a key role in setting research directions at the national and international levels.

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 CHIST-ERA uComp) and industry (Cap Digital DOXA and SONAR, Systematic PROJESTIMATE, BIG DATA REQUEST). 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 variation and to 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.

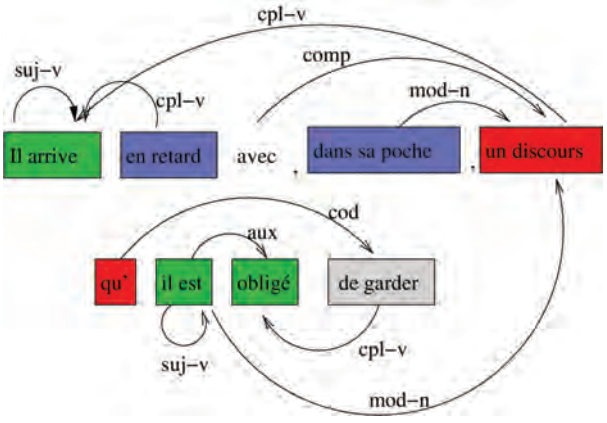

Illustration 1.a: PASSAGE syntactic annotation in syntactic groups and grammatical relations.

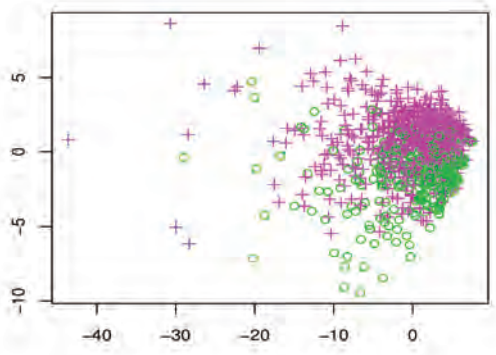

Illustration 1.b: Positive (crosses) and negative (circles) sentences of the i2b2 annotated corpus after PCA dimension reduction using the General Inquirer emotion lexicon feature space.

In the current period we have coordinated or are participating in the definition of annotations at several linguistic levels in various 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, DEFT evaluation campaigns, CHIST-ERA uComp, Cap Digital SONAR, BIG DATA REQUEST). 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, knowledge representation, communication sciences, digital libraries, statistics, graphical interfaces, database management, distributed computing...

Both the development of corpus usage in the industry (PROJESTIMATE, SONAR) 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 (CHIST-ERA uComp). For a few years, we have been witnessing a regain of interest for statistical measures like Cohen's Kappa to ensure that annotations are built 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 design (Grouin et al., LAW 2011, Rosset et al., LAW 2013).

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 Graphical 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), totalling about 3 million words with 500,000 annotations.

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, uComp). 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.

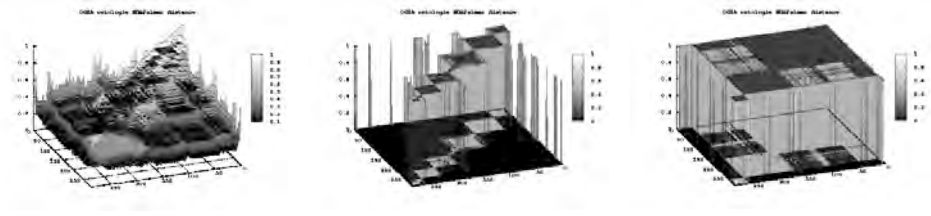

Illustration 2 - Inter-concept distance variation in DOXA with Wu & Palmer's measure, from left to right, similarity radius of 0 then 0,3 and 0.6.

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 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 (Grouin et al, 2013. For each task suitable metrics are selected or designed when needed. 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).

Since 2011, LIMSI has organized (with LPL) two DEGELS sign language annotation challenges. A video corpus of comparable French Sign Language and French and gesture productions are provided to the participants, whose annotations are compared and discussed (http://degels.limsi.fr/).

In the recent years, the scientific work associated to the topic corpora and representations has both gained maturity and thematic breadth. We kept building on our proven track record for corpus design and later on evaluation organization, while addressing new application domains like opinion mining. More importantly, in addition to the initial focus initially put on essentially linguistic aspects of the corpora and their annotation, we have started to address also more theoretical considerations about the expressive power of the representations and the measures used to describe their information content, as well as considerations about the use of corpora as a central approach for scientific investigation (sign language corpus and series of workshops on comparable corpora).

TOPIC 2: MULTILINGUALISM AND PARAPHRASING

***A. Max**, T. Lavergne, A.-L. Ligozat, A. Névéol; H. Bouamor, A. Bossard, B. Marie, with the participation of C. Grouin, V. Moriceau, X. Tannier, A. Vilnat, P. Zweigenbaum; B. Arnulphy, A. Ben Abacha, A. Bodnari, 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 issue in system development (Mariani et al, 2012). 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 in 2012-2013.

CONTRASTING NLP SYSTEM RESULTS ACROSS LANGUAGES

Different natural languages pose problems of different complexities to NLP systems. The ILES group therefore frequently conducts contrastive studies of NLP systems across languages.

The bulding of the FIDJI Question Answering system, developed for both French and English (Moriceau and Tannier, 2010), served to gauge the impact that the differences in resource availability and development efforts had on the task of language adaptation of a QA system.

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. During this work, a detailed contrastive typology of paraphrase phenomena was elaborated (Bouamor et al., 2013).

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.

The simplest way to transfer a system from one language to another is to create resources for the target language manually. The experience gained from work in the ILES group shows that this is possible for expert-based systems whose knowledge is clearly separate from the algorithms which apply it. This was the case in the domain of Question Answering (see the Information Extraction topic below), where 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 essential rules

are the only 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 are. Another experiment was the transfer of a drug prescription extraction system from English to French (Deléger et al., JAMIA 2010, MEDINFO 2010).

Ideally, one would like such transfer to be automatic as much as possible. We have started to investigate this topic in the context of the LIMSI-supported project TraLaLa (Transfer from Language to Language), which coordinates work performed along these lines in ILES and TLP; we have expanded this working group to our neighbouring colleagues of CEA LIST. A typical situation is that of a medical entity annotation system (Ben Abacha & Zweigenbaum, 2011) initially developed on English, for which reference corpora exist. We experimented its transfer to French by cross-lingual projection (Ben Abacha et al., 2012, 2013) along word alignment links in a parallel corpus. Our work so far showed an important drop in quality due to differences in corpora and to alignment difficulties. Similar experiments also took place in the context of the ANR EDyLex project, which addresses general named entity annotation in news articles in English and French, and showed that the transfer loss was reduced when simpler entities, closer to proper names, were targeted. This is also a topic investigated by a jointly supervised MIT PhD student who spent nine months at LIMSI in 2012-2013 under a Châteaubriand fellowship (Bodnari et al., CLEF ER Challenge 2013, to appear).

A third path to language adaptation is to use language-neutral cues to train a system. In the domain of Opinion mining, we have developed a language-independent approach to polarity mining which learns from emoticons in corpora of Twitter messages. 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 hold similar or related meanings in context, a phenomenon at the heart of natural language semantics which represents a major difficulty for NLP applications. Manually built resources describing all possible paraphrases are a key asset to study these phenomena and to propose new solutions for NLP systems, but they are limited in availability and coverage. The ILES group addresses this issue by developing 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 H 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 H et al., 2010), and new approaches based on edit rate computation (Bouamor H et al., 2011a) and automatic validation (Bouamor H et al., 2012a) have been developed and evaluated on French and English (see also Bouamor H, 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 H 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.

Work has also been initiated on the study of criteria that can motivate text rewriting. A joint study group has been set up on the topic on readability measures and text simplification, which involves members from our laboratory and colleagues from Strasbourg University, Marseilles University, and Leuven University (Belgium). We have also started to investigate the automatic identification of text written by non-native speakers, and have taken part to the first Task on Native Language Identification (Lavergne et al., 2013b).

A study of targeted automatic rewriting has also been started, taking as a starting point the improvement of automatically produced translation hypothesis (Master of B. Marie, 2012), where criteria for hypothesis selection include both translation accuracy and grammatical quality. This work continues with the PhD of B. Marie, in collaboration with the Lingua&Machina company. Work on lexical simplification is also ongoing (Ligozat et al., 2013).

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, 2012). An active cooperation between ILES and the SMT theme is the continued development of a framework for discriminative training of SMT systems (Lavergne et al., 2013a). Finally, as a continuation of work conducted on automatic translation of text in the biomedical domain (Jimeno Yepes et al., 2013; Jimeno Yepes and Névéol, 2013), a joint work has been started with the Cochrane Collaboration and Paris Diderot University to study high-quality translation of documents in a specific domain, which involves aspects such as expert knowledge integration and enrichment and novel methods for adapting translation systems.

TOPIC 3: INFORMATION EXTRACTION, FOCUSED INFORMATION RETRIEVAL, AND QUESTION-ANSWERING

P. Zweigenbaum, *B. Grau, C. Grouin, G. Illouz, T. Lavergne, AL. Ligozat, V. Moriceau, A. Névéol, I Robba, X. Tannier; A. Ben Abacha, B. Arnulphy, C. de Groc, MH. Falco, A. Garcia-Fernandez, A. Grappy, M. Marchand, AL. Minard, A. Pak, D. Sadoun, D. Valsamou, W. Wang, D. Bernhard, L Deléger, R. Kessler with the participation of P. Paroubek, A. Vilnat; A. Bodnari, MFM. Chowdhury, A. Bossard, N. Mokhtari*

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 (Chowdhury & Zweigenbaum, 2013). At another level, we work on temporal analysis and reasoning to build timelines by following up events in and across news stories (Kessler et al., 2012) or in patient notes (Grouin et al., JAMIA 2013). 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; Grappy et al., 2011).

In this reporting period we have increased our use and knowledge of supervised machine learning (ML) methods. Given our initial 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 has started to strengthen this whole line of research (e.g., Zweigenbaum et al., 2013).

LEVELS OF INFORMATION EXTRACTION

Information extraction 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 to specialized texts, including biological texts and patents (Galibert et al., 2010ab), medical texts (Deléger et al., 2010; Minard et al., 2011; Grouin et al., 2013), 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; Minard et al., 2011; Grouin et al., 2013).

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). We have also addressed the detection of noun-based events in clinical texts (Grouin et al., 2013). In the scientific literature, we worked on extracting the data related to a type of biological event: experiment results. The method proposed in (Minard et al., 2013) recognized terms guided by an ontology and their association by defining heuristics at text and passage levels.

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 ongoing 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, 2010). And more generally, different kinds of knowledge are required and have to be combined to be able to validate a candidate answer, in QA systems using a learning process, (Grappy, PhD 2011; Barbier, PhD 2008) or in QCM (Grau et al. 2012; Grau et al. 2013) by adapting textual entailment measures or to evaluate student answers to open questions, given the teacher reference by reducing the vocabulary difficulty (Gleize and Grau, 2013)

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; de Groc, PhD 2013).

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; É. Chételat, M. Delorme, J. Segouat. F. Badin, N. Devos*

Sign languages (SLs) are natural languages used by the deaf. These languages are expressed in space by means of a set of articulators (chest, shoulders, arms, hands, head, facial expressions, gaze directions, etc.), that are carried out simultaneously, providing a multilinear spatio-temporal signal. SLs have no

writing system and the only form of writing available to the deaf is generally that of the spoken language (SpL) of the country they live. But the majority of the profoundly deaf has limited skills in writing and reading, hence has limited access to written information. This need has generated an interest among researchers in Sign Language recognition, generation and machine translation.

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

SIGN LANGUAGE CORPORA

SLs are less-resourced languages, with few reference books (grammars, dictionaries) and only few small-scale corpora.

We participate in the creation of LSF corpora, and develop methodologies for elicitation, annotation (qualitative and quantitative), and analysis. Recently, we have created three corpora and conducted two studies related to annotation methodologies:

- In 2010: The LSF part (8 hours of dialogue) of the corpus produced within the Dicta-Sign project (http://www.dictasign.eu/), in collaboration with IRIT lab and WebSourd Company. This corpus has been used for a cross-linguistic analysis of some linguistic structures in the four SLs of the project.
- In 2011: The DEGELS1 corpus, a comparable corpus of French Sign Language and French and gestures, in collaboration with LPL lab. It has been created to serve as a test-bed corpus for the DEGELS workshops. Extracts of this corpus have been annotated by several teams participating in these events.
- In 2012: The 40brèves2012 corpus, a parallel corpus of written French and LSF, in collaboration with WebSourd Company. It has been created to serve the studies related to text-to-LSF translation.
- 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.

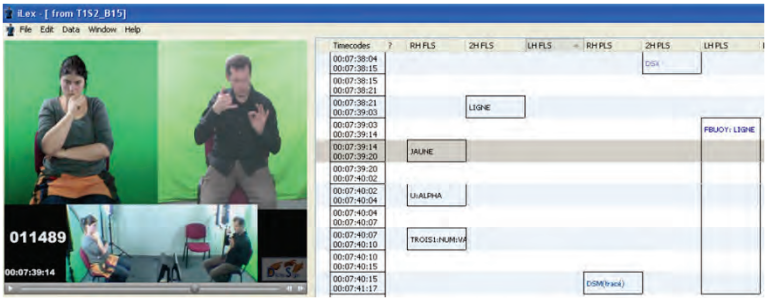

Illustration 3 - Extract of an annotation of the Dicta-Sign corpus using the iLex annotation software.

SIGN LANGUAGE MODELLING

The goal of Sign Language modelling is to build formal representations and tools that represent how the SL operates and that will be usable in analysis, recognition or generation software.

Formal approaches to representing the signs or the utterance of SL are generally based on models or approaches that have been developed for spoken language or even written language processing, with strong limitations and drawbacks. Thus we work on designing new models, based on corpus observation and analysis. Recently, we have initiated two studies related to formal representation that are still under development:

- A study on lexicon representation: Michael Filhol's PhD thesis on Zebedee for sign description. "Zebedescriptions" are based on articulatory, semantic and cognitive issues. Its 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.
- 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.

SIGN LANGUAGE GENERATION

The assessment of quality 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 (virtual character in 3 dimensions). Recently, we have conducted three studies related to automatic and computer-assisted generation:

A study on zebedescription solving and skeleton modelling: Maxime Demorme's PhD thesis. From a description in the Zebedee format, the skeleton postures are automatically output and displayed, with the aim to provide more “natural” postures.

The Octopus platform, which allows presets 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 collaboration with the WebSourd Company.

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

SIGN LANGUAGE TRANSLATION

The historic centerpiece of NLP is automatic translation. Considering the crucial part it can play in terms of accessibility for deaf people, it only appeared legitimate to us that we start investigating the path to text-to-Sign translation.

In 2011 we initiated an exploratory project, funded by LIMSI for 1.5 years. In order to ground our work on attested data, we looked for parallel French-LSF material both representative of the translation task and accepted by the deaf community as good language. The only set we found to exist was the daily collection of short news items published on WebSourd's web site in the form of a dozen LSF videos next to the original texts in French.

Our first step was to elaborate a methodology based on corpus study. We started exploring the use of space (SL property of paramount importance) by first analysing the videos, without any text bias. This was useful to place LSF at the centre of our methodology. Looking at the texts second for functional elements found in the videos first is an ordered process that eventually lead us to invert the approach to text-to-Sign translation. Instead of following the MT tradition of moving forward from the input to intermediate representations and rephrase, them in the target language, we now rather start with AZee descriptions of SL production rules, and use each one as the starting point of an extraction task in the source text. Detected patterns or extracted chunks of text therefore make the corresponding SL rule a candidate for translation.

We have first tested this methodology on LSF expressions for geographic localisation of sub-areas ("in the south of", etc.), which were found to be very specific to LSF. Extraction of the textual counterparts was done using tools like Wmatch developed at LIMSI. Once this methodology was elaborated and tested, it was decided to build a fresh corpus suitable for deeper analysis. We used WebSourd's SL translation services to collect 1 hour of signed data from real news items of 2006, each by 3 different translators on face- and side-view. The texts were chosen from fine semantic criteria on temporal relationships, balanced in order to sample in various temporally-specified events. This work was done in view of collaboration with researchers of the ILES group used to textual extraction of temporal expressions (cf. ChronoLines project). Annotation and study of SL time expressions are now being carried out on this two-view corpus, while we are moving on with the text extraction of a few already known rules (cf. DictaSign project) such as enumeration.

Highlights

During the period, the group recruited two CNRS researchers (2010 and 2012), two assistant professors (2008 and 2012), the second of whom on a BQR competitive project, obtained a Senior Researcher promotion (2011) and two PR1 professor promotions.

Repeated efforts to submit high-quality project proposals in the present period have succeeded in obtaining new project grants, including two European projects (Dicta-Sign, 2009-2012; Chist'Era uComp, 2012-), three ANR ContInt (EdyLex, 2009-2013; Chronolines, 2011-2014; Accordys, 2012-2015), three FUI (ProjEstimate, 2012-2015, Request, 2013-2016, and Sonar, to begin in 2013), and two Digiteo projects (Envie Verte, 2010-2013; Astre, 2013-2014), as well as a number of 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 (Dicta-Sign). 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 A.L. 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 for a sabbatical year in 2012-2013.

Sentiment analysis and opinion mining, newly addressed in ILES, has quickly reached excellence with a best system on the 5-class track on Russian sentiment classification at the ROMIP 2011 evaluation, and 270 citations to *Twitter as a Corpus for Sentiment Analysis and Opinion Mining* (Pak & Paroubek, 2010) in three years according to Google Scholar.

STAFF

PERMANENT STAFF

Last name	First name	Position	Employer	HDR	Arrival date	Departure date
Balkanski	Cécile	Ass.Prof.	Université Paris Sud			Left on 30/06/2012
Bolot	Laurence	Res. Eng.	CNRS			
Braffort	Annelies	DR	CNRS	HDR		
Choisier	Annick	Res. Eng.	CNRS			
Filhol	Michael	CR	CNRS		Hired as of 01/10/2010	
Grau	Brigitte	Prof.	ENSIIE	HDR		
Grouin	Cyril	Res. Eng.	CNRS			
Hurault-Plantet	Martine	Res. Eng.	CNRS			Retired on 10/09/2010
Illouz	Gabriel	Ass.Prof.	Université Paris Sud			
Lavergne	Thomas	Ass.Prof.	Université Paris Sud		Hired as of 01/09/2012	
Ligozat	Anne-Laure	Ass.Prof.	ENSIIE		Hired as of 01/09/2009	
Max	Aurélien	Ass.Prof.	Université Paris Sud			
Moriceau	Véronique	Ass.Prof.	Université Paris Sud		Hired as of 01/09/2008	
Névéol	Aurélie	CR	CNRS		Hired as of 01/10/2012	
Paroubek	Patrick	Res. Eng.	CNRS	HDR		
Robba	Isabelle	Ass.Prof.	Versailles			
Tannier	Xavier	Ass.Prof.	Université Paris Sud			
Verrecchia	Cyril	Ass.Eng.	CNRS			
Vilnat	Anne	Prof.	Université Paris Sud	HDR		
Zweigenbaum	Pierre	DR	CNRS	HDR		

NON PERMANENT STAFF

Last name	First name	Contract	Arrival date	Departure date
Alamarguy	Laurent	CDD	01/04/2009	31/07/2009
Albert	Pierre	CDD	01/12/2009	31/10/2012
Badin	Flora	CDD	01/10/2009	31/12/2010
Benoit	Caroline	CDD	20/04/2009	19/10/2009
Benoit	Caroline	CDD	01/01/2011	30/11/2011
Bernhard	Delphine	CDD	01/10/2009	30/09/2011
Cartoni	Bruno	Post-Doc	01/09/2009	31/08/2010
Deléger	Louise	CDD	01/03/2009	30/06/2010
Deléger	Louise	CDD	01/12/2012	30/11/2013
Delorme	Maxime	Post-Doc	01/01/2012	30/11/2012
Devos	Nadège	CDD	02/03/2009	29/02/2012
Fraisse	Amel	CDD	01/02/2013	31/07/2014
Glas	Nadine	CDD	01/12/2011	31/12/2011
Grappy	Arnaud	Post-Doc	01/10/2011	31/03/2012
Jacquemin	Bernard	CDD	01/09/2007	31/07/2008
Kessler	Remy	CDD	01/09/2011	31/08/2012
Loiseau	Sylvain	Post-Doc	04/12/2006	31/11/2008
Mokhtari	Noureddine	Post-Doc	01/01/2011	31/12/2011
Nguyen	Kiem-Hieu	CDD	01/03/2013	30/06/2015
Nouvel	Damien	CDD	01/08/2013	31/07/2014
Pak	Alexander	CDD	01/09/2012	30/11/2012
Tranchant	Clarine	CDD	05/06/2011	14/08/2011
Wlaz	Magali	CDD	01/07/2009	30/06/2010

PHD STUDENTS

Last name	First name	Thesis director	Arrival date	Date of defense
Arnulphy	Béatrice	Anne Vilnat	01/10/2008	02/10/2012
Barbier	Vincent	Michele Jardino	01/11/2004	22/01/2009
Ben Abacha	Asma	Pierre Zweigenbaum	01/10/2008	28/06/2012
Bouamor	Houda	Anne Vilnat	06/10/2008	11/06/2012
Chetelat	Emilie	Annelies Braffort	01/03/2007	25/03/2010
De Groc	Clément	Pierre Zweigenbaum	18/11/2009	05/06/2013
Delorme	Maxime	Annelies Braffort	01/10/2008	07/12/2011
El Ayari	Sarra	Brigitte Grau	01/10/2006	23/11/2009
Filhol	Michael	Annelies Braffort	01/10/2005	27/06/2008
Garcia Fernandez	Anne	Anne Vilnat	01/10/2006	10/12/2010
Grappy	Arnaud	Brigitte Grau	01/10/2007	08/11/2011
Grouin	Cyril	Pierre Zweigenbaum	01/09/2010	27/06/2013
Minard	Anne-Lyse	Brigitte Grau	01/10/2009	07/12/2012
Mouton	Claire	Anne Vilnat	01/11/2007	17/12/2010
Pak	Alexander	Anne Vilnat	01/09/2009	13/06/2012
Segouat	Jérémie	Annelies Braffort	01/12/2007	15/12/2010
Séjourné	Kévin	Anne Vilnat	01/10/2005	09/12/2009
Asadullah	Munshi	Anne Vilnat	01/10/2012	
Bodnari	Andrea	Pierre Zweigenbaum	03/09/2012	
Falco	Mathieu-Henri	Anne Vilnat	01/10/2010	
Gleize	Martin	Brigitte Grau	01/10/2012	
Marchand	Morgane	Anne Vilnat	05/12/2011	
Marie	Benjamin	Anne Vilnat	02/04/2013	

Pho	Van-Minh	Brigitte Grau	01/10/2012	
Sadoun	Driss	Brigitte Grau	01/10/2010	
Valsamou	Dialekti	Pierre Zweigenbaum	25/10/2012	

INTERNSHIPS

Last name	First name	Arrival date	Departure date	Prepared degree	School / University
Badin	Flora	06/05/08	30/06/08	Master 1	Université d'Orléans
Bessuges	Vincent	25/02/09	01/06/09	Master 1	Université Paris Sud
Falco	Mathieu-Henri	02/03/09	02/09/09	Master 2	Université Paris Diderot
Devos	Nadège	02/03/09	30/09/09	Master 2	Université Paris VIII
Boulet	Julien	01/04/09	30/09/09	Master Professionnel informatique	Université Paris Sud
Rassial	Gabriel	01/04/09	31/07/09	Master 2 Recherche SETI	Université Paris Sud
Leton	Estelle	01/04/09	31/07/09	Master 2	Université d'Orléans
Ngo	Thuy Linh	15/04/09	15/09/09	M2 Sciences du langage	Université Paris Descartes
Xiong	Feng	11/05/09	31/08/09	2ème année Ingénieur	IFIPS
Grandry	Fanny	01/06/09	31/07/09	Master linguistique	Université Paris Diderot
Hanoka	Valérie	15/06/09	31/07/09	Master linguistique	Université Paris Diderot
Hanoka	Valérie	15/06/09	31/07/09	Master Informatique	Université Paris Diderot
Papazoglou	Sophie	15/06/09	11/09/09	Master 1	Université Paris Ouest Nanterre
Buisson	Agnieszka	16/06/09	31/07/09	Master linguistique	Université Paris Diderot
Papazoglou	Sophie	08/03/10	09/07/10	Master2 Ingénierie de la langue	Université Paris Ouest Nanterre
Perinet	Amandine	15/03/10	15/05/10	Master 2	INALCO
Ben Slama	Inès	15/03/10	15/05/10	M2 Documenttion numérique	INALCO
Perinet	Amandine	15/03/10	15/05/10	M2 Documenttion numérique	INALCO
Safi	Waseem	01/04/10	31/07/10	Master 2	Université Paris Sud
Kim	Ha Trung	10/05/10	30/07/10	Ingénieur	Université Paris Sud
Atannon	Léton	10/05/10	30/07/10	Ingénieur Informatique	Université Paris Sud
Le Glouanec	Marine	11/05/10	11/08/10	Master 1 Informatique	Université d'Orléans
Fleifel	Laurent	31/05/10	03/09/10	Ingénieur	ENSIIE Evry
Braud	Chloé	07/06/10	23/07/10	Master 1	Université Paris Diderot
Deboin	Sybil	07/06/10	03/09/10	1ère année ingénieur	ENSIIE Evry
Shamsnejad	Valentin	07/06/10	13/08/10	Ingénieur	ENSIIE Evry
Merimi	Ayoub	14/06/10	10/09/10	Ingénieur	ENSIIE Evry
Raux	Xavier	28/06/10	10/09/10	1ère année ingénieur	ENSIIE Evry
De Viron	Louis	02/08/10	30/09/10	Master linguistique	U.C.L.
Libert	Cédric	09/08/10	24/09/10	Master linguistique	U.C.L.
Sylvain	Antoine	05/01/11	10/05/11	M1	Université Paris Sud
Dal Pra	Pierre	05/01/11	05/05/11	Master Informatique	Université Paris Sud
Liu	Zhifeng	01/04/11	01/09/11	M2	Université Paris Sud
Djedjig	Massinissa	05/04/11	30/09/11	M2R	Université Paris Nord
Makour	Lamia	18/04/11	30/09/11	M2	Université Paris Dauphine
Joyeux	Damien	09/05/11	10/09/11	4ème Année Ingénieur	INSA Lyon
Li	Jingjing	09/05/11	05/08/11	2ème année Ingénieur	Polytech
Ivanova	Elitza	30/05/11	26/08/11	Master 1	University San Diego
Sun	Yan	30/05/11	20/08/11	Master linguistique	Université Paris Diderot
He	Ruixin	01/06/11	31/07/11	Master 2	INALCO
Patris	Magali	01/06/11	31/08/11	M1	Université Paris Diderot
Fourny	Elodie	06/06/11	16/09/11	2ème année Ingénieur	ENSIIE Evry
Deluce	Corentin	06/06/11	26/08/11	2ème année Ingénieur	ENSIIE Evry
Brouwers	Laetitia	01/08/11	16/09/11	Master linguistique	U.C.L.
Metz	Lucie	27/02/12	15/07/12	Master 2	Université Stendhal

Pho	Van-Minh	21/03/12	16/09/12	M2 Recherche Informatique	Université Paris Sud
Wandji Tchami	Ornella	01/05/12	01/08/12	Master 1	Université Lille 3
Martinet	Mathieu	02/05/12	31/07/12	Master linguistique	Université d'Orléans
Marie	Benjamin	02/05/12	31/10/12	M2 ingénierie multilingue	INALCO
Mayhew	Olivier	07/05/12	27/07/12	4ème Année Ingénieur	Polytech
Grobol	Loïc	01/06/12	31/07/12	M1	Université d'Orléans
Beaumont	Romain	11/06/12	07/09/12	1ère année ingénieur	ENSIIE Evry
Loth	François	11/06/12	07/09/12	1ère année ingénieur	ENSIIE Evry
Woehrel	Jacques	11/06/12	07/09/12	1ère année ingénieur	ENSIIE Evry
Vismara	Charlie	02/07/12	31/08/12	Master	U.C.L.
Tian	Ying	02/07/12	30/09/12	Master International	Université Franche Comté
Sidahmed	Mana	21/01/13	31/05/13	M1	Université Paris Sud
Delaborde	Marine	01/03/13	31/07/13	Master	Université Sorbonne Nouvelle
Lahondes	Loïc	02/04/13	27/09/13	Master	ENSIIE Evry
Chatzimina	Maria	02/04/13	15/09/13	Master Franco-Héllénique	Université Paris Sud
Giannetti	Frédéric	08/04/13	30/09/13	M2 DEFI Linguistique	Université Paris Ouest Nanterre

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, chief editor (-2008)
- 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 (ACADEMIC)

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, TALN 2012 and TALN 2013
- 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 and 2013
- P. Zweigenbaum, creator and chair of the first workshop on Building and Using Comparable Corpora at LREC 2008
- P. Zweigenbaum, co-chair of the workshop on Building and Using Comparable Corpora at ACL 2009
- 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 workshop on Building and Using Comparable Corpora at ACL 2013
- P. Zweigenbaum, co-chair of the Int. Conf. on Terminology and Artificial Intelligence (TIA 2011)
- P. Zweigenbaum, chair of the workshop on Natural language Processing and Artificial Intelligence (joint ATALA & AFIA day, 2012)
- P. Zweigenbaum, chair of the workshop of the BioNLP Shared Task at ACL 2013
- P. Zweigenbaum, chair of the workshop of the Francophone SIG of IMIA at MEDINFO 2013

MEMBER OF PROGRAMME COMMITTEE IN INTERNATIONAL CONFERENCES AND WORKSHOPS:

- A. Braffort, B. Grau, C. Grouin, A. Max, X. Tannier, P. Paroubek, A. Vilnat, P. Zweigenbaum, Program Committee of international conference on Languages, Resources and Evaluation LREC 2008, 2010, 2012
- B. Grau, Program Committee of conference SIGIR 2009 and SIGIR 2010 and Poster Program Committee of conference SIGIR 2010, SIGIR 2011 and SIGIR 2012
- B. Grau, Program Committee of conference EACL 2009, ACL 2011 and ACL 2013, NAACL 2013
- B. Grau, Program Committee of conference COLING 2010 and COLING 2012
- B. Grau, Program Committee of Workshop MMIES-2, Multi-source, Multilingual Information Extraction and Summarization, in conjunction with COLING 2008
- P. Zweigenbaum, Program Committee of track Text Mining and Application (TeMA) at the Portuguese International Conference on Artificial Intelligence (EPIA 2009); B. Grau, P. Zweigenbaum, (TeMA) at (EPIA 2013)
- 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), (NAACL 2012); Program Committee of Workshop on Computational Linguistics and Writing (NAACL 2010), (EACL 2012); Program Committee of Joint Workshop on Statistical Parsing and Semantic Processing of Morphologically-Rich Languages (ACL 2012); Program Committee of Workshop on Syntax, Semantics and Structure in Statistical Translation (ACL 2011)
- A. Max, Program Committee of Workshop on Natural Language Processing for Improving Textual Accessibility (LREC 2012)
- V. Moriceau, Program Committee of Workshop on Constraints Solving and Language Processing (CSLP2011), (CSLP2012)
- P. Paroubek, Program Committee of the Language and Technology Conference LTC 2009, LTC 2011, LTC 2013.
- P. Paroubek, Program Committee of SIGDIAL 2009, SIGDIAL 2011
- P. Paroubek, Program Committee of CIRSE 2009 (ECIR)
- P. Paroubek, Program Committee of IWSDS09
- P. Zweigenbaum, Program Committee of session Translating biology: text mining tools that work (PSB 2008)
- P. Zweigenbaum, Program Committee of workshop on Cognitive Aspects of the Lexicon (COLING 2008)
- P. Zweigenbaum, Program Committee of conference Medical Informatics Europe MIE 2008, 2009
- P. Zweigenbaum, Program Committee of workshop on Biomedical NLP (ACL 2008), (ACL 2010), (ACL 2011), (ACL 2012), (NAACL-HLT 2009); BioNLP Shared Task (ACL 2011)
- P. Zweigenbaum, Program Committee of conference Artificial Intelligence in Medicine (AIME 2009, 2011, 2013)
- P. Zweigenbaum, Scientific Committee of the international conference on Languages, Resources and Evaluation (LREC 2008), Program Committee of workshop on Multilingual and Comparative Perspectives in Specialized Language Resources (LREC 2008), Program Committee of workshop on Building and evaluating resources for biomedical text mining (LREC 2008)
- P. Zweigenbaum, Program Committee of International Workshop on Describing Medical Web Resources (MIE 2008)
- P. Zweigenbaum, Program Committee of conference Languages in Biology and Medicine (LBM 2009)
- P. Zweigenbaum, Program Committee of workshop NLP Approaches for Unmet Information Needs in Health Care (IEEE BIBM 2009)
- P. Zweigenbaum, Program Committee of conference Terminology and Artificial Intelligence (TIA 2009)
- P. Zweigenbaum, Program Committee of workshop Terminology and Lexical Semantics (TLS'09) at the Fourth International Conference on Meaning-Text Theory (MTT 2009)
- 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), (AIME 2011), (LOUHI 2013)
- 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, 2012

- P. Zweigenbaum, Program Committee of International Workshop on Lexical Resources (ESSLLI 2011)
- P. Zweigenbaum, Program Committee of workshop Data and Text Mining in Biomedical Informatics (ACM DTMBIO) at the ACM Conference on Information and Knowledge Management (CIKM 2012)
- P. Zweigenbaum, Program Committee of track Morphology at the Congrès Mondial de Linguistique Française (CMLF 2012)
- P. Zweigenbaum, Program Committee of conference Les Décembrettes (2012)
- P. Zweigenbaum, Program Committee of workshop Building and Evaluating Resources for Biomedical Text Mining (LREC 2012)
- P. Zweigenbaum, Program Committee of conference Symposium on Semantic Mining in Biomedicine (SMBM 2012)
- P. Zweigenbaum, Program Committee of conference Terminology and Knowledge Engineering (TKE 2012)
- P. Zweigenbaum, Program Committee of conference IEEE International Conference on Healthcare Informatics (ICHI 2013)
- P. Zweigenbaum, Program Committee of workshop Web as Corpus (WAC-8) at Corpus Linguistics 2013
- P. Zweigenbaum, Program Committee of workshop TheoreticAl and Computational MOrphology: New Trends and Synergies (ICL 2013); Program Committee of session Computational Linguistics at the International Congress of Linguists (ICL 2013)

MEMBER OF PROGRAMME COMMITTEE IN NATIONAL CONFERENCES AND WORKSHOPS:

- A. Braffort, Program committee of DEGELS workshop 2011 and 2012
- P. Paroubek, P. Zweigenbaum, program committee of Workshop DEFT at TALN 2010, TALN 2011, TALN 2012 and TALN 2013
- B. Grau, AL. Ligozat, P. Zweigenbaum, Program Committee of conference CORIA 2008, 2009, 2010, 2011, 2012, 2013
- P. Zweigenbaum, Program Committee of workshop RISE (INFORSID 2009), (RFIA 2013); B. Grau, P. Zweigenbaum, Program Committee of workshop RISE (INFORSID 2010), (CORIA 2011), (EGC 2012)
- B. Grau, P. Zweigenbaum, Program Committee of Symposium sur l'ingénierie de l'information médicale, 2011
- A. Max, A. Vilnat, P. Zweigenbaum, Program Committee of conference TALN 2009; A. Vilnat, P. Zweigenbaum, Program Committee of conference TALN 2010,2011, 2012, 2013
- P. Zweigenbaum, Program Committee of session jeunes chercheurs RECITAL (TALN 2012); A. Vilnat, Program Committee of session jeunes chercheurs RECITAL (TALN 2013)
- P. Zweigenbaum, Program Committee of workshop Interactions langagières orales dans les habitats Intelligents pour personnes âgées: défis et enjeux (JEP-TALN 2012)
- P. Paroubek, Program Committee of CRELA 2013
- P. Paroubek, A. Vilnat, P. Zweigenbaum, Organisation Committee of 50th anniversary of ATALA, Paris, 2009
- P. Zweigenbaum, Program Committee of conference Journées Francophones d'Informatique Médicale (JFIM 2009)
- P. Zweigenbaum, Program Committee of conference RFIA 2012
- P. Zweigenbaum, Program Committee of workshop Symposium sur l'Ingénierie de l'Information Médicale (IC 2013)

INVITED LECTURES, TALKS OR SEMINARS

INVITED CONFERENCE SPEAKER

- P. Zweigenbaum. Natural Language Processing in the Medical and Biological Domains: a Parallel Perspective. In Third International Symposium on Semantic Mining in Biomedicine, Turku, Finland, 2008
- P. Zweigenbaum. Multilingualism and Medical Information Processing. In third conference Languages in Biology and Medicine, Jeju, Korea, 2009

TUTORIAL AT WORKSHOPS OR CONFERENCES OR SUMMER SCHOOLS

- A. Braffort, UQAM Montréal, 2013
- A. Braffort, Equipe Langue des Signes et Gestualité, Paris 8, 2013

- B. Grau, École d'Automne en Recherche d'Information et Application (EARIA 2008)
- Patrick Paroubek, CLARA Thematic training course on evaluation of Human Language Technologies, CLARA Marie Curie Initial Training Network, ELDA and University of Copenhagen, Paris, November 2012.
- 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
- C. Grouin and P. Zweigenbaum, workshop Rendez-vous SFDS: Méthodes et Logiciels, Société Française de Statistique, Paris, 2013
- A. Max, LORIA, Nancy, 2010
- A. Max, XRCE, Grenoble, 2012
- A. Vilnat, XRCE, Grenoble, 2012
- P. Zweigenbaum, CENTAL, Louvain-la-Neuve, 2008
- P. Zweigenbaum, Facultad Filología, Santiago de Compostella, 2008
- P. Zweigenbaum, CISMeF, Rouen, 2008
- P. Zweigenbaum, Mission pour l'informatisation des systèmes de santé (MISS), 2009
- P. Zweigenbaum, Pirstec workshop on multilingualism, Paris, 2009
- 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
- P. Zweigenbaum, workshop Plateforme d'indexation régionale (PLAIR), Rouen, 2012
- *P.* Zweigenbaum, workshop on NLP in France, INS2I, Nancy, 2013

PARTICIPATION IN EXPERTISE AND ADMINISTRATION OF RESEARCH

INTERNATIONAL OR NATIONAL SCIENTIFIC NETWORKING

INTERNATIONAL NETWORKS

- P. Zweigenbaum, chair of Natural Language Processing Working Group of the American Medical Informatics Association (2006-2008)
- P. Zweigenbaum, leader of WP3 (Context in Machine Translation) in T4ME European Network of Excellence (2011-2012)
- P. Zweigenbaum, founding chair of Francophone Special Interest Group of the International Association for Medical Informatics (2012-)

NATIONAL NETWORKS OR WORKING GROUPS

- C. Grouin, Board Member of French Association for Computational Linguistics (ATALA, 2011-)
- P. Paroubek, Vice-President of ATALA; President of ATALA (2013-)
- A. Vilnat, Vice-President of ATALA (-2012)
- A. Vilnat, member of Standing committee of the national TALN conference (-2012)
- P. Zweigenbaum, chair (-2012) then member at large of Standing committee of the national TALN conference
- P. Zweigenbaum, Board Member of French Association for Artificial Intelligence (AFIA, 2010-2013)
- P. Zweigenbaum, Board Member of Association for Medical Informatics (AIM, 2011-); in charge of international affairs (2013-)

PARTICIPATION IN EVALUATION OR EXPERTISE COMMITTEES

NATIONAL COMMITTEES (CONRS, CNU, CCSU…)

- P. Zweigenbaum: Chair (2011-2012) of CID 44 in CoNRS (2009-2012)
- A. Vinat: co-chair of CCSU 27 of Paris-Sud (-2012), member of CCSU 27 (2012-)
- X. Tannier: member of CCSU 27 of Paris-Sud
- V. Moriceau: member of CCSU 27 of Paris-Sud

EXPERT FOR SCIENTIFIC EVALUATION COMMITTEES

- A. Braffort, ANRT Cifre allocations, 2012
- 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
- 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, 2013
- P. Zweigenbaum, member of PRST MISN Evaluation committee (LORIA, 2010-2013)
- 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 2010
- Most members have been experts for various ANR programs

MEMBER OF THE ADMINISTRATION OR ADVISORY BOARD

- P. Zweigenbaum, board member, Department of Linguistics, Paris Diderot University (-2012)
- P. Zweigenbaum, invited member of the INS2I board (2011-2012)

MEMBER OF SELECTION JURIES

- A. Braffort, Grenoble University, MCF 2163 , 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 and 2013
- X. Tannier, Paris-Sud University, MCF 2011, Grenoble Stendhal University, MCF 2011
- A. Vilnat, chair, Paris-Sud University, PR 2010, 2011 and 2012, MCF 2013, Paris-Nord University, MCF 2011, 2013, Montpellier University, MC and PR 2010, PR 2011, Nantes University MC 2012, Cemagref CR, 2011
- P. Zweigenbaum, chair, Inalco, PR 2010, Caen University, MCF & PR 2011, Lille University, PR 2011, Université de la Méditerranée, PR 2009, Paris-Nord University, PR 2008, 2 MCF 2009, MCF & PR 2012, Paris-Ouest Nanterre La Défense University, PR 2013, Paris-Sud University, 2 MCF & 1 PR 2008, MCF & PR 2009, Rouen University, MCF 2012, Toulouse Paul Sabatier University, MCF 2010, Toulouse Le Mirail University, PR 2011

TEACHING ACTIVITIES AND DUTIES IN RELATION TO RESEARCH

- B. Grau, C. Grouin, T. Lavergne, 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, including Erasmus Mundus Master DMKM
- Numerous PhD and HDR defence committees, including rapporteur and president, in computer science, linguistics, and medical informatics, including abroad (see above)

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, 2012
- 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), UMLF (medical lexicon), Quaero structured named entity corpora, Apetite (tools for temporal annotation of texts), WiCoPaCo (Wikipedia Correction and Paraphrase Corpus), Dicta-Sign (LSF Corpus), DEGELS1 (LSF and aural French corpus), 40brèves2012 (LSF and written French corpus), Octopus (sign language generation software), Unoporuno (with AMI, detection of mobile researchers on the Web).

INDUSTRIAL RELATIONSHIPS

Long-term relationships are established with companies through CIFRE PhD theses (WebSourd: J. Segouat, Exalead: C. Mouton, Syllabs: C. de Groc, Lingua & Machina: B. Marie) and co-supervised PhD theses (CEA: D. Bouamor, H. Bouamor, M. Marchand, W. Wang), and through partnerships in funded projects (see list of EU, 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, ProjEstimate, Sonar and Request.

TABLE OF CONTRACTS FOR ILES GROUP

Contracts on public fundings	Acronym	Funding agency/ partner	Program	General coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
ANR Basic Science & JCJC	CONIQUE	ANR	Basic Science	Grau Brigitte	Grau Brigitte	06/12/2005	05/06/2009	93 340
	VERA	ANR	Basic Science	Estève Yannick	Rosset Sophie	01/01/2013	31/12/2015	75 810
ANR with industrials partners	uComp	ANR	CHIST-ERA	Wilhelmus Peters (U. Sheffield, UK)	Paroubek Patrick	15/11/2012	14/11/2015	183 997
	EDyLex	ANR	CONTINT	Sagot Benoit (INRIA)	Adda Gilles	01/11/2009	30/06/2013	181 835
	TRACE	ANR	CONTINT	Le Ny Benoit (Softissimo)	Yvon François	01/11/2009	31/07/2013	205 770
	ChronoLines	ANR	CONTINT	Battistelli Delphine (MoDyCo)	Tannier Xavier	01/02/2011	31/01/2014	112 074
	ACCORDYS	ANR	CONTINT	Charlet Jean (Inserm)	Zweigenbaum Pierre	01/09/2012	31/08/2015	206 072
	TransRead	ANR	CONTINT	Yvon François	Yvon François	01/10/2012	30/09/2015	236 222
	FILTRAR-S	ANR	CSOSG	Campion Nicolas (ERAKLE)	Grau Brigitte	19/02/2009	18/08/2011	59 565
	PASSAGE	ANR	MDCA	De la Clergerie Eric (INRIA)	Paroubek Patrick	01/01/2007	30/06/2010	155 888
	C-MANTIC	ANR	MDCO	Slodzian Monique (INALCO)	Zweigenbaum Pierre	01/01/2008	31/12/2010	48 533
	AUTOGRAPH	ANR	RNRT	Cardon Dominique (France Telecom R&D)	Habert Benoit	20/12/2005	20/07/2008	212 597
	PERF-RV2	ANR	RNTL	Gelin Rodolphe (CEA-LIST)	Bourdot Patrick	19/12/2005	19/06/2009	70 070
	SEVEN	ANR	RNTL	Nugier Sylvaine (EDF)	Jacquemin Christian	19/12/2005	19/05/2008	162 677
	AKENATON	ANR	TecSan	Burgun Anita (CHU de Rennes)	Zweigenbaum Pierre	01/12/2007	30/05/2011	84 106
	InterSTIS	ANR	TecSan	Forget Jean-François (VIDAL)	Zweigenbaum Pierre	01/01/2008	30/12/2010	98 762
Research collaborations	ANETH	Digiteo		Ligozat Anne-Laure	Ligozat Anne-Laure	01/10/2012	30/09/2015	102 200
	Envie Verte	Digiteo	Projet Emergent	Grau Brigitte	Grau Brigitte	01/09/2010	31/12/2013	110 940
	MyT	MyT		Vilnat Anne	Vilnat Anne	04/08/2011	03/02/2012	2 000
	QUAERO	OSEO		Gauvain Jean-Luc	Gauvain Jean-Luc	01/04/2008	31/12/2013	7 506 519
	DOXA	DGE	Pôle de compétitivité	Catherine Gouttas (Thalès)	Paroubek Patrick	02/01/2009	01/01/2012	460 214
	ProjEstimate	Région Ile de France	Pôle de compétitivité	Hamon Patrick (Spirula)	Paroubek Patrick	03/09/2012	02/09/2015	303 010
	ANETH	UniverSud Paris	PRES	Illouz Gabriel	Illouz Gabriel	02/04/2013	01/04/2014	3 000
UE contracts	INTUITION	EU	NOE	Bourdot Patrick	Bourdot Patrick	01/09/2004	31/10/2008	48 649
	Dicta-Sign	EU	STREP	Efthimiou Eleni (ILSP, Greece)	Braffort Annelies	01/02/2009	31/01/2012	382 156
	T4ME	EU	REX	Uszkoreit Hans (DFKI, Germany)	Mariani Joseph-Jean	01/02/2010	31/01/2013	516 000
PhD supervision		Université de Provence		Braffort Annelies	Braffort Annelies	01/03/2007	31/08/2009	0
		CEA		Vilnat Anne	Vilnat Anne	01/08/2008	30/07/2010	0
Resources Licences	ATILF-TLF	Université de Nancy		Vilnat Anne	Vilnat Anne	10/12/2007	09/03/2008	0
	Logiciel Syntex	Université de Toulouse Le Mirail		Vilnat Anne	Vilnat Anne	10/12/2007	10/12/2099	0
	Données lexicales	CNRS		Vilnat Anne	Vilnat Anne	08/04/2008	07/04/2013	0
	i2b2 2010	i2b2		Grouin Cyril	Grouin Cyril	01/04/2010	31/03/2011	0
	QA4MRE 2011	CELCT		Moriceau Véronique	Moriceau Véronique	01/04/2011	31/03/2012	0
	i2b2 2011	UPMC		Grouin Cyril	Grouin Cyril	01/05/2011	30/04/2012	0
	DEFT'08	ELDA		Grouin Cyril	Grouin Cyril	06/12/2011	Not applicable	0
	QA4MRE 2012	CLIPS		Grau Brigitte	Grau Brigitte	01/04/2012	31/03/2013	0
	QA4MRE 2013	CELCT		Grau Brigitte	Grau Brigitte	01/04/2013	31/03/2014	0
	Lexique UMLF	ASIP Santé		Zweigenbaum Pierre	Zweigenbaum Pierre	23/01/2013	NC	0

Industrial contracts, contracts on private fundings…								
	Acronym	Funding agency/ Partner	Program	General Coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
Non disclosure agreement	DOXA-NDA	EDF		Paroubek Patrick	Paroubek Patrick	13/10/2009	12/10/2020	0
		Meetic		Paroubek Patrick	Paroubek Patrick	23/11/2009	31/12/2011	0
	Octopus	Websourd		Braffort Annelies	Braffort Annelies	27/04/2007	26/04/2008	0
PhD supervision		Syllabs	CIFRE	Tannier Xavier	Zweigenbaum Pierre	01/11/2009	31/12/2012	6 000
		Websourd	CIFRE	Braffort Annelies	Braffort Annelies	01/01/2008	31/12/2011	15 000
Prestations of services	Prestation Websourd n°2	Websourd		Braffort Annelies	Braffort Annelies	01/12/2007	29/02/2008	14 900
	Prestation Websourd n°3	Websourd		Braffort Annelies	Braffort Annelies	01/10/2008	31/12/2008	9 382
	Formation 3DSMAX/LSF	Websourd		Braffort Annelies	Braffort Annelies	01/11/2008	30/04/2009	3 750
Licence agreement	XIP	XEROX		Vilnat Anne	Vilnat Anne	15/10/2008	15/10/2011	0

Patents, software registrations, licence agreements…					
	Software registration (APP)	LIMSI author	Co-authors	Date	Comment
Technology transfer	Logiciel MEDINA Personal data de-identification from clinical	Grouin Cyril	Zweigenbaum Pierre	01/11/2012	
	Licence agreements	Resp. for LIMSI	Licensee	Date	Comment
	OCTOPUS (Virtual signer animation software for French Sign Language synthesis from a concatenation of predefined animations). Duration: 6 months.	Bolot Laurence	Websourd	01/06/2008	
	OCTOPUS software - 10 years	Bolot Laurence	Websourd	01/12/2009	
	MEDINA software	Grouin Cyril	Université de Lille	01/06/2012	
	MEDINA software	Grouin Cyril	HEGP	01/01/2013	
	MEDINA software	Grouin Cyril	INSERM	2013	to be signed

SCIENTIFIC PUBLICATIONS

DOCTORAL THESES AND HDR

1. Arnulphy, B., *Désignations nominales des événements : Étude et extraction automatique dans les textes* 2012, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 8 novembre 2012, 202 p.
2. Barbier, V., *Utilisation de connaissances sémantiques pour l'analyse de justifications de réponses à des questions* 2009, thèse de l'Université Paris Sud/LIMSI. Soutenue à Orsay, France, le 22 janvier 2009.
3. Ben Abacha, A., *Recherche de réponses précises à des questions médicales : le système de questions-réponses MEANS* 2012, thèse de l'Université Paris Sud. Soutenue à Orsay, France, le 28 juin 2012, 162 p.
4. Bouamor, H., *Etude de la paraphrase sous-phrastique en Traitement Automatique des Langues* 2012, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 11 juin 2012, 160p p.
5. Braffort, A., *Traitement automatique de la Langue des Signes Française*, 2008, HdR Université Paris-Sud, soutenue à Orsay, France, le 27 juin 2008.
6. Chetelat, 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.
7. 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 à Orsay, France, le 07/12/2011, 196 p.
8. El Ayari, S., *Evaluation transparente du traitement des éléments de réponse à une question factuelle* 2009, thèse de l'Université Paris Sud/LIMSI. Soutenue à Orsay, France, le 23 novembre 2009.
9. Filhol, M., *Modèle descriptif des signes pour un traitement automatique des langues des signes* 2008, thèse de l'Université Paris Sud/LIMSI. Soutenue à Orsay, France, le 27 juin 2008.
10. 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 à Orsay, France, le 10 décembre 2010, 198 p.
11. Grappy, A., *Validation de réponses dans un système de questions réponses* 2011, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 8 novembre 2011, 166 p.
12. Grouin, C., Anonymisation de documents cliniques : performances et limites des méthodes symboliques et par apprentissage statistique 2013, thèse de l'LIMSI-CNRS, INSERM U872 Eq20, UPMC. Soutenue à Orsay, France, le 26 juin 2013, 258 p.
13. Minard, A.-L., *Extraction de relations en domaine de spécialité* 2012, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 7 décembre 2012, 182 p.

14. Mouton, C., *Ressources et méthodes semi-supervisées pour l'analyse sémantique de texte en français* 2010, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 17 décembre 2010, 249 p.
15. Pak, A., *Analyse de sentiments automatique, adaptative et applicative* 2012, thèse de l'Université Paris Sud. Soutenue à Orsay, France, le 13 juin 2012, 170 p.
16. 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 à Orsay, France, le 15 décembre 2010, 212 p.
17. Séjourné, K., *Question réponse et interaction* 2009, thèse de l'Université Paris Sud/LIMSI. Soutenue à Orsay, France, le 9 décembre 2009.

ARTICLES IN PEER REVIEWED SCIENTIFIC JOURNALS

1. Auray, N., M. Hurault-Plantet, C. Poudat, and B. Jacquemin, La négociation des points de vue. Une cartographie sociale des conflits et des querelles dans le Wikipédia francophone. Réseaux, 2009. 27 (154): pp.15-50.
2. 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.
3. Ben Abacha, A. and P. Zweigenbaum, Une étude comparative empirique sur la reconnaissance des entités médicales. TAL (Traitement Automatique des Langues), 2012. 53 (1): pp.39-68.
4. 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.
5. Bernhard, D., B. Cartoni, and D. Tribout, A task-based evaluation of French morphological resources and tools: a case study for question-answer pairs. LILT (Linguistic Issues in Language Technology), 2011. 5 (2): pp.1-41.
6. Bernhard, D., L. De Viron, V. Moriceau, and X. Tannier, Question generation for French: collating parsers and paraphrasing questions. Dialogue and Discourse, 2012. 3 (2): pp.43-74.
7. Berthelin, J.-B., The DEFT Text-mining Challenge. BULAG. Bulletin de Linguistique Appliquée et Générale, 2011. 35: pp.49-61.
8. Bouamor, H., A. Max, and A. Vilnat, Etude bilingue de l'acquisition et de la validation automatiques de paraphrases sous-phrastiques. TAL (Traitement Automatique des Langues), 2012. 53 (1): pp.1-27.
9. Bouamor, H., A. Max, and A. Vilnat, Multi-technique paraphrase alignment: A contribution to pinpointing sub-sentential paraphrases. ACM Transactions on Intelligent Systems and Technology, 2013. 4 (3): pp.39_1-39_26.
10. Braffort, A., E. Chetelat, and J. Segouat, Corpus de langue des signes : situer les biais des méthodes d'annotation et d'analyse. CORPUS, 2011. 10: pp.25-40.
11. Braffort, A. and P. Dalle, Sign language applications : preliminary modeling. International Journal of Universal Access in the Information Society, 2008. 6 (4): pp.393-404.
12. 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, 2010. 29 (7): pp.777-806.
13. 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.
14. Chowdhury, F. and P. Zweigenbaum, A controlled greedy supervised approach for co-reference resolution on clinical text. Journal of Biomedical Informatics, 2013. 46 (3): pp.506-515.
15. 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.
16. 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.
17. Deléger, L., M. Merkel, and P. Zweigenbaum, Translating medical terminologies through word alignment in parallel text corpora. Journal of Biomedical Informatic, 2009. 42 (4): pp.692-701.
18. Deléger, L., F. Namer, and P. Zweigenbaum, Morphosemantic parsing of medical compound words : transferring a French analyser to English. International Journal of Medical Informatics, 2009. 78 (1): pp.48-55.
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20. 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.
21. Filhol, M., A descriptive model of signs for Sign Language modelling. The Sign Language and Linguistics Journal, 2009. 12 (1): pp.93-100.
22. Fradin, B., G. Dal, N. Grabar, F. Namer, S. Lignon, D. Tribout, and P. Zweigenbaum, Remarques sur l'usage des corpus en morphologie. Langages, 2008. 171 (3): pp.34-59.

23. 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.
24. Grouin, C., N. Grabar, T. Hamon, X. Tannier, and P. Zweigenbaum, Eventual situations for timeline extraction from clinical reports. Journal of the American Medical Informatics Association - A scholarly journal of informatics in health and biomedicine, 2013. pp.27p.
25. Grouin, C., M. Hurault-Plantet, P. Paroubek, and J.-B. Berthelin, DEFT'07 : une campagne d'évaluation en fouille d'opinion. Fouille des données d'opinions, Revue des Nouvelles Technonologies de l'Information, 2009. 17: pp.1-24.
26. 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.
27. Jimeno Yepes, A., E. Prieur-Gaston, and A. Névéol, Combining MEDLINE and publisher data to create parallel corpora for the automatic translation of biomedical text. BMC Bioinformatics, 2013. 14: pp.146-146.
28. Kessler, R., X. Tannier, C. Hagège, V. Moriceau, and A. Bittar, Extraction de dates saillantes pour la construction de chronologies thématiques. TAL (Traitement Automatique des Langues), 2012. 53 (2): pp.57-86.
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30. 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.
31. 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.
32. 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. Biomedical Informatics Insights, 2012. 5 (1): pp.1-10.
33. 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.
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39. Zweigenbaum, P., T. Lavergne, N. Grabar, T. Hamon, S. Rosset, and C. Grouin, Combining an expert-based medical entity recognizer to a machine-learning system: methods and a case-study. Biomedical Informatics Insights, 2013. pp.13p.
40. Zweigenbaum, P., C. Retoré, and S. Kahane, Varia, Traitement Automatique des langues. TAL (Traitement Automatique des Langues), 2008. 49 (1): pp.7-10.

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1. Ben Abacha, A. and P. Zweigenbaum, Une approche hybride pour la détection automatique des relations sémantiques entre entités médicales, in Systèmes d'information pour l'amélioration de la qualité en santé, Ali Harmel Stéfan J. Darmoni Riadh Gouider Pascal Staccini, Editor. 2012, Springer. pp. 18_1-18_11.
2. Braffort, A. and E. Chetelat, Analysis and description of blinking in French Sign Language for automatic generation, in Gesture and Sign Language in human-computer interaction and embodied communication, G. Kouroupetroglou S. E. Fotinea E. Efthimiou, Editor. 2012, Springer, Lecture Notes in Computer Science 7206. pp. 173-182.
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7. Filhol, M., Combining two synchronisation methods in a linguistic model to describe Sign Language, in Gesture and Sign Language in Human-Computer Interaction and Embodied Communication (LNAI 7206), G. Kouroupetroglou S. E. Fotinea E. Efthimiou, Editor. 2012, Springer, Lecture Notes in Computer Science 7206. pp. 194-203.
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TLP
Spoken Language Processing

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).

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 and audio documents such as call center data. The main research subjects in Topic 2 are emotion and social cues identification in human-robot interaction, emotion detection based on verbal and non verbal cues (acoustic, visual and multimodal), dynamic user profile (emotional and interactional dimensions) in dialog 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.

Activities on statistical machine translation of speech or text (Topic 5) have been reinforced during the period thanks to the recruitement of a professor in 2007, an assistant professor in 2008, and a junior CNRS researcher in 2011. This research focuses on design and development of novel language and translation models as well as novel decoding statregies and is closely related to the developement of machine learning methodologies. Two major achievements during this period are the Wapiti open source software for large-scale linear chain CRFs, and the developement of new architectures and training strategies for neural network language models.

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). This topic also

includes research on language recognition, that is determining the language and/or dialect of an audio document for both wideband and telephone band speech.

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, but also for multilingual, multimodal, and mutimedia data. Those activities are mostly conducted in collaboration with national and international organizations and networks.

The following are what we consider to be the strong points of our activities.

The publications of the group have a significant impact on the scientific community. In many research topics the group has been at the forefront of the field, for example with its research activities on unsupervised training methods for acoustic models, continuous space language modeling, discriminative features produced by Multilayer Perceptrons (MLP) for speech recognition, speaker diarization (within individual audio documents and document collections), and emotion identification on real world data. This impact can be somewhat measured by looking at the h-index citation measure (based on Google Scholar) for the group members, which are quite high for the community (up to 45). For the reporting period the members of the group published 372 articles (50 in journals, 58 chapters in books, and 264 reviewed papers mostly at major international conferences).

During the reporting period we participated to over 30 **international evaluations** on speech and language technologies. These include 5 evaluations on speaker recognition (NIST SRE'08, SRE'10, SRE'13, Quaero'08 and '09) and 2 on language recognition (NIST LRE'09, LRE'11), as well as the yearly Quaero speech-to-text transcription and machine translation evaluations. As member of the the BBN-led Agile team in the DARPA GALE program, we consistently obtained top results in yearly evaluations from 2008 through 2011 on speech transcription in Mandarin and Arabic. We currently are on the BBN-led Babelone team which obtained the best results in the 2013 iARPA Babel evaluations for most conditions. The group was also ranked 1st in the following evaluations: ASR NBEST 2008, ASR Evalita 2011, ASR TechnoLangue Ester 2008, QAST QA@CLEF'08 and QA@CLEF'09 (Question Answering on Speech Transcripts), and had the best MT system for English to French translation in WMT 2011, IWSLT 2011, and WMT 2012.

The group has a long history of strong **implication in collaborative projects** (ANR, Quaero, DARPA, CapDigital, EquipEx, EU projects…), and in international networks (U-STAR, T4ME, Meta-Net, FlareNet ...). In particular the group has driven the CTC project of the Quaero program from 2008 to 2013, encompassing 21 French and German partners with a total funding of about 35M Euros. The group members contributed to the organization of many international conferences (InterSpeech, EAMT, JEP, RANLP, LREC, IWSDS, IWSLT, SLTU, Tralogy ...). As Interspeech 2013 is being held in Lyon, several group members are strongly involved in the organization holding important roles such as Technical Program Chair, Special Events Coordinator, Finance Manager and Prospective Committee Coordinator.

The group also has a strong contribution in the **structuration of research** in connection with the CNRS-UMI IMMI that was initiated by the group in 2006. In addition to the organization of the Quaero program, we contributed to the "Commission de réflexion sur l'Ethique de la Recherche en Sciences et Technologies du Numérique" (CERNA) within the Allistene alliance, the Fostering Language Resources Network (FLaReNet), and the Multilingual Europe Technology Network (Meta-Net).

The group has succeeded in **technology transfer** in particular with its long-term relationship with the Vocapia and Vecsys companies. It also has numerous cooperations with the industry through collaborative research projects in particular via the Cap Digital and Digiteo clusters, and CIFFRE scholarships (EDF, LNE, A2IA). In the context of the Quaero program, a transcription Web service was put in place allowing industrial partners to process large volumes of audio data. Ten partners have processed over 50,000 hours of data since the service was made available for research and evaluation purposes in 3 projects: Quaero, USTAR, Rapmat.

The **means and organization of the group** both in terms of contractual personnel and computer equipment have grown significantly over the last few years largely thanks to the Quaero program and numerous other research projects. In this context, Nadege Thorez has provided administrative support for CTC management, and Abderahman Azhar has contributed to computer infrastructure support. 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, as part of its **educational activities** the group is responsible for several graduate level speech processing courses, principally at the University of Paris-Sud. We have a high number of HDR members (11) which means a high level of supervision of the students. The group organizes open scientific seminars about 15 to 20 times per year at LIMSI, with at least 50% of non LIMSI intervenants. We also organize on a weekly basis paper review sessions on specific research topics. Also being in charge of the Quaero scientific activities we organised 11 bi-annual two-day workshops with a strong participation of the PhD students and Postdocs. Our policy is to encourage students to present their work at major international conferences, so if a student is the first author on a paper, the student is expected to attend the conference to present their work and is given priority over more senior researchers.

RESEARCH ACTIVITIES

TOPIC 1: SPEAKER CHARACTERIZATION IN A MULTIMODAL CONTEXT

***C. Barras**, H. Bredin, C-T. Do, M. Ferràs, J-L. Gauvain, L. Lamel, V.B. Le, C.C Leung, J Luo, J.L. Rouas, A. Roy, A. Sarkar, V.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

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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, compared to other aspects of social exchanges such as, facial expressions or gestures. There is a tendency within the area of emotion-oriented computing to use very exaggerated and unnatural emotional data portrayed by actors. It seems increasingly clear that this strategy is not effective, because the forms of expression that occur in natural interactions are fundamentally different from those that actors generate on command. 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 now consistently taken on the challenge of finding, annotating and analysing databases of “real-life” emotional data. The team has collected and analysed emotional speech databases 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). Analysis techniques that extracted spectral, prosodic and affect burst markers and automatic emotion detection systems using sophisticated machine learning techniques such as Support Vector Machines (SVM) have been developed to understand this comprehensive data. Recent comparisons show that they are on a par with those developed by other members of 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. We have studied the way paralinguistic cues impact the human-robot interaction as a first step, by linking the low-level clues computed from speech to 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, even boring. The system would provide a closed interaction loop, where the robot would react to the emotional message of the human, and trigger 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 emotions and social stances. We propose in our next steps of research to extract multimodal dimensions using gaze tracking (with a webcam), posture detection (with a Kinect 3D sensor) and a few physiological clues such as EEG with non-invasive sensors in order to improve the performance of our systems.

The detection of affective and social dimensions can be used for human-machine communication 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 project, we aim to analyse the quality of Client/Agent interactions in call center data (2009-11). Robotics is a relevant framework for assistive applications due to the learning and skills of robots. In the framework of the ANR Tecsan ARMEN project, we are involved in the designing and building of an assistive robot to maintain elderly people in their natural environment (2010-13). We also participated in the Cap Digital FUI ROMEO project (2009-2012) and now participate in OSEO PSPC ROMEO2 (2013-17) which has the main goal of building a social humanoid robot (a big brother of the NAO robot developed by Aldebaran Robotics) that can act as a comprehensive assistant to help persons suffering from autonomy loss. We are a member of the ROMEO Social Committee, which aims to provide a societal vision on the design of the

robot. 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 technique of role playing (2012-2015). In the framework of the ANR EMCO COMPARSE project, we also study, in collaboration with the CPU group, the relationships between cognition, motivation, and personality for emotional adaptation and regulation, using empathic virtual simulation (2012-15). The European CHISTERA project named JOKER (2013-16), JOKe and Empathy of a Robot/ECA: Towards social and affective relations with a robot, will emphasize the fusion of verbal and non-verbal channels for emotional and social behavior perception, interaction and generation capabilities. Our paradigm invokes two types of decision in the dialogs: intuitive (mainly based upon non-verbal multimodal cues) and cognitive (based upon fusion of semantic and contextual information with non-verbal multimodal cues).

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. We are also involved in the Ethical working group for research in robotics of CERNA (Committee on the Ethics of the Research in sciences and technologies of the Digital technology of Allistene).

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 was studied in collaboration with Maria Candea (Univ. Paris 3, sabbatical leave). Regional and foreign accents in Italian were also addressed by Italian PhD students - Ilaria Margherita (Univ. Pisa) and Marilisa Vitale (Univ. Naples "L'Orientale").

A first research axis is concerned with modelisation, identification and characterisation 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, Corsican, 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 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. Also, falling yes/no questions were found in Corsican French and Corsican: they may be attributed to prosodic transfer.

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 important for understanding possible sources of errors of automatic speech recognition systems. This holds in particular for reduced speech phenomena which have been extensively investigated in large spoken corpora in French and American English. 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 seek to gain information about the impact of increased context to help humans disambiguate problematic lexical items, typically homophone or near-homophone words. Studies of speech transcription errors are currently being investigated in relation to Named Entity detection, Spoken Language Understanding, Spoken Question-Answering and Dialog Systems. Furthermore, the same methodology can be applied to other linguistic features, such as other languages, accents and styles. Future work will try to take better account of social factors as well as accent, speaking style and expressive speech.

TOPIC 4: ROBUST ANALYSIS OF SPOKEN LANGUAGE AND DIALOG SYSTEMS

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This research topic addresses the analysis of spoken and written language for open domain interactive information retrieval. Given the wide scope, in addition to the requirement for fast-processing, there is a need for robustness in order to handle any kind of input (prepared speech, spontaneous speech, written texts, web documents, etc.). Spoken documents are complicated to process in part due to the nature of spoken language which includes phenomenas such as repairs, false starts, hesitations etc, and also may be subject to errors induced by automatic transcription. Searching for information in speech data provides new challenges as compared to the more usual newspaper-type documents often used in Information Retrieval and Question-Answering tasks. The syntax of speech is different, and in particular far less rigid, than written language syntax. Structure tends to be more local, with individual chunks generally 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 applied to speech transcripts.

Analyzing speech requires similar approaches as are needed for the analysis of not-so-well formed, or simply unusual, texts: 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 will be able to be interpreted within a formalism (POS, syntax, Named Entities, Dialog Acts...), but other parts cannot be. Automatic speech recognition exacerbates the need for robustness: not only errors are introduced in the transcription, but some useful clues present in text are unreliable. For example, the lack of reliable punctuation entails the loss of the sentence concept. Sentences are usually considered as self-contained units for text-based analysis modules, limiting the context size for rule-based systems and search space for stochastic ones. Commas provide chunk separations where ambiguity may happen, and prosody may provide the necessary context in speech for a human transcriptor. However, reliably providing such information is still beyond that of todays automatic speech recognition systems. Speech contains intrisic ambiguities that speech recognition systems cannot solve; therefore dealing with recognition errors (which can range from one word in ten to one in two being wrong depending of the language and of the task) is a part of any analysis task for 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. As a result, most of the tokenisation issues present with texts have already been handled by the system developers (Topics 5 & 6). Ideally, a text at the entry of an analysis step would combine the advantages of both speech and written text: words separated from punctuation

marks and from each other, uppercase only on proper nouns and acronyms, punctuation to be able to split into sentence units, etc.

In order to streamline the processing of both text and automatic (ASR) transcripts, all inputs to the analysis are converted to a common normalized form. This work builds upon extensive experience with normalizing data for language model building for ASR systems. However processing speech presents additional challenges related to spoken language and the inherent imperfection of ASR systems. A related activity thus aims to study and understand the different kinds of possible errors produced by ASR systems in order to better deal with them. The primary objective of two projects (ANR-CONTINT VERA project and PEPS ERRARE) launched in 2013 is to study the impact of ASR errors on systems using a semantic analysis of automatic transcriptions such as Named Entity detection, Spoken Language Understanding, Spoken Question-Answering and Dialog Systems. A PhD Thesis (Mohamed Ben Jannet) began in September 2012 on this subject as part of a CIFRE contract between LNE, LPP-Paris 3, and LIMSI. Another aim is to classify ASR errors according to their impact on different systems so as to lead to more robust analysis systems. Such studies are done in collaboration with and based on work produced by other topics of the group (ASR, Perception and Corpus).

A robust analyser is considered one that extracts as much structured information as possible from the data. Two complementary methodologies are studied, each applied to a class of applications. The first class of applications requires that a set of fuzzily defined information be extracted from the speech. A typical example is spoken language understanding for open domain dialog systems. The capability for experimentation on the classification of information is paramount. In such cases, symbolic approaches are privileged. An efficient rule-based 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. These analyzers serve as a basis for all of our dialogue systems. These experiments on multi-level analysis were further developed within the framework of the ANR-CONTINT GVLex project in collaboration with the AA group, for which our objective was to produce a multi-level analysis at the document level.

The second type of methodology applies when the task is well defined and annotated corpora are available, for which stochastic approaches are preferred. A typical case is that of Named Entity recognition and classification. Different machine learning approaches including Decision Trees, Support Vector Machines or Hidden Markov Models have been used for sequence labeling tasks, such as Named Entity Recognition. Conditional Random Field (CRF) have been growing in popularity over the last few years, their main advantage being their capacity to include a variety of symbolic and stochastic features. The standard features used for training a CRF model for NE detection include word prefixes and suffixes, various predicates such as Does the word start with a capital letter? and morphosyntactic labels. The originality of our approach is to leverage the rule-based multi-level analysis to provide a series of features at the word level for the CRF model. This information was used to predict single-layer named entities (Ester project). When handling semantically driven tree-structured named entities (Quaero project), this approach was used to bootstrap tree rebuilding via Probabilistic Context Free Grammars (PCFG). These analysers are used for Question-Answering (Quaero project) and spoken dialog systems (Ritel project), and have led to collaborations with other laboratories.

The objective of the REPERE challenge (see Topic 1), is to recognize who is speaking and who is seen. As it is common practice for anchors to introduce their guests by stating their name, different person entity detection systems were developed based on CRF models. In addition to multimodal person identification, one of our aims is to study different features and their robustness against ASR errors.

Our research on spoken language dialog systems mainly concerns open domain interactive search and intelligent assistants. Our main scientific interest is on dialog management and more specifically, managing dialog context and history. Our model is based on the use of semantically motivated clusters and a three-step algorithm which manages explicit and implicit user and system confirmations. The Ritel system is used as an experimental platform to validate our approaches. We recently launched two projects in order to explore new research directions. The first one aims at developing a cognitive assistant, which involves developing a multi-task model for dialog management. A first version of the multi-task dialogue management model has been implemented in a demonstration system within the Compagnon Numérique, a Futur En Seine project (Cap Digital and Région Ile de France). The second one aims at developing a system able to learn a task via interaction with a user, and involves work on automatic learning of dynamic task models.

All these activities are carried out in collaboration with the ILES and AA groups.

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 our own Machine Translation software(s).

Statistical Machine Translation systems rely on the statistical analysis of large bilingual corpora to train stochastic models describing the mapping between a source language (SL) and a target language (TL). In their simplest form, these models express probabilistic associations 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 more complex representations (eg. chunks, trees, or dependency structures) and to probabilistic mappings between these representations. Translation models are typically trained using parallel corpora containing examples of source texts aligned with their translation(s), where the alignment is defined at a 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 properly evaluated and diagnosed and significant efforts are devoted to the vexing issue of quality measurements of MT outputs. These research activities have been published in a number of international conferences or journals (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, 2012) in order to improve both word alignment and phrases extraction. (Lardilleux et al, 2011a, 2011b, 2012, 2013) 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 this approach, translation is defined as a two step process, in which an input SL sentence is first non-deterministically reordered yielding a large word lattice of 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 discriminatively optimized 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 our in-house CRF toolkit (Lavergne et al, 2010). We are exploring more agile and adaptive approaches to training for MT where the model parameters are computed on the fly (Li et al, 2012).

LIMSI's activities are not restricted to these core modules and many other aspects of SMT are also investigated, such as "tuning" (Sokolov & Yvon, 2011), multi-source machine translation (Crego et al 2010a, 2010b), diagnostic evaluation of MT, notably via the computation of oracle scores (Max et al, 2010; Wisniewski et al, 2010, 2013; Sokolov et al, 2012), confidence estimation (Zhang et al, 2012), word sense disambiguation for MT (Sokolov et al, 2012; Apidianaki et al, 2012), extraction of parallel sentences from comparable corpora (Braham-Ghabiche et al, 2011), sentence alignment (Yu & al, 2012a, 2012b), etc.

LIMSI's MT systems have taken part in several international MT evaluation campaigns. This includes a yearly participation to the WMT evaluation series (2006-2013), where LIMSI has consistently been ranked amongst the top systems, especially when translating from and 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 for translation of speech.

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 tagging, Named Entity Recognition, 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 (Gauvain & Schwenk, 2002) and which has provided us consistent performance improvements in many tasks. The recent work of (Le & al, 2010, 2011, 2013) 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 has been generalized to Neural Network Translation Models (Lavergne et al, 2011; Le et al, 2012) which are even more demanding in terms of their output vocabulary (bilingual segments).

TOPIC 6: SPEECH RECOGNITION

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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 adaptation, 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.

We also supported the MediaEval 2010-2013 and TrecVid 2007-2013 evaluations by providing automatic transcripts for several hundreds of hours of audio data.

TOPIC 7: LANGUAGE RESOURCES

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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.

Error classification, diagnosis and impact measurement via perceptive tests constitute important steps in identifying weaknesses in the models of state-of-the-art transcription systems and preparing for future generations of spoken language processing systems. We address this important matter in close coordination with other topics of the group, Topic 3 (perception), 4 (robust analysis), and 6 (speech recognition). In this topic the focus is on the problem of multilevel annotation of errors in speech corpora.

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. Another technique to ensure consistence within annotations is to compute inter-annotator agreement (IAA) when possible. 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 was made available to the research community.

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.

For some purposes, such as person recognition in broadcast news shows, semantic information is found not only in the speech, but from all different modalities present in the media. In this context, we are developing collaborative tools and guidelines to annotate multilingual, multimodal, multimedia data.

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 "Ethics and Big Data" has been developed in collaboration with the Aproged, Cap Digital, AFCP and ATALA.

Highlights

Best system in NBEST (2008) and Evalita evaluations (Nov. 2011)

Best MT system for English to French translation (WMT 2011, IWSLT 2011, WMT 2012)

Best results in REPERE challenge 2013 (main supervised and unsupervised tasks)

ACM Multimedia Grand Challenge 2010 award

Best spoken QA systems in QAst track in the QA@CLEF evaluation for English, Spanish and French (QA@CLEF'08 and QA@CLEF'09)

Wapiti: an open source package for linear chain Conditional Random Fields (CRFs) tailored for very large scale tasks

STAFF

PERMANENT STAFF

Last name	First name	Position	Employer	HDR	Arrival date	Departure date
Adda	Gilles	Res. Eng.	CNRS	HDR		
Adda-Decker	Martine	DR	CNRS	HDR		Left on 01/10/2010
Allauzen	Alexandre	Ass.Prof.	Université Paris Sud			
Apidianaki	Marianna	CR	CNRS		Hired as of 01/10/2011	
Barras	Claude	Ass.Prof.	Université Paris Sud	HDR		
Bilinski	Eric	Res. Eng.	CNRS			
Boula De Mareüil	Philippe	CR	CNRS	HDR		
Bredin	Hervé	CR	CNRS		Hired as of 01/09/2010	
Devillers	Laurence	Prof.	Université Paris Sorbonne	HDR		
Gangolf	Jean-Jacques	Res. Eng.	CNRS			
Gauvain	Jean-Luc	DR	CNRS	HDR		
Guinaudeau	Camille	Ass.Prof.	Université Paris Sud		Hired as of 01/09/2013	
Lamel	Lori	DR	CNRS	HDR		
Mariani	Joseph-Jean	DR	CNRS	HDR		
Maynard	Hélène	Ass.Prof.	Université Paris Sud	HDR		
Rosset	Sophie	DR	CNRS	HDR		
Rouas	Jean-Luc	CR	CNRS		Hired as of 01/10/2008	Left on 31/08/2010
Vasilescu	Ioana	CR	CNRS			
Wisniewski	Guillaume	Ass.Prof.	Université Paris Sud		Hired as of 01/09/2008	
Yvon	François	DR	Université Paris Sud	HDR		

NON PERMANENT STAFF

Last name	First name	Contract	Arrival date	Departure date
Agueev	Dimitri	CDD	03/08/2009	30/09/2011
Albert	Pierre	CDD	01/02/2013	13/06/2013
Alumäe	Tanel	Post-Doc	01/03/2008	28/02/2009
Armeni	Kristijan	CDD	01/12/2012	31/01/2013
Baratze	Eukène	CDD	15/09/2009	30/04/2011
Batko Wolfrum	Laure	CDD	01/10/2009	30/01/2010
Benzeghiba	Mohamed	Post-Doc	02/04/2007	31/12/2012
Bilinski	Isabelle	CDD	01/05/2012	31/10/2012
Bossard	Aurélien	Post-Doc	01/11/2011	31/10/2012
Bouguet	Carolyn	CDD	10/11/2009	30/06/2011
Brendel	Matthias	Post-Doc	01/04/2009	31/03/2010
Buffa	Maria Rosaria	CDD	01/09/2010	31/08/2011
Champliau	Renata	CDD	02/08/2010	31/07/2011
Chastagnol	Clément	Post-Doc	01/06/2013	30/11/2013
Chiaruttini	Despina Lilian	CDD	01/10/2009	31/12/2010
Coutant	Alice	CDD	01/12/2008	01/09/2011
Crego	Josep-Maria	CDD	01/03/2008	15/08/2011
Déchelotte	Daniel	Post-Doc	01/01/2008	31/03/2008
Didiot	Emmanuel	Post-Doc	01/02/2010	30/11/2010
Dinarelli	Marco	CDD	01/06/2010	30/09/2013
Diouf	Fallou	CDD	18/05/2009	25/01/2010
Doukhan	David	CDD	01/10/2013	30/09/2014
Draoui	Loredana	CDD	01/09/2010	31/08/2011
Durand	Tom	CDD	17/11/2008	30/04/2009
Durgar El Khalout	Ilknur	Post-Doc	01/08/2009	31/07/2010
Elver	Judith	CDD	16/11/2009	30/06/2011
Elver	Judith	CDD	01/03/2012	30/06/2012
Fousek	Petr	Post-Doc	01/05/2007	30/04/2008
Gahbiche-Braham	Souhir	Post-Doc	01/09/2013	31/07/2014
Galibert	Olivier	CDD	01/08/2006	31/07/2009
Garau	Giulia	Post-Doc	01/10/2010	03/03/2011
Giray	Aybuke	CDD	01/08/2012	14/10/2012
Hartmann	William	Post-Doc	01/10/2012	31/12/2013
Kolar	Jachym	Post-Doc	01/01/2010	31/12/2012
Kostrzanowska	Krystyna	CDD	01/10/2009	31/12/2010
Lardilleux	Adrien	Post-Doc	03/10/2010	31/03/2012
Laurent	Antoine	CDD	01/10/2013	31/05/2014
Le	Viet Bac	CDD	01/09/2008	30/09/2010
Lebedeff	Angelina	CDD	01/07/2009	31/08/2011
Lencina	Julieta	CDD	01/07/2010	31/07/2011
Leung	Cheung Chi	Post-Doc	01/09/2007	31/08/2008
Lysaght	Ruth	CDD	01/01/2013	30/04/2013
Massinon	Stéphane	CDD	01/09/2009	31/12/2010
Meissner	Stephan	CDD	01/12/2008	30/11/2009
Meng	Sha	Post-Doc	01/01/2010	31/12/2010
Messaoudi	Abdelkhalek	CDD	01/10/2011	31/12/2013
Miyake	Meno Matsui	CDD	23/08/2010	30/11/2010
Mouilleron	Virginie	CDD	11/01/2010	31/12/2010
Munck	Signe Andrea	CDD	01/11/2012	31/03/2013
Nemoto	Rena	CDD	01/12/2011	31/01/2012

Oparin	Ilya	Post-Doc	01/11/2009	30/10/2012
Ozolina	Alise	CDD	01/09/2011	15/11/2011
Pereira	Patty	CDD	01/07/2009	31/08/2011
Perez De Carvasal	Cynthia	CDD	12/07/2010	30/04/2011
Ping	Ke	CDD	15/08/2012	14/10/2012
Rajna	Gyula	CDD	01/10/2011	15/12/2011
Rakic	Vernarcikova	CDD	15/02/2012	15/06/2012
Rollet	Nicolas	CDD	01/11/2008	31/01/2010
Roy	Anindya	Post-Doc	01/12/2011	30/06/2014
Sarkar	Achintya Kumar	CDD	01/07/2012	30/06/2014
Schuller	Bjoern	CDD	01/10/2009	31/03/2010
Seck	Alassane	CDD	02/11/2009	31/10/2010
Sehili	Mohamed El Amine	CDD	01/10/2013	30/09/2014
Sidabraite-Brunet	Rita	CDD	09/11/2009	31/12/2013
Singh	Anil Kumar	Post-Doc	02/05/2012	30/10/2013
Snoeren	Natalie	CDD	20/03/2008	20/01/2012
Sokolov	Artem	Post-Doc	06/09/2010	31/08/2012
Sprivul	Aija	CDD	01/09/2011	31/12/2011
Srbkova	Katerina	CDD	01/02/2012	15/04/2012
Strucl Rojko	Mirjam	CDD	01/01/2013	31/03/2013
Ta	Anh-Phuong	CDD	01/12/2012	30/11/2014
Tahiri	Hicham	CDD	01/05/2013	31/05/2013
Thorez - Oparin	Nadège	CDD	01/03/2008	31/12/2013
Tillieux	Richard	CDD	23/04/2012	31/01/2013
Toney	Dave	Post-Doc	28/05/2007	28/11/2008
Tran	Viet Anh	Post-Doc	01/02/2010	30/04/2011
Tribout	Delphine	CDD	01/01/2010	31/08/2010
Tribout	Delphine	CDD	01/01/2011	31/12/2011
Ungureanu	Mioara Marcela	CDD	01/12/2011	31/03/2012
Vanmol	Liesbeth	CDD	01/04/2012	31/08/2012
Vargas Röhl	Amadeus	CDD	15/10/2009	30/06/2012
Verheyden	Beata	CDD	01/10/2009	31/05/2011
Vidrascu	Laurence	Post-Doc	01/01/2008	30/09/2008
Vieira	Lilian	CDD	01/09/2010	30/09/2013
Wagner	Christoph	CDD	01/10/2009	30/11/2011
Williams	Sara	CDD	05/11/2009	31/12/2010
Wurth	Isabelle	CDD	01/09/2011	30/11/2011
Yahia	Dahbia	CDD	01/04/2010	30/06/2011
Yu	Qian	CDD	01/04/2011	30/04/2012
Zaccarelli	Riccardo	Post-Doc	01/02/2008	30/07/2010
Zhang	Qing Qing	Post-Doc	01/08/2010	31/07/2011
Zikou	Christina	CDD	05/10/2009	31/05/2011

PHD STUDENTS

Last name	First name	Thesis director	Arrival date	Date of defense
Bernard	Guillaume	Martine Adda-Decker	01/10/2007	06/06/2011
Dimulescu-Vieru	Bianca	Christophe D'Alessandro	01/10/2004	16/05/2008
Ferràs Font	Marc	Jean-Luc Gauvain	01/02/2006	06/07/2009
Galibert	Olivier		01/11/2008	04/06/2009
Karanasou	Panagiota	Lori Lamel	01/09/2009	11/06/2013
Le	Hai Son	François Yvon	01/10/2009	20/12/2012
Nemoto	Rena	Martine Adda-Decker	01/10/2007	16/11/2011
Pellegrini	Thomas	Lori Lamel	01/10/2004	11/04/2008

Tahon	Marie	Laurence Devillers	03/02/2009	15/11/2012
Tomeh	Nadi	François Yvon	01/10/2008	27/06/2012
Vaudable	Christophe	Laurence Devillers	01/10/2008	11/07/2012
Woehrling	Cécile	Lori Lamel	01/10/2005	19/05/2009
Ben Jannet	Mohamed	Sophie Rosset	15/10/2012	
Bluche	Théodore	François Yvon	01/10/2011	
Chastagnol	Clément	Laurence Devillers	01/01/2010	
Delaborde	Agnès	Laurence Devillers	04/09/2009	
Do	Quoc Khanh	François Yvon	01/10/2012	
Dutrey	Camille	Sophie Rosset	06/12/2011	
Foucault	Nicolas	Sophie Rosset	01/10/2009	
Fraga Da Silva	Thiago Henrique	Jean-Luc Gauvain	01/07/2009	
Gahbiche-Braham	Souhir	François Yvon	01/11/2009	
Gong	Li	François Yvon	01/10/2011	
Pécheux	Nicolas	François Yvon	01/10/2012	
Soury	Mariette	Laurence Devillers	01/10/2011	
Xu	Yong	François Yvon	01/10/2012	
Yang	Fan	Claude Barras	01/10/2012	

INTERNSHIPS

Last name	First name	Arrival date	Departure date	Prepared degree	School / University
Mirghane	Soulaimane	15/01/08	15/05/08	Master 1	Université Paris Sud
Tephany	Julien	15/01/08	15/05/08	M1	Université Paris Sud
Najar	Salma	10/03/08	30/09/08	M2R	Université Paris Sud
Rejeb	Hela	01/04/08	30/09/08	Master 2	Université René Descartes
Vaudable	Christophe	01/04/08	01/10/08	Master 2	Université Paris Nord
Layachi	Omar	09/04/08	16/07/08	3ème année Ingénieur	Ecole Polytechnique
Detrez	Grégoire	07/07/08	07/09/08	M1	Université Paris Diderot
Payen	Raphael	01/03/09	30/09/09	Master 2	Université Paris Diderot
Ben Ayed	Maaouia	16/03/09	15/09/09	Master 2	Université Paris 8
Le	Hai Son	14/04/09	11/09/09	M2R	ENS Cachan
Sehili	Mohamed El Amine	20/04/09	11/09/09	Master 2 Recherche SETI	Université Paris Sud
Darmé	Cécile	23/11/09	02/04/10	M2R	Université Paris Ouest
Charles	Aurélien	15/02/10	30/09/10	Master Recherche	ENSAM Paris
Martinet	Lucie	22/02/10	16/05/10	Master 1	Université Claude Bernard Lyon
Zhang	Fan	01/04/10	30/09/10	Master 2 Recherche SETI	Université Paris Sud
Yahia	Dahbia	01/04/10	30/09/10	Master 2 Recherche SETI	Université Paris Sud
Dutrey	Camille	15/04/10	31/07/10	M1	Université Lille 3
Mbengue	Cheikh	26/04/10	26/09/10	M2 Recherche Informatique	Université Paris Sud
Bienvenu	Fréderic	10/05/10	30/07/10	Ingénieur	Université Paris Sud
Bernard	Arthur	17/05/10	30/08/10	2ème année Ingénieur	Université Paris Sud
Pavageau	Max	01/06/10	15/09/10	Ingénieur Informatique	Université Paris Sud
Hoeckman	Myrtille	01/06/10	15/09/10	Master Sciences du langage	Université Lille 3
Yapomo Domkem	Manuela	01/06/10	31/08/10	Master 1	Université Franche Comté
Radoszycki	Julia	21/06/10	10/09/10	Ingénieur	INSA Toulouse
Sami	Ismael	01/10/10	31/03/11	1ère année ingénieur	EURECOM
Decremps	Sylvain	05/01/11	10/05/11	Master 1 Informatique	Université Paris Sud
Dulin	Guillaume	28/03/11	30/09/11	Master 1 Informatique	Université Paris Sud
Maioli	Vincent	01/04/11	31/08/11	M2	ENS Cachan
Yu	Qian	01/04/11	30/09/11	Master Recherche	Université Paris Sud
Gong	Li	01/04/11	30/09/11	M2R	Université Paris Sud

Bouchekif	Abdesselam	01/04/11	30/09/11	M2R	Université Paris Sud
Al Mohamad	Diaa	01/04/11	19/09/11	M2 ingénierie mathématiques	Université Paris Sud
Lorenzi	Pierre	06/04/11	01/07/11	3ème Année Ingénieur	Ecole Polytechnique
Blusseau	Samy	08/04/11	15/09/11	Master Recherche	Telecom Paris Tech
Wottawa	Jane	01/05/11	31/08/11	M1	Sorbonne Nouvelle
Xu	Yong	02/05/11	31/08/11	M1	Université Paris Sud
Cochin	Emilie	02/05/11	30/06/11	Master 1	Université d'Orléans
Lupinski	Nicolas	01/06/11	15/09/11	Master Informatique	Université Paris Sud
Bouchinet	Denis	15/06/11	15/09/11	Master 1 Informatique	Université Paris Sud
Zhuang	Yong	20/10/11	15/04/12	1ère année ingénieur	Université Paris Sud
Ben Khalifa	Rim	16/01/12	11/05/12	Master 1 Informatique	Université Paris Sud
Berthier	Vincent	17/01/12	30/04/12	Master Informatique	Université Paris Sud
Hamet	Valentin	09/02/12	11/05/12	Master Informatique	Université Paris Sud
Kerry	Nina	19/03/12	31/08/12	M2	Université de Bordeaux
Yang	Fan	19/03/12	31/08/12	3ème Année Ingénieur	Polytech
Kerry	Nina	21/03/12	31/08/12	M2	Université Bordeaux
Xu	Yong	01/04/12	30/09/12	Master 2 informatique	Université Paris Sud
Pécheux	Nicolas	01/04/12	15/09/12	Master 2	ENS Cachan
Poltavchenko	Irina	16/04/12	16/09/12	Master 2 Ingénierie	INALCO
Tillieux	Richard	23/04/12	31/07/12	Master	UCL
Amaya Trivino	Adriana	02/05/12	15/09/12	Master 1	Sorbonne Nouvelle
Do	Quoc Khanh	30/07/12	30/09/12	Master 2 informatique	ENS Cachan
Ivent	Fanny	01/03/13	31/07/13	M2 Sciences du langage	Sorbonne Nouvelle
Knyazeva	Elena	02/04/13	30/09/13	Ingénieur	Télécom Paristech
Wang	Xin	15/05/13	31/08/13	Master 1 Informatique	Université Paris Sud

INDICATORS OF SCIENTIFIC NOTORIETY

PRIZES AND AWARDS

- Gilles Adda received the CNRS Crystal Medal in 2010 (best engineer distinction) on behalf of the InSIS Institute.
- Joseph Mariani was elected ISCA Fellow in 2009.
- Joseph Mariani was nominated ISCA Life Honorary member in 2010.
- Joseph Mariani was elected ELRA Honorary President in 2010.

EDITORIAL BOARD APPOINTMENT

- M. Adda-Decker, Editorial Board member "Computer Speech and Language" (Elsevier) (2009-)
- M. Adda-Decker, Editorial Board member "RFLA" (2009-)
- J.L. Gauvain co editor-in-chief of the Speech Communication journal (2006-2008)
- J.L. Gauvain Scientific Advisory Board of Annals of Telecommunications
- J.L. Gauvain Speech Communication Editorial Board Member
- J.L. Gauvain Advisory board of Information-Interaction-Intelligence Journal
- 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. 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)
- J. Mariani Member of the Scientific Committee of the ISTE-Wiley "Cognitive Science and Knowledge Management" Book series (2013-)
- F. Yvon, editor in chief of the TAL Journal (2007-2010), Editorial board member (2005-)

ORGANIZATION OF INTERNATIONAL OR NATIONAL SCIENTIFIC EVENTS

ORGANIZATIONAL COMMITTEE

- G. Adda (General chair), J. Mariani (Co-Chair), C. Barras, H. Bredin, S. Rosset, F. Yvon, G. Wisniewski members of the Organizational Committee of the ERRARE Workshop (Paris, 21-22 November, 2013)
- H. Bredin Organizational Committee of the 1st "Workshop on Speech, Language and Audio in Mutimedia (SLAM) (Marseille 22-23 August 2013)
- L. Devillers, Organizational committee: show & tell and roundtable, Interspeech 2013 (Lyon)
- J. Mariani (General Chair), L. Devillers, S. Rosset members of the Organizational Committee of the "International Workshop on Spoken Dialog Systems" IWSDS'2012 (Paris, 2012)
- J. Mariani Member of the Program Committee of the Language Resources and Evaluation Conferences LREC'08 (Marrakech, 2008), LREC'10 (Malta, 2010), LREC'12 (Istanbul, 2012), LREC'14 (Reykjavik, 2014)
- J. Mariani General chair of the International Workshop on Spoken Language Translation (IWSLT'10) (Paris, 2010)
- J. Mariani Co-chair of the International Workshop on Spoken Language Translation (IWSLT'13) (Heidelberg, 5-6 December 2013)
- J. Mariani Member of the Program Committee of the TRALOGY'2011 Conference (Paris, 2011), TRALOGY'2013 Conference (Paris, 2013) and TRALOGY'2015 Conference (Strasbourg, 2015)
- J. Mariani Co-chair of the "Getting Less-Resourced Languages on-board " Workshop at the "Language and Technology Conference" (L&TC'09) (Poznan, 2009)
- 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 Organization Committee of the ETHICOMP and CEPE 2014 Conferences (Paris, 2014)

INTERNATIONAL ADVISORY COMMITTEE

- J. Mariani Member of the Program Committee of the LANGTECH'08 conference (Rome, 2008)
- J. Mariani Member of the Scientific Committee of the 2nd International Symposium on Multilingualism in Cyberspace, SIMC'2011 (Brasilia, 7-9 November 2011)
- J. Mariani Member of the Advisory Committee of the "Etats Généraux du Multilinguisme dans les Outre-Mer" (Cayenne, 2011)
- 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 Technical Program Committee of the Speech Processing Conference (Tel Aviv) (2011, 2012 and 2013)
- J. Mariani Member of the International Advisory Committee of Oriental Cocosda (2011, Taiwan), (2012, Macau), (2013, Gurgaon, India)

STEERING COMMITTEE

- J. Mariani Member of the Steering Committee of the "International Workshop on Spoken Dialog Systems" IWSDS'2009 (Irsee, 2009), IWSDS'2010 (Gotemba, 2010), IWSDS'2011 (Granada, 2011)

SCIENTIFIC COMMITTEE

- G. Adda: JEP (2008, 2010, 2012), LREC (2008, 2010, 2012), Interspeech (2008-2013), ICASSP (2008-2013), ASRU (2009, 2011,2013), SLT 2010, SLAM 2013
- A. Allauzen: ACL 2013, CICling 2013, Interspeech (2010-2013), ICLR 2013, IWSLT (2010-12), ESANN 2011, LREC (2010, 2012)
- C. Barras: Odyssey (2008, 2010, 2012), Interspeech (2011-2013), IEEE ICASSP (2008-2011,2013), LREC (2008, 2010, 2012), SLAM 2013
- P. Boula de Mareüil: TALN (2008), JEP (2008, 2010, 2012), JEL (2009), RJC Parole (2009), LREC (2010, 2012), Interspeech (2011, 2013), PPLC (2013), Colloque international sur La perception des accents du français hors de France, Avignon
- L. Devillers: conferences (2008-2013) Interspeech, ICASSP, LREC, ACII, JEP; workshops (2008-13): EPIA, AVEC, AFFINE, WACAI

- L. Lamel, RANLP (2011, 2013), LREC (2008, 2010, 2012), SLTU (2008, 2010, 2012), IEEE ICASSP (2010, 2011, 2012)
- J. Mariani Member of the Scientific Committee of COLING'2010 (Beijing, 2010) and COLING'2012 (Mumbai, 2012) conferences
- J. Mariani Member of the Scientific Committee of the ACIVS'10 Conference (Sydney, 2010)
- J. Mariani Member of the Program Committee of the IJCNLP'13 conference (Nagoya, October 14-18, 2013)
- J. Mariani Member of the Program Committee of the CREIS-TERMINAL Conference (Nantes, 3-4 April, 2014)
- S. Rosset: TALN (2008, 2010, 2011, 2012), LREC (2008, 2010, 2012), KRAQ (2012), Interspeech (2013)
- G. Wisniewski: TALN (2010-2013), CTAI 2010, CORIA (2010, 2012), NAACL 2012, Interspeech 2013, CVSC 2013, TALCTAI 2013
- F. Yvon: EMNLP (2011-2013), NAACL (2013), ECML (2009), TALN (2008-2013), ICGI (2012), LREC (2012, EAMT (2010-2012), SSST(2011, 2012), WMT (2010-2013), MT-Summit (2013)

TECHNICAL PROGRAM

- G. Adda, I. Vasilescu, P. Boula de Mareüil, 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.
- L. Devillers, J. Mariani, S. Rosset Program Committee of the "International Workshop on Spoken Dialog Systems" IWSDS'2012 (Paris, 2012)
- L. Devillers, Program committee 3th International Workshop satellite of LREC 2010 "Corpora for Research on Emotion and Affect", May 2010, Malta.
- L. Devillers, Program committee 4th International Workshop satellite of LREC 2012 "Corpora for Research on emotion sentiment & social signals", May 2012, Istanbul.
- J.L Gauvain, Technical Program Committee Interspeech 2010, Brighton
- L. Lamel, Steering Committee, Co-technical program chair, Interspeech 2013 (Lyon)
- L. Lamel, Program Committee for the 1st International Conference on Statistical Language and Speech Processing (SLSP 2013)
- L. Lamel, Program Committee 7th International Symposium on Chinese Spoken Language Processing (ISCSLP 2010), Tainan, Taiwan, November 29-December 3.
- 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 Scientific Committee of the LRTS Workshop at IJCNLP'11 (Chiang Mai, November 2011)
- J. Mariani Member of the Program Committee of the FLaReNet 2009 Forum "Shaping the Future of the Multilingual Digital Europe" (Vienna, 2009), FLaReNet 2010 Forum "Language Resources for the future – The future of Language Resources" (Barcelona, 2010), 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" (Poznan) (L&TC'2009, L&TC'2011 and L&TC'2013)
- J. Mariani Member of the Scientific Committee of the ACIVS'09 Conference (Bordeaux, 2009)
- J. Mariani Member of the Scientific Committee of the 3rd International Symposium on Multilingualism in Cyberspace, SIMC'2012 (Paris, 21-23 November 2012)
- J. Mariani Member of the organization committee (in charge of the coordination of the Prospective) of Interspeech 2013 (Lyon, 2013)
- S. Rosset, François Yvon, Program committee of TALN 2012
- S. Rosset and L. Devillers, Program Committee of the "International Workshop on Spoken Dialog Systems (IWSDS)" (Paris, 2012)
- 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

INVITED LECTURES, TALKS OR SEMINARS

KEYNOTE SPEAKER AT INTERNATIONAL CONFERENCES

- L. Lamel, keynote, "Multilingual Speech Processing Activities in Quaero: Application to Multimedia Search in Unstructured Data," at HLT 2012 The Fifth International Conference Human Language Technologies — The Baltic Perspective, Tartu, Estonia, October 4–5, 2012.
- L. Lamel, invited talk at GoTAL 2008 "Speech Processing for Audio Indexing", Chalmers University, Goteborg, 25-27 August 2008.
- L. Lamel, invited talk Some Open Challenges for Spoken Language Processing, Chist-era, Cork Sept 6, 2011
- J. Mariani, « Funding agencies in support to Language Processing: from the regional to the multinational scale », LREC'08, Marrakech, 28-30 May 2008
- J. Mariani, « Les technologies de la langue en soutien au Multilinguisme: une perspective Européenne », Congrès Mondial sur la Traduction Spécialisé, La Havane, 8-12 December 2008
- J. Mariani, « Les Technologies de la Langue en soutien au Multilinguisme », International Forum on multilingualism, Bamako, 19-21 January 2009
- J. Mariani, « Language Technology Infrastructures in support to Multilingualism", 3rd International Universal Communication Symposium, Tokyo, 3-4 December 2009
- 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, 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, 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
- J. Mariani, Language Technologies for a Mutilingual Europe, "Crosslingual LT in service of an integrated multilingual Europe" Conference, Hamburg, 4-5 May 2012
- J. Mariani, Socially Aware Interactive Assistant, META-FORUM 2012 A strategy for Multilingual Europe, Brussels, 20-21 June 2012
- J. Mariani, P. Paroubek, G. Francopoulo, A. Max, F. Yvon, P. Zweigenbaum, The White Paper on the French language in the Digital Age, 3rd International Symposium on Multilingualism in Cyberspace (SIMC III), Paris, 21-23 November 2012
- J. Mariani, P. Paroubek, G. Francopoulo, M. Deleborde, Rediscovering 25 years of discoveries, Interspeech'2013, Lyon, 26-29 August 2013
- F. Yvon, "Statistical Alignment of Bitexts: challenges, methods and applications", Journées Internationales d'Analyse des Données Textuelles (JADT), Liège, 15-06-2012.
- F. Yvon, "Grammatical Inference: some news from the Machine Translation front", International Conference on Grammatical Inference (ICGI), Saint Malo, 28-07-2008.

INVITED WORKSHOP SPEAKER

- P. Boula de Mareüil, « Perception d'accents étrangers et régionaux en français », Bern, 8 November 2013.
- L. Devillers, B. Schuller: Position paper Session 5 "LRs of the future", The Essential Role of Language Resources for the Future of Affective Computing Systems: A Recognition Perspective, FLaReNet forum 2010, 19.02.2010
- L. Devillers, NaoTechDay 2013, La Villette
- J.L. Gauvain, Quaero: multilingual and multimedia technologies, IWSLT Workskop, 2010 Paris
- 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
- L. Lamel, A. Wailbel, "Transcription de la parole et traduction" Quaero Journée de l'Innovation Collaborative, Paris, March 28, 2013
- J. Mariani, « Les Technologies de la Langue en soutien au Multilinguisme », Seminar international « Instrumente pentru asistarea traducerii », Bucarest, 28-29 February 2008
- J. Mariani, "Towards common priorities and recommendations for the future of Language and Speech Resources", Cocosda workshop, Marrakech, 1st June 2008

- J. Mariani, « Soutien des technologies de la langue au multilinguisme », Atelier « Multilinguisme, traduction, circulation des œuvres », Etats Généraux du Multilinguisme, Paris, 23 June 2008
- J. Mariani, "Broadening the Coverage, Addressing the Gaps", FLaReNet Forum "Shaping the Future of the Multilingual Digital Europe", Vienna, Austrian Academy of Sciences, 12-13.02 2009
- J. Mariani, « Sharing the effort to produce the needed Language Resources», Parole Workshop "New Horizons for Linguistic Resources in a Global Context", Barcelona, 7-8 July 2009
- J. Mariani, "Introductory remarks", "Getting Less-Resourced Languages on-Board" Special Session, LTC'09, Poznan, 6-8 November 2009
- J. Mariani, "Speech and Language Technologies Frameworks in the European Research Area", Multisaund seminar, Istanbul, 16-18 June 2010
- 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
- J. Mariani, The LT 2020 Vision Paper: The Future European Multilingual Information Society, Multisaund Seminar, Bursa, 13-14 June 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
- K. Choukri, J. Mariani, Z. Vetulani, Addressing the Gaps in Language Resources and Technologies, LTC'2011, Poznan, 25-27.11.2011
- J. Mariani, Multilingualism & LT in India & EU: Similarities, Differences and Collaboration, First Workshop on Indian Language Data: Resources and Evaluation (WILDRE), LREC'2012, Istanbul, 21 May 2012
- N. Calzolari, J. Mariani, A journey from the LRE Map to the Language Matrices and the Language Resource Impact Factor (LRIF), Coco-FLaRe Workshop "Reinforcing International Collaboration on LRE", LREC 2012, 26 May 2012
- J. Mariani, C. Soria, The LR Wiki Survey and the National Contact Points, Coco-FLaRe Workshop "Reinforcing International Collaboration on LRE", LREC 2012, 26 May 2012
- J. Mariani, An historical perspective on Language Resources and Evaluation in Europe, LDC 20th Anniversary Workshop, Philadelphia, 6-7 September 2012
- J. Mariani, G. Francopoulo, Language Matrices and the Language Resource Impact Factor, Parole Workshop, Lisbon, 18-19 October 2012
- S. Rosset, invited talk Open Domain Dialogue System Resources, Workshop on Reinforcing International Collaboration on Language Resources and Evaluation (Coco-FLaRE), Istanbul, May 26, 2012

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
- J. Mariani, Language Technologies in Support to Multingualism, 3rd International Symposium on Multilingualism in Cyberspace (SIMC III), Paris, 21-23 November 2012

INVITED TALK (NATIONAL OR INTERNATIONAL)

- 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
- 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
- P. Boula de Mareüil, invited talk on "Processamento perceptivo e automático de sotaques em francês", INESC, Lisbon, February 13, 2013.

- H. Bredin, Video semantic indexing, DGA workshop on speech, language and multimedia document processing, 2010
- H. Bredin, invited talk on Unsupervised speaker identification in TV broadcast, Télécom SudParis, Orsay, June 11, 2013 and BBC R&D, London, June 25, 2013.
- L. Devillers, invited talk on Affective and social dimension of spoken interactions, JEFP 2012, June 18 2012
- J.L Gauvain, "LIMSI's Activities in Spoken Language Processing," NATO working group, 9th IST-078 meeting, Paris May 5, 2011
- L. Lamel, "Overview of Quaero Speech Processing Activies", NATO working group, 9th IST-078 meeting, Paris May 5, 2011
- 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. Mariani, « Structures de soutien aux technologies pour le multilinguisme », Séminaire DGA/DET/CEP, Paris, 24 June 2008
- J. Mariani, « Vers une infrastructure européenne en soutien aux Technologies de la Langue.», Séminaire DGA/DET/CEP, Paris, 30.06-01.07 2009
- J. Mariani, "Challenges for LT", ICT « Written and Spoken Language Technologies » Workprogram consultation, Luxembourg, November 2009
- 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
- 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, LT2020 Vision: Interactive Systems, in "Strategic Priorities for LT in Europe" Panel, LTC'2011, Poznan, 25-27.11.2011
- J. Mariani, Language Resources and Evaluation for a Multilingual Europe, HLT Workshop, French Month of Science in Estonia, Tallinn, 5-6 June 2012
- J. Mariani, La langue française à l'heure du numérique / The French Language in the Digital Age, Expolangues, Paris, 7 February 2013
- S. Rosset, Named entities at LIMSI, France Telecom Orange Labs, Lannion, 27.11.2011.
- S. Rosset, Corpus Annotation Campaigns and Inter-annotator agreements, from theory to practice. CLLE-ERSS, Toulouse 28.03.2013.
- F. Yvon, "Algorithmic Foundations of Statistical Machine Translation", DGA workshop on Traitement de l'Information Multimédia (TIM'12), june 4th 2012.
- F. Yvon, "Optimisation et évaluation des systèmes de traduction statistique", DGA workshop on speech, language and multimedia document processing, 2011.
- F. Yvon, "Approches Multi-systèmes en traduction statistique", DGA workshop on speech, language and multimedia document processing, 2010.
- F. Yvon, "Une architecture pour le traitement automatique des SMS", invited talk, CENTAL, Univ. Louvain-la- Neuve, 12 nov 2009.
- F. Yvon, Recent Progress in Machine Translation, DGA workshop on speech, language and multimedia document processing, 2009.
- F. Yvon, invited talk on "Statistical Learning in Natural Language Processing, a brief retrospective", IRISA, march 22nd 2013.
- F. Yvon, invited talk on "Méthodes Statistiques en Traitement des Langues, Etat des lieux et Perspectives", Journées TAL, Nancy, jan 15th 2013.
- F. Yvon, invited talk on "Bleu Oracles in Machine Translation, how to compute them, how to use them" at U. Stüttgart (nov 29th 2012) and LORIA, dec 6th 2012.

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 Invited Expert at the « Toplevel researchers Working Session on LT » (Luxemburg, january 2009)
- J. Mariani Invited Expert at the ICT Workprogram consultation « Written and Spoken Language Technologies » (Luxemburg, November 2009)
- J. Mariani Member of the Steering Committee of the FLaReNet Thematic Network (2008-2011)
- J. Mariani Member of the T4ME NoE Management Board (2010-2013)
- J. Mariani Member of the META-NET Technological Council (2010-2013)
- J. Mariani Member of the META-NET Executive Board (2011-)
- J. Mariani Coordinator of the META–Net Interactive Systems Vision Group (2010-2013)
- J. Mariani Member of the META–Net Media and Information Services Vision Group (2010-2013)
- J. Mariani Member of the META–Net Translation and Localisation Vision Group (2010-2013)
- J. Mariani Founding Member of the META-TRUST Association (2012-)
- J. Mariani Invited Expert at the ICT Workprogram consultation « Infrastructures for Human Language Technology Research » (Paris, December 2011)
- J. Mariani Invited Expert at the Horizon 2020 "European Industrial Leadership in ICT » Workshop (Brussels, June 2011)
- J. Mariani Member of the QTLaunchPad Planning Panel (2012-)
- J. Mariani Member of the ROCKIT Roadmap Board (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 (2011-2012,2013-2014)
- P. Boula de Mareuil, L. Devillers, S. Rosset, Scientific committee of the IRCOM (IR Copus Oraux et Multimodaux)
- H. Bredin, GdR-ISIS IRIM[5] coordinator
- L. Devillers GT ACAI Affects, Compagnons Artificiels et Interactions (ACAI), GDR I3, responsible of the axe 2: Detection and synthesis of emotional behavior, annotation and representation from sound, text and image (2012).
- L. Lamel, Gale data committee chair (May'09-May'10)
- J. Mariani Member of the Editorial Committee of the “Ethics and Big Data” Charter (2012-2013)

STRUCTURATION OF RESEARCH

The group provides a strong contribution in the structuration of research at local, national, European and international levels, within a close relationship with the CNRS-UMI IMMI, that was initiated by the group (and this already constitutes a mark of strong international presence) and which includes the participation of several group members. At the national level, the most important contributions concern the management of the national Quaero program, as Scientific Director and Head of the CTC project (J.L. Gauvain) and within the Quaero Integrated Management Team together with Technicolor and DGA, and the creation of the Commission de réflexion sur l'Ethique de la Recherche en Sciences et Technologies du Numérique (CERNA) within the Allistene alliance, following a report coordinated by J. Mariani within the CNRS Ethics Committee (COMETS). At the European level, the group was involved in the Fostering Language Resources Network (FLaReNet) and in the Multilingual Europe Technology Network (META-NET), through the EC T4ME project. It produced the Whitepaper on The French language in the Digital Age, published by Springer, and had a strong participation in the definition of The Strategic Research Agenda for Multilingual Europe 2020 for the Horizon 2020 Framework Program of the European Commission. It initiated and organized several international events on major topics (such as IWSLT10 on Spoken

[5] http://mrim.imag.fr/irim/

Language Translation, IWSDS12 on Spoken Dialog Systems, the Tralogy conference series on MT and Translators, the LREC conference series on Language Resources and Evaluation and the SIMC conference series on multilingualism in the Cyberspace).

PARTICIPATION IN EVALUATION OR EXPERTISE COMMITTEES

NATIONAL COMMITTEES (CONRS, CNU, CCSU…)

- A. Allauzen, C. Barras, H. Bonneau-Maynard, F. Yvon, members of the CCSU, section 27, Univ. Paris-Sud (2010-)
- J.L. Gauvain member of CoNRS, section 07 (2008-2010)
- 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)
- J. Mariani Member of the Allistene Working Group on the Ethics of Research in ICT (2010-2012)
- J. Mariani Member of the Allistene Ethics Committee (CERNA) (2012-)
- F. Yvon, member of CoNRS, section 07 (2012-2013)

EXPERT FOR SCIENTIFIC EVALUATION COMMITTEES

- G. Adda, expert in the International Advisory Panel of Dutch/Flemish Stevin program (2005-2012)
- L. Devillers, expert in the Commission Connaissances of Cap Digital
- L. Lamel ERA-Net CHIST-ERA Evaluation Panel 2012 (Call 2011).
- L. Lamel, External reviewer, IIS, Academia Sinica (tenure promotion)
- L. Lamel, Expert reviewer for European Commission ongoing FP6 Project (2008-2010)
- J. Mariani Member of the Scientific Advisory Board of the Austrian Academy Corpus (2003-2009)
- J. Mariani Member of the International Advisory Board of the FP6 « Intuition » Network of Excellence (2005-2009)
- J. Mariani Member of the NECTEC International Scientific Advisory Panel (Thailand) (2008)
- J. Mariani Evaluation Expert for EC FET (2009)
- J. Mariani Member of the EC High Level researchers in Language Technology Advisory Group (2009)
- J. Mariani Member of the ENSIEE Scientific Committee (2008-2012)
- 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 International Advisory Committee of the MULTISAUND program (Turkey) (2010-2013)
- J. Mariani Member of the ANR CONTINT Project Evaluation Committee (2011)
- J. Mariani Member of the evaluation committee of the CHIST-ERA Intelligent User Interfaces (IUI) program (2013)
- J. Mariani Member of the Loebner Prize 2013 Production Crew (2013)
- S. Rosset, expert in the Commission Connaissances of Cap Digital (2011-)
- F. Yvon, expert for the evaluation of INRIA teams on "Language, Speech and Audio Processing" (2011)

MEMBER OF THE ADMINISTRATION OR ADVISORY BOARD

- L. Lamel, ISCA (International Speech Communication Association) International Advisory Council (2005-2010)
- 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 (2009-2012)
- J. Mariani Member of the OSEO FUI Romeo2 project Societal Committee (2013-)
- 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 Representative of CNRS at the Institut pour la Société Numérique (ISN) Pilot Committee (2012-)
- 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 (2011-2012)
- J. Mariani Member of the Conseil d'orientation des politiques linguistiques dans les Outre-mer, DGLF2 (2013-)
- J. Mariani Member of the organization committee of the DGLFLF-Silicon Sentier “Nouvelles technologies, langue française et langues de France” BarCamps (2012-2013)
- J. Mariani Member of the DGLFLF Pilot Committee of the “Language Resources for the languages of France” study (2012-2013)
- F. Yvon, Member of the scientific Committee of the "Center for New Localisation Generation", Dublin, Ireland (2009-2012)
- F. Yvon, Member of the Programme Committee of DIGITEO Thematic Network, Saclay (2011-)
- F. Yvon, Member of the "Research and Innovation Committee", LabEx Digicosmes, Saclay (2012-)

MEMBER OF SELECTION JURIES

- A. Allauzen, selection committees for associate professor positions (Université d'Avignon et des pays de Vaucluse, 2012 ; Université du Maine, 2013),
- H. Bonneau-Maynard, selection committees for associate professor positions (Université du Maine, 2011 ; Université de Paris Sud, 2012)
- L. Devillers, selection committee for professor positions (UPMC, 2013)
- L. Lamel,Member of the IEEE James L. Flanagan Speech & Audio Processing Award Committee (2006-2009)
- J. Mariani Referee for the IEEE J.L. Flanagan Speech and Audio Processing Award Committee (2009-2010)
- J. Mariani Member of the ISCA Fellowship Committee (2011-)
- S. Rosset, selection committee for associate professor positions (Université d'Avignon et des Pays du Vaucluse, 2013)
- F. Yvon, selection committees for professor positions (Université d'Avignon et des pays de Vaucluse, 2009, 2010; Université de Paris Nord, 2010) and associate professor positions (Université de Nantes, 2011; Université de Paris 1, 2012; CNAM/Cédric, 2012; Université de Paris Sud, 2012; Université Paris-Sud, 2013)
- F. Yvon, expertise of applications for a position of Full Professor, University Basel (2010)
- F. Yvon, expertise of applications for a position of Lecturer, University Helsinki (2012)

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 University Paris-Sud (2008-2013), Telecom ParisTech, École Centrale, and Inalco.
- S. Rosset, courses on dialog systems, Master 2 level at University Paris-Sud.
- F. Yvon, then A. Allauzen, co-head of the speciality IAC (Information, Apprentissage, Cognition) of the Computer Science Master, Université Paris Sud (2010-2013)
- F. Yvon, Member of the council of EDIPS, ED427 (2010-)

THESIS COMMITTEES

- G. Adda (2 committees, 1 as President, 1 as Reviewer)
- C. Barras (6 committees, 1 as President, 2 as co-Director)
- L. Devillers (9 committees, 1 as President, 1 as Reviewer, 2 as Director, 4 as co-Director)
- J.L. Gauvain (4 committees, 1 as Director)
- L. Lamel (12 committees, 6 as Reviewer, 3 as President, 1 as Director, 2 as co-Director)
- J. Mariani (6 committees, 5 as President)

- S. Rosset (9 committees, 2 as Reviewer, 1 as President, 2 as co-Director)
- I. Vasilescu (1 commitee, 1 as Co-Director)
- F. Yvon (30 committees, 16 as Reviewer, 9 as President, 4 as Director)

HDR COMMITTEES

- L. Devillers (1 commitee, 1 as Reviewer)
- J.L Gauvain (3 committees, 2 as President)
- L. Lamel (3 committees)
- J. Mariani (3 committees, 1 as President)
- S. Rosset (1 committee, 1 as President)
- F. Yvon (3 committees, 2 as Reviewer)

DISSEMINATION AND VULGARIZATION

- P. Boula de Mareüil, Interviews for radio shows (RFI, France Inter, RTL...) and daily newspapers (Sud-Ouest, Le Parisien...)
- H. Bredin, Customise your favourite TV show[6], NewScientist, November 2012
- L. Devillers, C. Chastagnol, M. Tahon, Le tour des labos par NAO le robot[7], January 2011.
- J.L. Gauvain, Highlight of some CTC activities, Quaero dissemination event, l'Echangeur, Paris, may 2010.
- J. Mariani, Interview pour les vignettes vidéos des Etats-Généraux du Multilinguisme[8], Ministère de la culture, September 2008
- J. Mariani « Un institut pour naviguer d'une langue à l'autre», Le Journal du CNRS, n°232, May 2009
- J. Mariani « Pour que l'Europe ne soit plus un No man's langue », Plein Sud, July 2009
- J. Mariani « Breaking language barriers», CNRS International magazine n°14, July 2009
- J. Mariani Interview « Traitement de la parole et des documents multimédias: un enjeu défense », Diagonal, DGA/COM, Ministère de la défense, Numéro 215, September 2009
- J. Mariani « Des technologies au service du Multilinguisme », Journal Culture Communication, Ministère de la Culture et de la Communication, November 2009
- J. Mariani, The ESCA Enterprise[9], site Web de l'ISCA, November 2009
- 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[10], préservation et code informatique, Atelier des Médias, Radio France International, 2 février 2012
- J. Mariani, « Quaero et l'automatisation du traitement des documents multilingues et multimédias », Rapport annuel Digiteo 2010, June 2011
- J. Mariani, Au moins 21 langues européennes en danger d'extinction numérique ! Press Release, October 2012
- J. Mariani, Interview sur la Traduction Automatique, SR2 Kulturradio, ARD (Allemagne), 23 October 2012
- J. Mariani, 21 langues menacées d'extinction numérique[11], Journal du CNRS, n° 270, January-February 2013

[6] http://www.newscientist.com/article/mg21628905.300-customise-your-favourite-tv-show.html
[7] http://www.lemonde.fr/week-end/video/2011/04/29/le-tour-des-labos-par-nao-le-robot_1514792_1477893.html
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- J. Mariani, Faciliter l'intercompréhension: une Europe libérée des barrières linguistiques, Press Release, February 2013
- J. Mariani, L'extension du modèle Quaero au niveau Européen[12], Quaero White Paper, March 2013
- J. Mariani, Quelle place pour le multilinguisme dans le cyberespace ?, Interview pour le magazine La Recherche, September 2013

RESEARCH CONVENTIONS AND CONTRACTS

VALORIZATION

- Wmatch: an engine and a framework for language analyzer development (APP)
- Ritel-nca: a French multi-level analyzer developed within the Wmatch framework (APP)
- N-code: an n-gram based SMT toolkit (ncode.limsi.fr)
- Wapiti: a large-scale CRF package (wapiti.limsi.fr)
- Quaero Old Press Extended Named Entity corpus (1.5 million words) distributed through ELRA (ELRA-W0073)
- Quaero Broadcast News Extended Named Entity corpus (1.5 million words) distributed through ELRA (ELRA-S0349) list here Patents protected software and digital works, inventions, license agreements, databases…

INDUSTRIAL RELATIONSHIPS

- EC-FP7 FLaReNet (Fostering Language Resource Network) Thematic Network (J. Mariani, PI for LIMSI) (2008-2011)
- EC-FP7 T4ME (Technologies for a Multilingual Europe) Network of Excellence (J. Mariani, PI for LIMSI) (2010-2013)

[12] http://immi-lists.limsi.fr/IMG/pdf/Livre-Blanc-Quaero-V3-final.pdf

TABLE OF CONTRACTS FOR TLP GROUP

Contracts on public fundings								
	Acronym	Funding agency/ partner	Program	General coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
ANR Basic science & JCJC	PFC-COR	ANR	Blanc	Laks Bernard (Modyco)	Adda-Decker Martine	21/12/2005	20/06/2008	35 075
	OTIM	ANR	Blanc	Blache Philippe (LPL)	Martin Jean-Claude	10/10/2008	30/06/2012	54 916
	VERA	ANR	Blanc	Estève Yannick (LIUM)	Rosset Sophie	01/01/2013	31/12/2015	75 810
	PADE	ANR	JCJC	Rilliard Albert	Rilliard Albert	15/12/2010	30/11/2014	163 513
ANR with industrial partners	GV-Lex	ANR	CONTINT	Gelin Rodolphe (Aldebaran)	D'Alessandro Christophe	15/12/2008	14/06/2012	202 807
	EDyLex	ANR	CONTINT	Sagot Benoit (INRIA)	Adda Gilles	01/11/2009	30/06/2013	181 835
	TRACE	ANR	CONTINT	Le Ny Benoit (Softissimo)	Yvon François	01/11/2009	31/07/2013	205 770
	QCOMPERE	ANR	CONTINT	Barras Claude	Barras Claude	01/11/2010	31/08/2014	90 500
	TransRead	ANR	CONTINT	Yvon François	Yvon François	01/10/2012	30/09/2015	236 222
	DIADEMS	ANR	CONTINT	André-Obrecht Régine (IRIT)	Barras Claude	01/01/2013	31/12/2015	74 708
	MATRICE	ANR	Equipex	Peschanski Denis (CHS)	Gauvain Jean-Luc	22/02/2011	31/12/2017	180 000
	CROTAL	ANR	MDCO	Tellier Isabelle (LIFO)	Yvon François	01/01/2008	31/08/2010	61 144
	AFFECTIVE AVATARS	ANR	RNTL	Devillers Laurence	Devillers Laurence	01/12/2007	31/03/2010	297 704
	ARMEN	ANR	TecSan	Devillers Laurence	Devillers Laurence	01/02/2010	30/07/2013	160 051
Research collaborations	AMADEO	Digiteo	Projet Emergent	Adda-Decker Martine	Adda-Decker Martine	01/10/2007	31/12/2010	99 804
	DISLOG - Chaire H. Ney	Digiteo	Chaire	Gauvain Jean-Luc	Gauvain Jean-Luc	01/04/2010	31/12/2013	426 000
	INFOM@GIC 3	MEFI	Pôle de compétitivité	Gauvain Jean-Luc	Gauvain Jean-Luc	15/12/2007	30/06/2009	137 681
	VOX FACTORY	Région Ile de France	Pôle de compétitivité	Zenouda Gilles (Vocalcom)	Gauvain Jean-Luc	01/01/2009	31/12/2010	297 541
	ROMEO	Région Ile de France	Pôle de compétitivité	Maisonnier Bruno (Aldebaran)	Devillers Laurence	01/01/2009	31/12/2012	209 000
	SAMAR	MEFI	Pôle de compétitivité	Yvon François	Yvon François	04/05/2009	30/10/2012	208 602
	E-therapies	Région Ile de France	Pôle de compétitivité	Devillers Laurence	Devillers Laurence	01/09/2011	31/08/2014	134 776
	RAPMAT	DGCIS	Pôle de compétitivité	Courcinous Sandrine (Vocapia Research)	Gauvain Jean-Luc	01/06/2012	31/05/2014	197 089
	ROMEO2	OSEO	Pôle de compétitivité	Bessière Pierre (Aldebaran)	Devillers Laurence	01/12/2012	30/11/2016	293 308
	QUAERO	OSEO		Gauvain Jean-Luc	Gauvain Jean-Luc	01/04/2008	31/12/2013	7 506 519
	Le Compagnon Numérique	Région Ile de France		Rosset Sophie	Rosset Sophie	11/10/2012	13/06/2013	22 910
	CAMOMILE	EU	Chist-ERA	Barras Claude	Barras Claude	01/10/2012	31/03/2016	230 894
	Analyse de corpus	Université de Radbout		Adda-Decker Martine	Adda-Decker Martine	22/02/2008	21/08/2008	13 000
UE contracts	VITAL	EU	STREP	Rodriguez Tomas	Gauvain Jean-Luc	01/01/2007	30/09/2010	223 132
	FlareNet	EU	TN	Baroni Paola (ILC-CNR)	Mariani Joseph-Jean	01/09/2008	31/08/2011	36 000
	T4ME	EU	REX	Uszkoreit Hans (Univ. Saarlandes)	Mariani Joseph-Jean	01/02/2010	31/01/2013	516 000
Research support	Extension Equipement Quaero	Digiteo		François Yvon	François Yvon	01/09/2011	31/12/2013	300 000
	Computing Platform	Digiteo	Equipement	Gauvain Jean-Luc	Gauvain Jean-Luc	01/07/2008	31/10/2011	1 234 000

Industrial contracts, contracts on private fundings…								
	Acronym	Funding agency/ Partner	Program	General Coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
Non-disclosure agreement		Reverso-Softissimo		Yvon François	Yvon François	08/06/2012	07/07/2015	0
	prêt de corpus	EDF		Gauvain Jean-Luc	Gauvain Jean-Luc	10/05/2010	31/12/2010	0
Research collaborations	SMS	FT		Yvon François	Yvon François	01/10/2007	30/04/2008	18 750
		A2IA		Ney Hermann	Ney Hermann	01/09/2012	30/08/2014	8 040
		XEROX		Yvon François	Yvon François	01/12/2009	30/11/2012	21 000
Prestatinos of services		Vecsys/DGA	PEA	Gauvain Jean-Luc	Gauvain Jean-Luc	01/11/2002	30/09/2013	776 585
		Vocapia Research		Gauvain Jean-Luc	Gauvain Jean-Luc	16/09/2002	03/05/2010	255 000
Licence agreements	prêt de corpus	INA		Gauvain Jean-Luc	Gauvain Jean-Luc	28/02/2002	27/02/2020	0
	prêt de corpus	INA		Gauvain Jean-Luc	Gauvain Jean-Luc	01/05/2009	30/04/2013	0
	SDC	NTU-INL		Lamel Lori	Lamel Lori	27/05/2009	27/05/2020	0
	i2b2 2010	i2b2		Grouin Cyril	Grouin Cyril	01/04/2010	31/03/2011	0
	i2b2 2011	UPMC		Grouin Cyril	Grouin Cyril	01/05/2011	30/04/2012	0
	Corpus émissions TV et radio	ELDA		Barras Claude	Barras Claude	04/11/2011	NC	0
	Corpus CHIL	ELDA		Rosset Sophie	Lamel Lori	06/12/2011	NC	0
	Corpus QUAERO	ELDA		Rosset Sophie	Rosset Sophie	28/12/2011	NC	0
	IWSLT Corpus	NICT		Yvon François	Yvon François	28/12/2011	03/12/2012	0
	Spoken Dutch corpus	ELDA		Lamel Lori	Lamel Lori	02/02/2012	NC	0
	MOBIO Corpus	IDIAP		Barras Claude	Barras Claude	15/02/2012	NC	0
	U-STAR	NICT		Gauvain Jean-Luc	Gauvain Jean-Luc	01/04/2012	01/04/2013	0
	U-STAR	NICT		Gauvain Jean-Luc	Gauvain Jean-Luc	29/03/2013	31/03/2014	0
Other	Google Award	Google		Yvon François	Yvon François	01/01/2011	31/12/2012	78 000
PhD supervision		EPITECH		Devillers Laurence	Devillers Laurence	01/10/2008	30/09/2011	0
		EDF	CIFRE	Rosset Sophie	Rosset Sophie	06/12/2011	05/12/2014	45 000

Patents, software registrations, licence agreements…					
	Software registration (APP)	LIMSI author	Co-authors	Date	Comment
Technology transfer	IDIAL : distributed architecture and integration platform for information and interaction processing	Rosset Sophie	Galibert Olivier	01/06/2013	
	WMATCH (analysis engine for natural language processing) and BDD Ritel (rules, lexicon and gazetteers used by WMATCH) for	Rosset Sophie	Galibert Olivier	01/05/2010	
	Corpus registration (SCAM)	LIMSI author	Co-authors	Date	Comment
	Corpus NCCfr	Adda Decker Martine	Ernestus Myrjiam (Univ. Radbout)	01/04/2009	
	Licence agreements	Resp. for LIMSI	Licensee	Date	Comment
	Non exclusive licence agreement for	Lamel Lori	ELDA	01/11/2008	
	WMATCH software	Rosset Sophie	INRA	01/05/2010	
	RITEL Corpus	Rosset Sophie	LNE	01/06/2010	
	WMATCH software	Rosset Sophie	LNE	01/06/2010	
	WMATCH sofware and RITEL corpus	Rosset Sophie	Apps4Cars	01/11/2011	

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19. Sarkar, A.K., V.B. Le, C.T. Do, A. Roy, C. Barras, L. Lamel, and J.-L. Gauvain. LIMSI/Vocapia speaker verification system for NIST SRE 2012. in The 2012 NIST Speaker Recognition Evaluation (SRE12). 2012: NIST. 4p.
20. Soury, M. and L. Devillers. Collecte de données pour la détection du stress dans les interactions sociales. in Workshop Affects, Compagnons Artificiels et Interactions (WACAI 2012). 2012: Université Paris Sud Orsay.

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 spatialization and 3D audio, spatial hearing, virtual audio, and room acoustics;
- Expressive prosody, including production and perception of emotions, relationships with language and culture, and 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.

Note that 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 and the Mechanics and Energetics Departments. There are a number of active collaborations with the TLP group (expressive prosody, prosody in dialectology), AMI group (haptic- and visual-sound interfaces), CPU group (sound in cognition and interaction), AERO group (voice source, cavity-flows), and VENISE group (virtual acoustics). Moreover, a member of the AA group, N. Delprat, is co-leading the VIDA action and a part of our work (sonic art and virtual materiality) is also presented under this transverse action elsewhere in this report.

RESEARCH ACTIVITIES

TOPIC 1: SOUND & SPACE

B. Katz (head), D. Schönstein (Arkamys), T. Bouchara, G. Parseihian, P. Luizard, L. Pointal, M. Rébillat, C. André (U. Liège), M. Aussal (Digital Media Solutions), D. Poirier-Quinot (EADS-Astrium)

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 HRTFs has been exploited in the thesis work of D. 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.

Along this direction we aimed 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. Illustration 1) show how subjects with good individually matched HRTFs exhibited steady improvement relative to the control group and subjects with bad individually matched HRTFs.

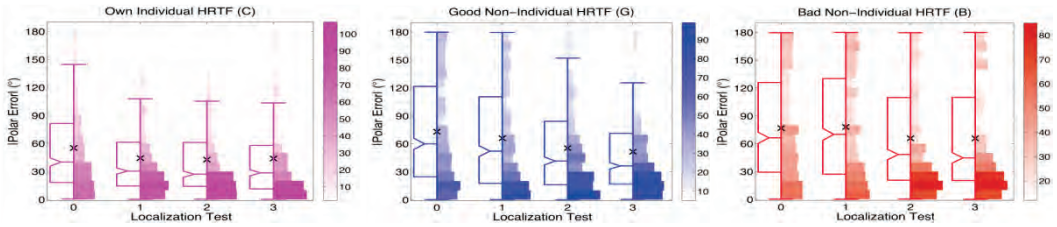

Illustration 1 - Improvement in localization performance through repeated training for the control group (subjects with individual HRTFs), subjects with HRTFs that were a good individual match, and those with HRTFs that were a bad individual match.

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 that 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. While coupled volumes have been present as a design element in a number of performing arts venues over the past decades, the physical behavior 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 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 work concerns fundamental studies in multimodal perception as well as numerous "applied" aspects. It 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 that provides high spatial audio precision without the limitations of previous systems concerning image projection. The system, labeled SMART-I² (cf. Illustration 2), 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 with a priority on the audio rather than visual rendering.

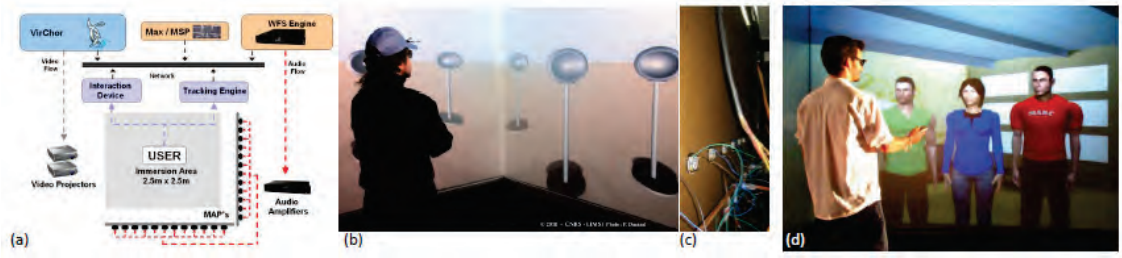

Illustration 2: SMART-I² (a) architecture, (b) view from the user perspective, and (c) rear view of actuators. (d) Virtual characters of the MARC platform (developed by groups AMI and CPU) for real-time affective interaction integrated into SMART-I².

A specific task under consideration concerns video collection 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, extending 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-centered 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) had as 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-centered reference frame. Our main effort in the project, the context of the thesis of Gaëtan Parseihian, concerned the development of sonification strategies related to informative guidance. This work is now being extended towards applications for hands-free guidance of rescue workers.

TOPIC 2: EXPRESSIVE PROSODY

A. Rilliard (head), 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, etc.), as well as to manage the relationship with their interlocutor (social attitudes such as (im)politeness, seduction, etc.). Such strategies are based on the use of specific lexical and syntactic elements, kinetic behavior, 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, Brazilian Portuguese, and American English 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). Second language acquisition is also targeted. 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 (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. Illustration 3). Current works investigate a possible prosodic transfer from Corsican to Corsican French, and its implications on the representation of the Corsican accent in France.

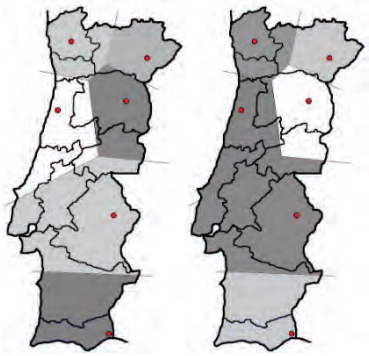

Illustration 3: Examples of dialectometric maps of European Portuguese prosodic variations obtain from 6 dialectal inquiries. Grey scale represents the prosodic distance measured between the white area and another investigation point.

Observed distances confirm the results of a previous perception test measuring the perceived distances between these dialects.

Objective measurements 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 in 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 (head), 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 analyzed 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 analyzed 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.

PERFORMATIVE SPEECH SYNTHESIS: PROSODY AND SINGING VOICE. Performative speech synthesis, i.e. gesture controlled real-time 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 synthesizers 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 analyzed. 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.

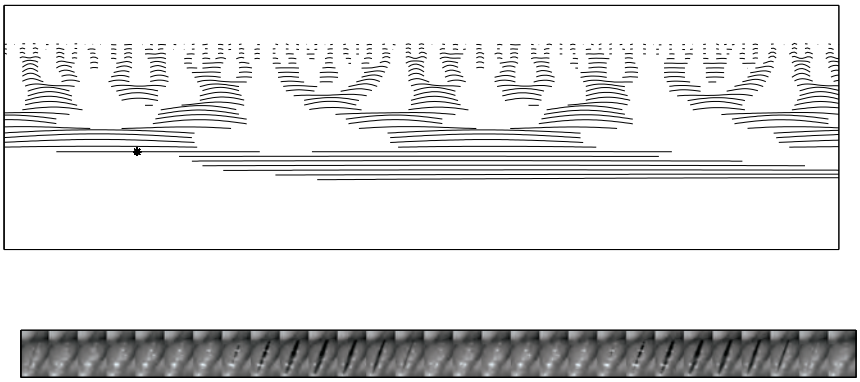

Illustration 4: Wavelet analysis and high-speed video imaging of the glottal vibration.

VOICE SOURCE AND SIGNAL ANALYSIS. Signal processing methods for analysis of expressive speech are developed. We are developing toolboxes for analyzing voice source parameters using different methods like the ZZT, Lines of Maximum Amplitude of the Wavelet transform (see Illustration 4), and 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 visualization of the motion of vocal folds has been studied (glottovibrography) in the framework of an ERASMUS project with Greece. In the framework of the STIC-AMsud program "modeling voice production", we worked on the functioning of vocal folds and ventricular bands using models and numerical simulations.

We proposed a new interpretation of the Rossiter formula used for mode frequency prediction in compressible cavity-flows. The method is based on a so-called modulation analysis approach, initially developed in the domain of audio computing. It has been used to clearly identify secondary components in spectra with complex features and has revealed the existence of a very low-frequency modulation process and its possible combination with the modulation mechanism at the cavity-edge through the recirculating flow. In collaboration with the AERO group, the approach has been applied to spectral data of various incompressible cavity-flows and the coupling between non-linear interactions and modulation mechanisms has been investigated. Additional connections between low-frequency modulations and mode competitions have been highlighted 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.

In the augmented reality field, audio-visual digital augmentation of the pipe organ has been developed since 2008. The pipe organ is equipped with several microphones to capture the internal field sound. These signals are real-time processed and played back in real-time over various loudspeaker networks. A joint audio-visual display also enhances the concert experience (we worked with artist Bernard Planes). This project has a scientific side (virtual reality, audio effects, acoustic display) as well as an artistic side (organ composition, concerts, recordings).

An interdisciplinary project (CLOUD) devoted to the investigation of virtual materiality through the experience of a cloud-avatar has been initiated. The device (M1_ and K1_prototypes) developed at LIMSI offers a new kind of mediation between the user and his/her virtual body, which has the density and dynamical properties of a cloud. This research addresses complex issues related to bodily awareness, self and space relationship, and explores the correlation of audio and visual dimensions in virtual embodied representations. An experimental protocol is currently being tested to characterize the user's bodily sensations and to better understand the role of imaginary aspects in the cognitive loop of action-perception.

Discussion

Despite its relatively modest size, the AA group has developed many collaborations and exchanges with other research groups and companies in the domain of audio, music, speech, and acoustics. It is internationally renowned for its work on voice source and prosody, voice synthesis, 3D audio, and audio augmented and virtual reality.

The central object of study of the AA group, human sound interaction, is by its very nature interdisciplinary. This is reflected by the institutional affiliations of permanent researchers, post-docs, and students in the group: Information science (CNRS section 7), Linguistics (CNRS section 34), Acoustics (CNRS section 9), Mechanics (UPMC). About half of the doctoral students are in the computer science or electrical engineering doctoral schools at Université Paris-Sud, and the other half in the Mechanics and Acoustics doctoral school at UMPC.

However, this richness is also a weakness, as the group is not strongly rooted in a specific department, the consequence being that the group has never benefited from fresh permanent researcher recruitment. This fact also limits the extent to which the research activities can grow and develop in order to better respond to increasing demands.

Highlights

- Chironomic stylization of intonation and performative speech synthesis

- We demonstrate that the melodic movements of speech (intonation) may be reproduced as accurately by voice as by manual gesture (chironomy). This required the development of an original interface (Calliphonie 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 performative (gesture-controlled real-time) 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 vibration actuators on rigid video projection screens.
- Digital augmentation of the pipe organ

We have 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. A CD recording has been released in 2012 and received a very positive national and international feedback, including journals and Internet reviews, including a "5 diapason" award from the musical journal Diapason.

STAFF

PERMANENT STAFF

Last name	First name	Position	Employer	HDR	Group	Arrival date	Departure date
d'Alessandro	Christophe	DR	CNRS	HDR	AA		
Delprat	Nathalie	Ass.Prof.	UPMC		AA		
Doval	Boris	Ass.Prof.	Université Panthéon-Assas		AA		Left on 31/01/2008
Katz	Brian	CR	CNRS	HDR	AA		
Pointal	Laurent	Res. Eng.	CNRS		AA/AMI		
Rilliard	Albert	CR	CNRS		AA		
Sciamarella	Denisse	CR	CNRS		AERO/AA		

NON PERMANENT STAFF

Last name	First name	Contract	Arrival date	Departure date
Audibert	Nicolas	CDD	01/01/2012	31/08/2012
Do	Cong Thanh	Post-Doc	01/11/2011	30/09/2014
Emiya	Valentin	CDD	28/10/2007	08/10/2008
Feugère	Lionel	Post-Doc	01/09/2013	30/07/2014
Le Beux	Sylvain	Post-Doc	01/09/2010	31/10/2011
Lehka-Lemarchand	Iryna	CDD	15/01/2012	14/01/2013
Luizard	Paul	CDD	01/10/2013	30/11/2013
Mariette	Nicholas	Post-Doc	15/04/2008	30/11/2009
Noisternig	Markus	CDD	03/07/2007	31/03/2008
Picinali	Lorenzo	CDD	03/07/2007	30/09/2008
Simon	Laurent	CDD	01/11/2013	31/10/2014

PHD STUDENTS

Last name	First name	Thesis director	Arrival date	Departure date
Greff	Raphaël	Christophe D'Alessandro	01/11/2004	25/11/2008
Lamesch	Sylvain	Christophe D'Alessandro	22/11/2006	28/02/2010
Le Beux	Sylvain	Christophe D'Alessandro	01/10/2005	11/12/2009
Parseihian	Gaëtan	Christophe D'Alessandro	03/11/2008	23/10/2012
Rebillat	Marc	Xavier Boutillon	01/09/2008	17/11/2011
Schonstein	David	Christophe D'Alessandro	02/04/2007	12/09/2012
Sturmel	Nicolas	Christophe D'Alessandro	01/12/2006	15/12/2010

Bouchara	Tifanie	Christian Jacquemin	01/10/2008	29/10/2012
Aussal	Matthieu	Brian Katz	01/10/2011	
Doukhan	David	Christophe D'Alessandro	01/10/2009	
Evrard	Marc	Christophe D'Alessandro	01/01/2012	
Feugère	Lionel	Christophe D'Alessandro	01/12/2009	
Luizard	Paul	Jean Polack	01/10/2010	
Nguyen	Thi Thu Trang	Christophe d'Alessandro	01/09/2010	
Perrotin	Olivier	Christophe d'Alessandro	01/10/2012	
Poirier-Quinot	David	Jean-Paul Sansonnet	15/10/2011	
Rugeles Ospina	Felipe Enrique	Brian Katz	01/11/2012	

INTERNSHIPS

Last name	First name	Arrival date	Departure date	Prepared degree	School / University
Feugère	Lionel	19/02/08	30/07/08	M2R	Université Paris Sud
Rebillat	Marc	01/03/08	29/08/08	M2R	UPMC
Rigaud	François	02/06/08	01/08/08	Master 1	ENS Cachan
Honigman	Ambre	01/04/09	30/09/09	Master 2	Université Paris Nanterre
Luizard	Paul	27/04/09	30/07/09	Master 2	UPMC
Anden	Joakim	12/05/09	20/07/09	M1	UPMC
Karakozoglou	Sevasti Zoi	01/10/09	15/07/10	Master Recherche	Université Paris Sud
Brulez	Johan	26/03/10	24/09/10	3ème année Ingénieur Acoustique	Ecole Centrale de Marseille
Luizard	Paul	19/04/10	30/09/10	M2R	UPMC
Pousse	Julien	08/06/10	08/08/10	1ère année ingénieur	ESIEA
Vidal	Quentin	15/06/10	13/08/10	Ingénieur 3ème année	ESIEA
Muller	Marie	01/07/10	30/09/10	Master 2	ENJMIN
Conan	Simon	28/03/11	23/09/11	3ème année Ingénieur	Ecole Centrale de Marseille
Lelong	Alexandra	02/05/11	29/07/11	Master 1 Physique Appliquée	Université Paris Sud
Baly	Nathalie	14/06/11	14/08/11	3ème année Ingénieur	Université Paris Sud
Debonne	Aimé	14/06/11	14/08/11	4ème année Ingénieur	ESIEA
Le Borgne	Mathias	01/08/11	30/09/11	1ère année ingénieur	Telecom Paris Tech
Pavard	Amélie	12/12/11	31/05/12	Master 1 Psychologie	Université Vincennes
Ajang	Bahman	14/02/12	13/04/12	Master 2 Recherche SETI	EHESS
Herquel	Philippe	01/03/12	31/08/12	Master 2	Université Paris Sud
Fuzellier	Marc	02/04/12	28/09/12	Master 2	UPMC
Hakoun	Aurore	02/04/12	28/09/12	M2	ENSEA
Mahenc	Guillaume	16/04/12	30/08/12	M1	UPMC
Roggerone	Vincent	04/06/12	04/08/12	Master 1	ENS Cachan
Finel	Victor	04/06/12	27/07/12	Master 1	ENS Cachan
Palacin	Baptiste	19/06/12	27/07/12	Master Image & Son	ENS LOUIS LUMIERE
Leblanc-Guindon	Renaud	28/01/13	26/04/13	3ème Année Ingénieur	E.P.F.

INDICATORS OF SCIENTIFIC NOTORIETY

PRIZES AND AWARDS

- B. Katz received the European Acoustics Association: Award for Outstanding Recent Scientific Results Published in Acta Acustica united with Acustica, 2008. (with C. Guastavino, J.-D. Polack, D. J. Levitin, & D. Dubois).
- Marc Rebillat has been awarded the Société Française d'Acoustique "Rocard prize" 2012.
- C. d'Alessandro has been awarded a distinguished lectureship at McGill Université (Montreal, Canada), CIRMMT (Center for Interdisciplinary Reaserch in Music Media and Technology, 2012).
- L. Feugère has been awarded the Société Française d'Informatique Musicale "Science et Musique prize" 2012.

- C. d'Alessandro has been awarded "5 diapason" by the musical magazine Diapason for his Organ and Augmented Reality CD Hortus 096, in February 2013.
- T. Bouchara, B. Katz, C. Jacquemin received the best paper award at the Ergo'IHM2012 conference, Biarritz, France.

EDITORIAL BOARD APPOINTMENT

- C. d'Alessandro is an Associate Editor of the EURASIP Journal on Speech Audio and Music Processing,
- C. d'Alessandro is a member of the editorial board of the Journal of Speech Sciences.
- C. d'Alessandro is a member of the editorial board of the electronic journal Musimédiane (musicology)
- C. d'Alessandro is a member of the editorial board of the electronic "carnet de recherche Science et Voix"
- 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 organized and was the chairman of the International Summer Workshop on Multimodal Interfaces Enterface 2008, held at LIMSI July-August 2008.
- N. Delprat co-organized 2008 the workshop "Simulation technologique et matérialisation artistique", Paris 2009.
- D. Sciamarella coordinated the Regional Program STIC-Amsud, between France and South America.
- C. d'Alessandro has been member of the Local Scientific Committee of the 14th International Conference on Digital Audio Effects, DAFx-11, Paris.
- B. Katz was in the organizing committee of The 2nd International Symposium on Ambisonics and Spherical Acoustics, Paris, France (2010)
- C. d'Alessandro was member of the scientific review committees of many international conferences, including: Int. Conf. Speech Comm. Interspeech 2008, 2009, 2010, 2011, 2013, Pan Europ. Voice. Conf. 2009, Int. Conf. Acoust. Speech, Sig. Proc. ICASSP 2008, 2009, 2010, 2011, 2012, Journ. Inf. Mus. 2012, Int. Conf. Phonetic. Sci. ICPhS2011, P3S 2011, Int. Conf. Digit. Audio Effects DAFx 2011, 2012, 2013, Europ. Sig. Proc. Conf. Eusipco 2009, IALP 2012, Int. conf. Asian Lang. Proc. 2013, ISCA Speech Synth. Workshop. SSW 2008, 2013.

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.
- C. d'Alessandro "Orgue intérieur/orgue extérieur", Journées d'études publiques "arts, sciences et technologies", Simulation technologique et matérialisation artistique, 8-9 janvier 2009, Bétonsalon Paris, France
- C. d'Alessandro, S. Le Beux, A. Rilliard "Towards kinematical modelling of expressive speech prosody: experiments in computerized chironomy" workshop Microgenesis and semiotics of perceptual process, September 25th-26th 2008, Paris, France
- C. d'Alessandro "Prosody as movement in speech and music", workshop Prosody of Expressivity in Music and Speech, Festival Agora, June 17th-18th 2008, IRCAM, Paris, France
- A. Rilliard "Stratégies expressives et variations interculturelles – perception et mesure d'expressions d'(im)politesse", Journées Perception Sonore, 10/11 December 2012, Marseille, France
- A. Rilliard "On the measurement of the perceptive distance of prosodic social affects through its acoustic correlates", Acoustical Society of Japan Monthly Meeting, 9-10 October 2009, Wakayama, Japan
- N. Delprat "Walking Clouds and Augmented Reverie", Workshop Studio Lab Project, Water is in the air, in collaboration with LEONARDO/OLATS, 25-26 June, IMERA, Marseille, 2012

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.
- A. Rilliard "Metodoloxía cuantitativa para a medida das distancias prosódicas" Xornadas de Dialectoloxía Perceptiva, January 17-18 2013, Universidade de Santiago de Compostela, Spain.
- C. d'Alessandro (2008) "New paradigms for speech analysis and processing: the source-filter model revisited and gesture-controlled analysis-by-synthesis", invited tutorial, proceedings of ISCA ITRW, Speech Analysis and Processing for Knowledge Discovery, June 4-6, 2008, Aalborg University, Denmark

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.
- C. d'Alessandro "contrôle gestuel de la voix chantée" Atelier Science et Voix, Grenoble, Février 2013.
- A. Rilliard "Acoustic correlates of prosody: measures, stylization and modifications." Kumamoto University, 8 October 2009, Kumamoto, Japan
- A. Rilliard "The expressive function of prosody: a multimodal and cross-cultural approach" Kumamoto University, 8 October 2009, Kumamoto, Japan

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*), in charge of databases – grouping researchers from more than 10 countries and 30 universities across romance speaking countries across Europe and Latin America.
- B. Katz was a visiting associate professor at Suzuki & Iwaya Laboratory, Tohoku Univeristy, Sendai, Japan in 2009
- D. Sciamarella is responsible for the topic "Biofluidos" at Laboratorio de Fluidodinámica of the Engineering Faculty of Buenos Aeres University, and responsible of the International Associated Laboratory Physics and Fluid Mechanics, LIA/FMF (since 2009).

NATIONAL NETWORKS OR WORKING GROUPS

- B. Katz is an elected member of the Musical Acoustic Committee of the Société Française d'Acoustique, a member of the Technical Committee on Architectural Acoustics of the Acoustical Society of America, and a member of the Spatial Audio Technical Committee of the Audio Engineering Society.

PARTICIPATION IN EVALUATION OR EXPERTISE COMMITTEES

NATIONAL COMMITTEES (CONRS, CNU, CCSU…)

- C. d'Alessandro is member of the CCSU in computer science (section 27), Université Paris-Sud.
- C. d'Alessandro has been a member of the "Comité de spécialistes" in signal processing (section 61), Université 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 has been president of the AERES scientific evaluation committees of STMS/IRCAM (Paris, 2012)
- C. d'Alessandro participated to the AERES scientific evaluation committees of GIPSA-LAB (Grenoble, 2010), STMS/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 (pipe organs and musical instruments), Ministry of Culture.
- C. d’Alessandro is member of the advisory board of the Enterface worshops series.

MEMBER OF SELECTION JURIES

- C. d’Alessandro participated to selection committees in electrical engineering at UPMC (UPMC, 2009, 2010, 2011, 2013), and computer science at Université Paris-Sud (2012) and IRIT (Toulouse, 2013)
- A. Rilliard has been president of a selection committee for recruiting a IT specialist at CNRS (DR20, 2012)

TEACHING ACTIVITIES AND DUTIES IN RELATION TO RESEARCH

- B. Katz taught the audio virtual reality in the computer science master, Université Paris Sud.
- N. Delprat is responsible for the UE transversale "Le son Musical", Licence, UPMC and has been in charge of the project UE "Science et Musique", Licence, UPMC
- B. Katz participated in PhD committees at École Polytechnique, (2011), UPMC (2011), and Aalto University, Finland, (2010)
- C. d’Alessandro participated in PhD committees at Telecom Paris (2008), Université Paris-Sud (2008, 2009, 2009, 2009, 2011, 2011), University of Rennes (2008), KTH, Stockholm (2009), University of Mons, Belgium, (2009, 2011), INSA, Lyon, (2011), Technischen Universität Berlin, (2010), UPMC, (2008, 2009, 2010), University of Grenoble, (2008, 2010, 2013), Aalbord University, Denmark, 2012, University of Bordeaux (2013).
- A. Rilliard participated in a PhD committee at University Grenoble 3 (2008)
- N. Delprat participated in a PhD committee at Université Saint Denis Paris 8 (2008)

DISSEMINATION AND VULGARIZATION

- N. Delprat presented her work at the « Nuit des chercheurs de l'X », 23 sept. 2011, École Polytechnique-Palaiseau, and in the « Fête de la Science en Ile de France », 13 oct. 2011, Créteil
- G Parseihian and B. Katz participated to the “Fête de la Science en île-de-France”, 22-24 oct. 2010, in Orsay.
- C. d’Alessandro participated in the science related television series E=M6 (M6 TV Chanel) twice in 2011.
- C. d’Alessandro played a number of concerts for Organ and Augmented Reality: Festival Science sur Seine (Paris, 2008), opening concert of the European Heritage Day (Lille 2010), Festival “le Paris des Orgues” (Paris 2011), Paris 2013, and released a recording of his work (CD produced by Hortus, 096, 2012)
- The Chorus Digitalis (choir of electronic singers) played many concerts: University of Vancouver (20011), Festival “le printemps des sciences” (Orsay 2012), Science Festival Rennes (2012), NIME conference (Daejeon, Korea, 2013).
- L. Feugère participated in the “science et montagne” association (École Normale Supérieure) program for promoting science to a high school (Lycée) public.
- N. Delprat is co-responsible of transverse action VIDA (see the description in the report).
- The AA group developed a Youtube channel where video demonstrations are available for the general public.

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, and A. Novak 30 Mar 2011 (Updated 08 Feb 2012, Matlab Toolbox)

- Brian Katz is a consultant/collaborator for Kahle Acoustics (Brussels), for modeling and measurements of concert halls.

INDUSTRIAL RELATIONSHIPS

- CIFRE conventions with Arkamys CIFRE (2007-2010), Digital Media Solutions, (2011-2014), EADS-Astrium, (2012-2015)
- Collaboration with Sonic Emotion, Aldebaran Robotics, Orange Labs, Puce-Muse, AND, Vocally. Acapela, Arkamys, Digital Media Solutions, Astrium.

TABLE OF CONTRACTS FOR AA GROUP

Contracts on public fundings

	Acronym	Funding agency/ partner	Program	General coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
ANR Basic science & JCJC	PADE	ANR	JCJC	Rilliard Albert	Rilliard Albert	15/12/2010	30/11/2014	163 513
ANR with industrial partners	CoRSAIRe	ANR	ARA MDMSA	Bourdot Patrick	Bourdot Patrick	06/05/2006	05/11/2009	131 700
	SOUND DELTA	ANR	RIAM	Georges-François David (REMU)	Katz Brian	01/12/2006	30/11/2009	135 507
	2PIM/MI3	ANR	RIAM	De Laubier Serge (Puce Muse)	D'Alessandro Christophe	01/12/2006	30/08/2009	37 411
	CARE	ANR	RIAM	De La Rivière Jean-Baptiste (Immersion)	Martin Jean-Claude	05/12/2007	04/12/2010	93 987
	GV-Lex	ANR	CONTINT	Gelin Rodolphe (Aldebaran)	D'Alessandro Christophe	15/12/2008	14/06/2012	202 807
	NAVIG	ANR	TecSan	Jouffrais Christophe (IRIT)	Katz Brian	01/01/2009	31/10/2012	263 802
Research collaborations	POPAART	CNRS- MAE		Sciamarella Denisse	Sciamarella Denisse	01/01/2005	31/12/2008	6 600
		CNRS	ATIP	Rilliard Albert	Rilliard Albert	01/01/2006	31/12/2008	10 000
	STIC-AmSud	CNRS	Programme STICAmSud	Donzeau-Gouge Véronique (CNRS)	Sciamarella Denisse	01/01/2007	31/12/2009	5 000
	PLOREAV	CNRS	PEPS	Jouffrais Christophe (IRIT)	Katz Brian	01/05/2007	30/04/2009	7 000
	LIA	CNRS		Romat Hubert (PPRIME)	Sciamarella Denisse	01/01/2010	NC	5 850
	OrJo	Région Ile de France	FEDER	De Laubier Serge (Puce Muse)	D'Alessandro Christophe	01/12/2009	30/11/2012	128 000
	ADN-TR	Région Ile de France	Pôle de compétitivité	Guiard Cédric (ADN)	Martin Jean-Claude	01/10/2011	30/09/2014	531 140
	BiLi	OSEO	Pôle de compétitivité	Parmentier Matthieu (France Télévisions)	Katz Brian	01/09/2012	30/09/2016	369 083
UE contracts	INTUITION	UE	NOE	Bourdot Patrick	Bourdot Patrick	01/09/2004	31/10/2008	48 649
	ATRACO	UE	SMCP	Bellik Yacine	Bellik Yacine	01/02/2008	30/07/2011	361 320
Prestations of services	Orgue et Réalité Augmentée	Ville de Lille		D'Alessandro Christophe	D'Alessandro Christophe	01/06/2010	30/09/2010	7 525
	Science sur Seine	Ville de Paris		D'Alessandro Christophe	D'Alessandro Christophe	01/01/2008	30/05/2008	10 000

Industrial contracts, contracts on private fundings…

	Acronym	Funding agency/ Partner	Program	General Coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
Non-disclosure agreements		University of York		Katz Brian	Katz Brian	09/05/2007	08/05/2009	0
	Mesures sur maquettes acoustiques	Kahle Acoustics		Katz Brian	Katz Brian	01/04/2008	30/03/2009	0
	Technologies acoustiques	Sonic Emotion		Katz Brian	Katz Brian	01/02/2009	31/01/2014	0
	Prêt LSE	Arkamys		Katz Brian	Katz Brian	12/01/2010	11/07/2010	0
		DMS		Katz Brian	Katz Brian	10/03/2011	NC	0
Research collaborations	Prototype d'écran haut-parleur	Sonic Emotion		Katz Brian	Katz Brian	03/03/2008	02/09/2013	0
		France Télécom		D'Alessandro Christophe	D'Alessandro Christophe	01/10/2009	30/09/2010	31 740
PhD supervision	CRTF	A-Volute	CIFRE	Katz Brian	Katz Brian	01/12/2004	31/03/2008	36 000
		Arkamys	CIFRE	Katz Brian	Katz Brian	02/04/2007	01/04/2010	44 252
		DMS	CIFRE	Katz Brian	Katz Brian	01/10/2011	30/09/2014	15 000
		ASTRIUM	CIFRE	Katz Brian	Katz Brian	02/02/2012	31/01/2015	39 600
Prestations of services		Philharmonie de Paris		Katz Brian	Katz Brian	01/12/2008	30/01/2009	10 000
		Kahle Acoustics		Katz Brian	Katz Brian	09/02/2009	08/03/2009	2 000

Patents, software registrations, licence agreements…

Technology transfer	Patent	LIMSI author	co-owner	Date	Comment
	Method for selecting perceptually optimal HRTF filters in a database according to morphological parameters	Katz Brian	Arkamys	01/04/2010	PCT international extension
	Software registration (APP)	LIMSI author	Co-authors	Date	
	Limsi spatialisation engine (L S E)	Katz Brian	E. Rio Emmanuel, Picinali Lorenzo	01/07/2010	
	Licence agreement	Resp. for LIMSI	Licensee	Date	
	Licence for the corpus "semantically unpredictable sentences for reception threshold measurement in french"	Katz Brian	ENTPE (Ecole des travaux publics de l'Etat)	02/12/2010	

SCIENTIFIC PUBLICATIONS

DOCTORAL THESES AND HDR

1. Bouchara, T., Comparaison et combinaison de rendus visuels et sonores pour la conception d'interfaces homme-machine : des facteurs humains aux stratégies de présentation à base de distorsion 2012, thèse de l'Université Paris Sud. Soutenue à Orsay, France, le 29 octobre 2012, 196 p.
2. Cadic, D., *Développement rapide de voix de synthèse, algorithmes et évaluation* 2011, thèse de l'Université Paris-Sud. Soutenue à Lannion, France, le 10 juin 2011, 187 p.
3. Greff, R., *Holophonie binaurale - Spatialisation sonore sur réseaux de haut-parleurs circumauraux* 2008, thèse de l'UPMC/LIMSI. Soutenue à Orsay, France, le 25 novembre 2008, 210p p.
4. Katz, B., *« Son & Espace » : Contributions to research concerning sound in space*, 2011, HdR Université Pierre et Marie Curie, soutenue à Orsay, France, le 18 novembre 2011. 220 p.
5. Le Beux, S., *Contrôle gestuel de la prosodie et de la qualité vocale* 2009, thèse de l'Université Paris Sud/LIMSI. Soutenue à Orsay, France, le 11 décembre 2009, 252p p.
6. Parseihian, G., *Sonification binaural pour l'aide à la navigation* 2012, thèse de l'Université Pierre et Marie Curie. Soutenue à Orsay, France, le 23 octobre 2012, 205p p.
7. 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 Palaiseau, France, le 17 novembre 2011, 274 p.
8. Schonstein, D., L' individualisation des indices spectraux pour la spatialisation acoustique: étude perceptive de la variabilité inter-individuelle dans les fonctions de transfert relatives à la tête 2012, thèse de l'Université Pierre et Marie Curie. Soutenue à Orsay, France, le 12 septembre 2012, 261 p.
9. Sturmel, N., *Analyse de la qualité vocale appliquée à la parole expressive* 2011, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 2 mars 2011, 230p p.

ARTICLES IN PEER REVIEWED SCIENTIFIC JOURNALS

1. 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.
2. 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, 2010. **29** (7): pp.833-857.
3. Basley, J., L. Pastur, N. Delprat, and F. Lusseyran, *Space-time aspects of a three-dimensional multi-modulated open cavity flow.* Physics fo Fluids, 2013. **25** (6): pp.064105_1-064105_26.
4. 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.
5. Bouchara, T., C. Jacquemin, and B. Katz, *Cueing multimedia search with audio-visual blur.* ACM Transactions on Applied Perception, 2013. **10** (2): pp.7_1-7_21.
6. 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, 2012. **55**: pp.263-293.
7. Boula De Mareüil, P., A. Rilliard, and A. Allauzen, *Variation diachronique dans la prosodie du style journalistique : le cas de l'accent initial.* Revue Française de Linguistique Appliquée, 2012. **17** (1): pp.97-111.
8. Chisari, N., G. Artana, and D. Sciamarella, *Experimental and numerical study of patterns in laryngeal flow.* Journal of Physics: Conference Series, 2009. **166**: pp.012013_1-012013-7.
9. 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.
10. Contini, M., J. Lai, A. Rilliard, A. Romano, R. Coimbra, and L. De Castro Moutinho, La collaboration scientifique franco-portugaise : une constance dans l'orientation scientifique du centre de dialectologie de Grenoble. Bollettino dell'Atlante Linguistico Italiano, 2008. **III Serie** (32): pp.205-214.
11. 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.
12. 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.
13. 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.
14. 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.

15. Delprat, N., *Low-frequency components and modulation processes in compressible cavity flows.* Journal of Sound and Vibration, 2010. **329** (22): pp.4797-4809.
16. Delprat, N. and C. Jacquemin, *VIDA - Une thématique art-science dans un laboratoire de recherche scientifique.* Technique et Science Informatiques, 2013. **32** (3-4): pp.499-502.
17. 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.
18. Erikson, D., T. Shochi, C. Menezes, H. Kawahara, K. Sakakibara, and A. Rilliard, Nichi eigobogowasha niyoru kanjouonseichikaku no hikaku - kihonshuhasu igai no onkyotekitokusho kara erareru jouhou ni chumokushite. Grammar and Speech VI (in Japanese), 2009. pp.13p.
19. Ferey, N., J. Nelson, C. Martin, L. Picinali, G. Bouyer, A. Tek, P. Bourdot, J.M. Burkhardt, B. Katz, M. Ammi, C. Etchebest, and L. Autin, *Multisensory VR interaction for protein-docking in the CoRSAIRe project.* Virtual Reality, 2009. **13** (4): pp.273-293.
20. 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.
21. Kammoun, S., G. Parseihian, O. Gutierrez, A. Brilhault, A. Serpa, M. Raynal, B. Oriola, M. Macé, M. Auvray, M. Denis, S. Thorpe, P. Truillet, B. Katz, and C. Jouffrais, *Navigation and space perception assistance for the visually impaired: The NAVIG project.* IRBM, 2012. **33** (2): pp.182-189.
22. Karakozoglou, S.Z., N. Henrich, C. d'Alessandro, and Y. Stylianou, *Automatic glottal segmentation using local-based active contours and application to glottovibrography.* Speech Communication, 2012. **54** (5): pp.641-654.
23. Katz, B., F. Dramas, G. Parseihian, O. Gutierrez, S. Kammoun, A. Brilhault, L. Brunet, M. Gallay, B. Oriola, M. Auvray, P. Truillet, M. Denis, S. Thorpe, and C. Jouffrais, *NAVIG: Guidance system for the visually impaired using virtual augmented reality.* Technology and Disability, 2012. **24** (2): pp.163-178.
24. Katz, B., S. Kammoun, G. Parseihian, O. Gutierrez, A. Brilhault, M. Auvray, P. Truillet, M. Denis, S. Thorpe, and C. Jouffrais, *NAVIG: augmented reality guidance system for the visually impaired.* Virtual Reality, 2012. **16** (3): pp.253-269.
25. Katz, B. and G. Parseihian, *Perceptually based head-related transfer function database optimization.* Journal of the Acoustical Society of America, 2012. **131** (2): pp.EL99-EL105.
26. Krebs, F., F. Silva, D. Sciamarella, and G. Artana, *A Three-dimensional study of the glottal jet.* Experiments in Fluids, 2011. pp.1-15.
27. Krebs, F., F. Silva, D. Sciamarella, and G. Artana, *A three-dimensional study of the glottal jet.* Experiments in Fluids, 2012. **52** (5): pp.1133-1147.
28. Mokhtari, A., S. Tabuchi, T. Shochi, and A. Rilliard, A cross-linguistic and cultural comparison of perception for Japanese communication - A contrastive study between Japanese and French. Enseignement du Japonais en France, 2009. **4**: pp.86-94.
29. Noisternig, M., B. Katz, S. Siltanen, and L. Savioja, *Framework for real-time auralization in architectural acoustics.* Acta Acustica united with Acustica, 2008. **94**: pp.1000 -1015.
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33. 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.
34. 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.
35. Rebillat, M., B. Katz, X. Boutillon, and E. Corteel, *Audio, visual, and audio-visual egocentric distance perception by moving subjects in virtual environments.* ACM Transactions on Applied Perception, 2012. **9** (4): pp.19_1-19_17.
36. Rilliard, A., *On the measurement of the perspective distance of prosodic social affects through its acoustic correlates.* Transaction on Technical Committee of Psychological and Physiological Acoustics, The Acoustical Society of Japan, 2009. **39** (6): pp.471-476.
37. Rilliard, A., *La base de données AMPER.* Géolinguistique, 2011. **Hors série n°4**: pp.13-23.
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44. Shochi, T., G. Gagnié, A. Rilliard, D. Erickson, and V. Auberge, *Perception of prosodic French social affects for Japanese learners of French language.* Transaction on Technical Committee of Psychological and Physiological Acoustics, The Acoustical Society of Japan, 2009. **39**.
45. Tabuchi, S., T. Shochi, A. Mokhtari, and A. Rilliard, Nihongo shigenkaiwa niokeru hatuwataido no ninshiki: Nihongobogowasha to kankokujin shokyugakushusha wo taishoni. Grammar and Speech IV, 2009. pp.13p.
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BOOKS & CHAPTERS IN BOOKS

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2. Bianchini, S., N. Delprat, and C. Jacquemin, Simulation technologique et matérialisation artistique - une exploration transdisciplinaire arts/sciences 2012: L'Harmattan. 194p.
3. Boeffard, O. and C. d'Alessandro, *Speech synthesis*, in *Spoken language processing*, J. Mariani, Editor. 2009, John Wiley. pp. 99-168.
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AMI
Architectures and Models for Interaction

JEAN-PAUL SANSONNET

INTRODUCTION

The Research team « 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-ludic activities; expect that these devices will learn to recognize and anticipate upon their on-going and constantly changing needs; and are happy when information is embodied in digital objects which convey attitudes and feelings that help to make that information meaningful. This is the reason why we are working to replace the “key-mouse-window” paradigm with an “in the world” paradigm where a sensual and/or aesthetic experience is important, as is working hands-on with tangible user interfaces to manipulate physical objects, surfaces or spaces. Besides, ambient environments and augmented reality spaces provide the designers of new interfaces with new modalities and new requirements, thus enriching the traditional issues in multimodal interfaces.

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 field which explains why we tend to update our multidisciplinary priorities every two or three years. Consequently the structure of the AMI team has evolved during the period covered by this report. In 2008, AMI was composed of three main topics:

- Topic « Modalities Interaction and Ambient » (MIA) focused on issues dealing with the `physicality' of interactions;
- Topic « Animated Conversational Agents and Virtual Humans » (ACA&VH) focused on issues dealing with the `conversationality' of interactions;
- Topic « Virtuality, Interaction, Design and Art » (VIDA) focused on interdisciplinary exchanges between the new modalities of interactions described above and the domain of Design and Arts, which plays a new and significant socio-economic role in the society.

In 2011, the CHM department of LIMSI underwent a significant scientific evolution, which had an important impact on two AMI topics: 1) the main activity of ACA&VH was transferred to the CPU team, in order to strengthen ties with research in psychology and ergonomics at LIMSI; 2) VIDA was promoted as a LIMSI transversal action, in order to facilitate the participation of researchers from other LIMSI teams in this action. Therefore, a significant part of AMI research work of for the period 2008-2011 is presented in other parts of this document, namely in the topic « Virtual agents and emotions » of the CPU team and in LIMSI’s transversal action VIDA.

This scientific evolution has meant that one of AMI’s professors (J-C Martin, sept 2001) changed groups and joined the CPU team. This departure was counterbalanced by the recruitment of a new professor (N. Sabouret, sept 2012) and the arrival of two assistant professors (F. Bimbard, M. Gouiffès, febr 2013) from team the ACCIS in the IEF laboratory at Paris-Sud University. The new structure of AMI’s research has strengthened AMI’s research focus on Human/Computer interaction, as described in the following presentation of four closely-related topics.

RESEARCH ACTIVITIES

Since 2011, the research of AMI team is composed of four main topics, which capture what we consider a significant evolution in the domain of human/Computer interactions:

- 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 test-bed 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, F. Bimbard, T. Bouchara, H. Ding, S. Fdili Alaoui, M. Gouiffès, A. Hasasneh, C. Jacquemin, A. Osorio, A. Setkov*

The theme “Image” gathers several research fields concerning augmented reality, computer vision, or advanced medical imaging, arts-sciences. Each of them aims at developing new technologies in automatic processing of digital images and improvement of human visual interaction.

The problems addressed in this theme are:

- Use of physics related to vision, camera-projector systems: geometric and colorimetric characterization, color invariance, use of the Human Visual System properties.
- Scene analysis: 1) detection of saliencies, robust features, color, texture, features points and regions, 2) Spatial and temporal matching, tracking, 3) 3D Reconstruction, 4) scene recognition (collaboration with CPU team, P. Tarroux)
- Rendering: geometric and colorimetric adaptation, shaders for real-time calibration, adaptation, and interaction with moving targets or moving cameras.
- Acceleration of the algorithms, Graphic Processing Unit (GPU) programming.

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/

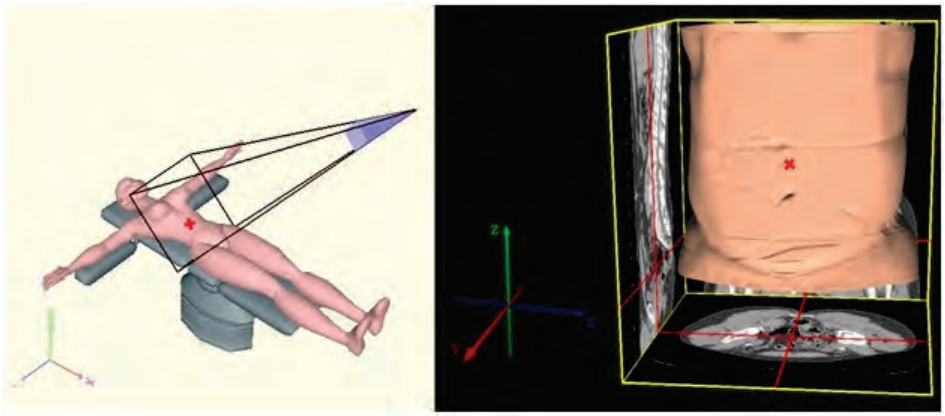

Illustration 1: Projection computation for online surgery helping, a screen capture: the orientation of the projector is computed from the puncture path (displayed right, with CT images for control) and the patient's body inclination (displayed left, with the projector and the entrance point for the puncture).

IMAGE PROCESSING FOR AUGMENTED REALITY AND FOR ROBOTIC VISION.

Image processing for Augmented Reality. For Projector-based 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. In addition to the core calibration issues, Projector-based Augmented Reality raises many challenges in image processing, 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 GPU in order to optimize processing time and make them compatible with real-time interaction.

Concerning calibration and real-time images compensation, research collaboration has been developed with the IEF lab (team ACCIS). Calibration allows rebuilding the physical world geometry and uses it for computing image correction on plane parts of the physical scene. This collaboration was materialized at the end of 2012 by the beginning of Alex Setkov PhD, and the integration of two members (Michèle Gouiffès and Franck Bimbard) of ACCIS in our laboratory. Two projects proposals have been made on this topics: 1) "ANR blanc bilateral" project has been submitted in January 2013, in collaboration with Germany (HU and TUC universities), 2) a Digiteo project "Post-doctorant" (a collaboration with F. Vernier, AMI, and C. Clavel CPU)

Since a few years, cameras and projectors are widely used and are integrated to many electronic devices (smartphones, pico-projectors). Thus, we can now use these technologies in Projector-based Augmented Reality applications. Knowing that the pin-hole model can be applied both to projectors and cameras, we can use these two kinds of devices for 3D reconstruction and 3D tracking. To do so, we have to calibrate the devices. For this purpose, since 2012, we are working on the two following problems:

- Calibration of cameras and projectors using seen and projected calibration grids;
- Self-calibration of cameras and projectors only based on correspondences between seen and projected images.

As calibration algorithms are widely used and developed since many years for cameras, we are working on projectors calibration, which requires new image processing algorithms to be reliable despite the physical problems inherent to these devices (luminosity, …). Once the calibration is done, we can compute 3D reconstruction by using classical algorithms based, for example, on the essential matrix.

In addition, we optimize and/or adapt the previous algorithms for several architectures such as CPU/SIMD and GPGPU. This point is really important in order to be able to use these algorithms in real-time applications.

Our researches concerning Projector-based Augmented Reality are 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.

Four PhD are 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. Tifanie Bouchara is developing comparative analysis methods for visual and auditory perceptions in audio-graphic scenes. The PhD has been defended in October 2012. Sarah Fdili Alaoui PhD proposes new perspectives for gesture interaction using the whole body and motion analysis in collaboration with IRCAM. Her PhD has been defended in December 2012. A. Setkov has started his PhD in 2012. He is currently working on color and geometric invariance for feature matching applied to camera-projector systems.

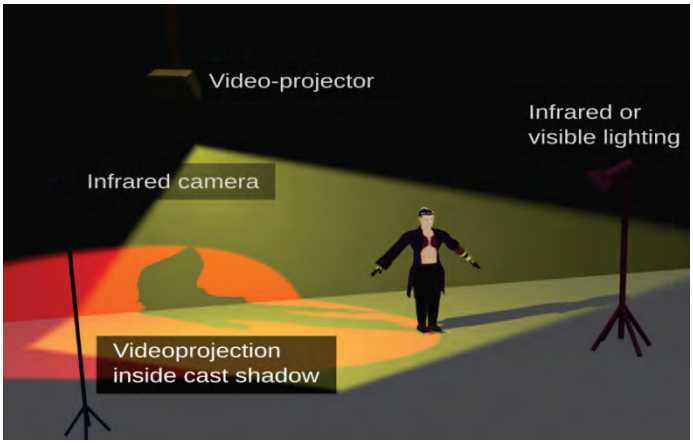

Illustration 2: PICRI project "Toute la lumière sur l'ombre", in collaboration with didascalie.net and "L'ange Carasuelo" companies and with Taverny's library "Les Temps Modernes": real-time image processing for video-projection inclusion in shadows or in a silhouette captures.

Image Processing and Robotic Vision. This theme is the object of collaboration with members of the CPU group of the LIMSI (detailed in Topic 1 of CPU group presentation). The PhDs of Ahmad Hasasneh and Mathieu Dubois concerned the development of machine learning methods for semantic place recognition and robot localization. Both PhD have been defended in 2012, and researches concerning these topics continue through a collaboration with Philippe Tarroux (CPU).

DETECTING SALIENCIES IN IMAGES SEQUENCES. HDRI (High Dynamic Range Imaging) techniques are used to produce dynamic and well-contrasted images of real-world luminance, by capturing several images of the same scene through exposure bracketing. In the same vein, we have developed a new approach to image fusion from a series of photographs of the same scene taken at different timestamps. When compared with HDRI, exposure bracketing at a single timestamp is replaced by timestamp variation disregarding exposure times. Because of the parallel between these two approaches, this technique is called HTRI (High Time Range Imaging), it aims at capturing ephemeral events occurring over a long time period during which a sequence of images is shot. For each pixel location, the most salient colors are privileged in the series of photographs. The choice of the saliency criterion is based on an analysis of the existing admitted definitions of visual attention. In a second stage, a higher priority is assigned to the pixels with high temporal saliency, i.e., which appear very briefly in the sequence, jointly producing spatial and temporal changes of contrast between two successive frames. The proposed algorithm captures all these salient objects in the final image, without introducing a significant amount of noise, and despite the large illumination changes that may occur in the acquisition conditions from one frame to the next. This method has been published in a journal paper in 2013.

TOPIC 2: AMBIENT AND INTERACTION

Y. Bellik, *D. Béroule, A. Gharsellaoui, A. Mohamed, G. Pruvost, J.P. Sansonnet, N. Sabouret, 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, etc. 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 modeling 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 people's comfort and well-being in future ambient environments. One of the major issues is the global acceptability of such systems, which raises the question of the nature of the relationships 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 two main directions:

1) Context and semantics for intelligent ambient systems: any ambient system should support a function of assistance along two main modes a) Implicit assistance is not prompted by users but is integrated as a behind-the-scene capability, intended to make interaction more comfortable. To do that, the ambient system must understand the context of the interaction with the user. Hence, we have proposed a semantic service orchestration model for cooperation between intelligent agents, which takes into account contextual information in the ambient system. b) Explicit assistance is triggered by user's requests, often expressed in spoken natural language. This results in conversational situations, between a user and an assistant agent. they are defined according to the role endorsed by the agent: presenter, teacher, coach etc. In order to increase the acceptability factor of these assistants, we have defined a framework enabling them to endorse a role and a personality that is expressed in terms of influence operators over the rational decision making process controlling the conversations.

2) Personification of ambient systems: it is based on the hypothesis that providing an ambient with human-like behaviors can increase the bond with users. This presupposes that users can perceive and categorize such behaviors when they are expressed by the ambient system, through its output modalities for example. We have proposed a first model for the expression of character cues through ambient output modalities and we have defined a model for natural language interaction that focuses on the expression of emotions and traits in abstract entities (in relation with work in social informatics). Aimed at the longer-term, a neurobiological model of decision-Making has been designed, in which the system choices depend on its experience of emotional states.

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 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 of 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 doing so 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 is confidence in the solidity, mutual respect and reciprocity of social relationships built up? We consider that appropriate linguistic behavior in a flow of conversation is crucial and are studying how words can trigger confidence reinforcement mechanisms in ambient systems.

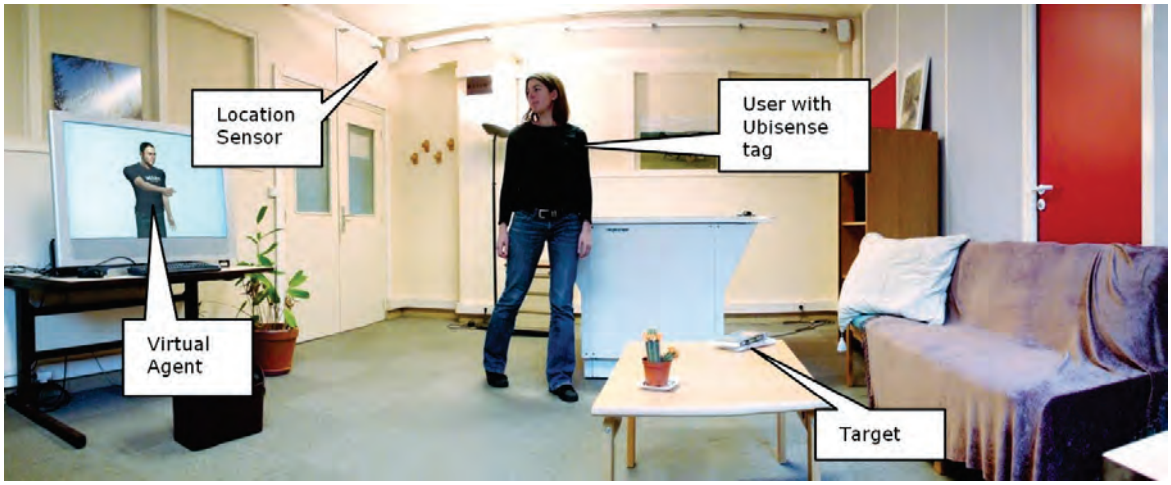

Illustration 3: An experiment conducted in the IRoom (Intelligent Room) in collaboration with the "Conversational Agents" research topic of group CPU. Users and objects are tracked thanks to the Ubisense location system. Users had to find some objects disseminated in the IRoom with the help of a virtual 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 behavior 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, Y. Tsalamlal.*

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, as well as the use of the haptic channel for the interpersonal communication. We can summarize our research in four main axes.

CHARACTERIZATION OF ABSTRACT ENVIRONMENTS. This research begins with a first collaboration with the mechanics department of the LIMSI lab for the perception of CFD data. Several haptic rendering algorithms were developed according various constraints of CFD data (discontinuities, variation of gradient, etc.). Afterward, we propose to develop a complete approach for the analysis Eulerian structures in complex flow including several vortices. Based on this first experience, we propose a Digiteo project (FLUCTUS, Digiteo) aiming to accelerate 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. After exploring the role of haptics for the perception and manipulation of complex molecular structures, we propose to investigate the role of haptics for the coordination of actions of several users during collaborative manipulations of molecular structures. The objective was 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, 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 began 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 define one haptic expression for each investigated emotion. These haptic expressions were combined with visual expressions to study the complementarity 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, HumanTouch/Digiteo).

LEARNING WITH HAPTICS. This axis includes several collaborations which aim to develop learning platforms for undergraduate students and disabled people. First, we collaborate with the mechanics department of the LIMSI Lab to design a learning platform for dynamic systems (e.g., pendulum). The proposed approach aimed to 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 a colleague working at IUT d'Orsay was initiated to study and design a learning platform for blind people. This platform concerns the study and exploration of electronic circuit with the haptic channel.

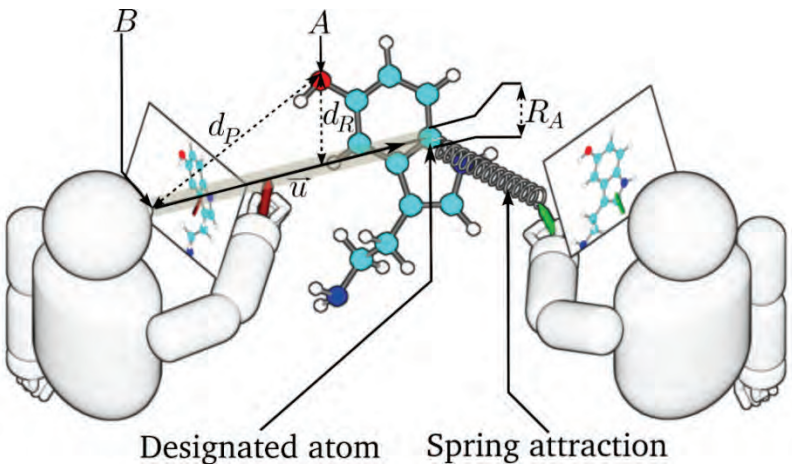

Illustration 4: Collaborative Metaphor for Haptic Pointing: Based on the image–plane pointing technique and a spring–time attraction model, we propose to guide physically the partner to the designated target. Experiments were carried out in the context of a molecular deformation procedure and according 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 the first prototype generates 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. These pioneering works on hardware lead nowadays to a very rich work on software to take advantage of the new possibilities offered.

At LIMSI, the theme "Interaction on Tactile Surfaces" includes many works in this area that we can organize in three categories. First, our approach questions 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. Illustration 5-a shows for instance a context menu that can be pulled after being triggered. The second axis of our approach is then to seek new forms of interaction based on the extraordinary potential of multi-touch inputs (richness, ease of learning, etc.). Illustration 5-b shows for instance how multitouch input can be naturally mapped to the complex manipulation of fisheye lens. Finally, we look forward, like many colleagues of the community, for application domains to encounter a hit with users (game, architecture / urban planning, map making, brainstorming, etc.). Illustration 5-c 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: Left) A re-rootable context menu Middle) Multitouch input for the complex manipulation of fisheye lens; right) 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 work on bigger and higher resolution tabletops 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

- Creation and animation of the GDR I3 workgroup on Animated Conversational Agents (GT ACA).
- AMI is the group that gave rise to the VIDA action (see VIDA transversal theme).
- Implementation of an experimental platform, IRoom (Intelligent Room, Digiteo project), to study ambient intelligence. The IRoom served to conduct different user studies by different groups of the Lab.
- Definition of a model (DAME) for distributed multimodal interfaces in ambient environments. DAME was developed in the context of the ATRACO European project and was validated in the IRoom.
- Collaboration with artists in the OSEO project « Haptic Channel » to implement a haptic telepresence platform for emotions communication in the framework of Futur en Seine 2011.
- Production and enrichment of tools dedicated to clinical diagnosis, through filtering, segmentation, tracking and 3D reconstruction (PTM3D, WSAM and Scot).

STAFF

PERMANENT STAFF

Last name	First name	Position	Employer	HDR	Arrival date	Departure date
Ammi	Mehdi	Ass.Prof.	Université Paris Sud			
Bellik	Yacine	Ass.Prof.	Université Paris Sud	HDR		
Béroule	Dominique	CR	CNRS			
Bimbard	Franck	Ass.Prof.	Université Paris Sud		Hired as of 01/04/2013	
Castaing	Marie-Françoise	Res. Eng.	CNRS			Left on 06/04/2008
Frenoux	Emmanuelle	Ass.Prof.	Université Paris Sud			
Gouiffès	Michèle	Ass.Prof.	Université Paris Sud		Hired as of 01/03/2013	
Jacquemin	Christian	Prof.	Université Paris Sud	HDR		
Osorio Sainz	Angel	DR	CNRS	HDR		Retired on 30/08/2012
Sabouret	Nicolas	Prof.	Université Paris Sud		Hired as of 01/09/2012	
Sansonnet	Jean-Paul	DR	CNRS	HDR		
Turner	William	Res. Eng.	CNRS			
Vernier	Frédéric	Ass.Prof.	Université Paris Sud			

Pointal	Laurent	Res. Eng.	CNRS			

NON PERMANENT STAFF

Last name	First name	Contract	Arrival date	Departure date
Besacier	Guillaume	Post-Doc	01/09/2010	30/09/2011
Ding	Hui	Post-Doc	01/10/2013	31/08/2014
Eyharabide	Maria Victoria	CDD	02/08/2010	31/08/2012
Fang	Xianyong	Post-Doc	01/08/2007	31/07/2008
Fdili Alaoui	Sarah	Post-Doc	20/12/2012	31/07/2013
Garcia-Flores	Jorge	CDD	01/02/2010	30/04/2012
Garnier	Laurent	CDD	01/07/2009	30/11/2009
Monjaux	Perrine	Post-Doc	01/02/2008	31/01/2009
Munsch	Vincent	CDD	01/11/2013	31/12/2013
Pointal	Elisabeth	CDD	17/10/2011	31/12/2013
Rebai	Issam	Post-Doc	01/04/2008	31/03/2010
Simard	Jean	Post-Doc	16/12/2011	31/08/2012

PHD STUDENTS

Last name	First name	Thesis director	Arrival date	Date of defense
Ajaj	Rami	Christian Jacquemin	01/10/2006	16/11/2009
Besacier	Guillaume	Michel Beaudouin-Lafon (LRI)	01/10/2006	09/09/2010
Bouchet	Francois	Jean-Paul Sansonnet	01/10/2006	09/12/2009
Chaboissier	Jonathan	Yacine Bellik	01/10/2008	20/12/2011
Dahdouh	Sonia	Angel Osorio Sainz	01/10/2007	23/09/2011
Fdili Alaoui	Sarah	Christian Jacquemin	01/10/2009	19/12/2012
Hasasneh	Ahmad	Philippe Tarroux	02/11/2009	23/11/2012
Leray	David	Jean-Paul Sansonnet	01/10/2005	17/12/2009
Nauroy	Julien	Angel Osorio Sainz	01/10/2006	09/12/2010
Pham	Huynh-Phong	Philippe Tarroux	02/05/2007	31/03/2010
Pruvost	Gaëtan	Yacine Bellik	01/09/2008	11/02/2013
Simard	Jean	Philippe Tarroux	01/10/2008	12/03/2012
Bouchara	Tifanie	Christian Jacquemin	01/10/2008	29/10/2012
Ding	Hui	Christian Jacquemin	01/11/2009	
Gaffary	Yoren	Jean-Claude Martin	01/10/2011	
Gharsellaoui	Asma	Yacine Bellik	01/10/2011	
Girard	Adrien	Yacine Bellik	01/10/2010	
Gueniat	Florimond	François Lusseyran	01/10/2010	
Mohamed	Ahmed	Yacine Bellik	01/11/2009	
Perin	Charles	Jean-Daniel Fekete (INRIA Saclay)	01/10/2011	
Setkov	Aleksandr	Christian Jacquemin	01/10/2012	
Tsalamlal	Mohamed Yacine	Jean-Claude Martin	01/10/2012	

INTERNSHIPS

Last name	First name	Arrival Date	Departure Date	Prepared degree	School / University
Marty	Agathe	03/03/08	29/08/08	Master 2	Université René Descartes
Azizi	Asmaa	03/03/08	30/09/08	M2R	Université Marne la Vallée
Chaboissier	Jonathan	10/03/08	30/09/08	M2R	Université Paris Sud
Barzaj	Yasmin	01/04/08	30/09/08	M2R	Université Paris Sud
Khatiwada	Rohita	01/04/08	01/10/08	M2R	Université Paris Sud
Bernies	François	01/05/08	31/07/08	2ème année Ingénieur	IFIPS

Wu	Han	01/10/08	29/03/09	1ère année ingénieur	IFIPS
Favier	Mathilde	16/02/09	30/09/09	Master 2	Paris Est Créteil
Wang	Yun	16/02/09	16/09/09	Master Recherche CAM	ENSAM Paris
Ben Youssef	Nadia	01/03/09	30/06/09	Master Informatique	Université René Descartes
Chan	Wai-Kit	01/04/09	31/07/09	3ème Année Ingénieur	Université Marne la Vallée
Gaffary	Yoren	04/06/09	03/09/09	Master Informatique	Université Paris Sud
Gaffary	Yoren	08/01/10	31/05/10	Master 1	Université Paris Sud
Cornuet	Nicolas	13/01/10	13/05/10	Master 1 Informatique	Université Paris Sud
Cornuet	Nicolas	13/01/10	13/05/10	Master 1	Université Paris Sud
Girard	Adrien	22/03/10	10/09/10	Master 2	ISTIA
Wu	Han	06/04/10	06/08/10	M2 Recherche Informatique	Université Paris Sud
Bonnet	David	14/06/10	30/07/10	M2 Recherche Informatique	Université Paris Sud
Dai	Da	11/10/10	31/01/11	1ère année ingénieur	Polytech
Perin	Charles	31/01/11	01/07/11	Master Recherche Informatique	Université Rennes
Gaffary	Yoren	07/03/11	07/07/11	Master 2	Université Paris Sud
Wu	Han	18/04/11	30/09/11	M2 Recherche Informatique	Université Paris Sud
Marcon	Jean-Charles	16/05/11	02/09/11	M1	Université Paris Sud
Whannou De Bravo	Vincent	11/07/11	11/09/11	Master 1 Informatique	Université Paris Sud
Jacquemot	Julien	18/07/11	26/08/11	2ème année Ingénieur	Ecole Polytechnique
Chalbi	Amira	13/01/12	31/05/12	Master 1 Informatique	Université Paris Sud
Kassa	Walid	13/01/12	31/05/12	Master 1 Informatique	Université Paris Sud
Issartel	Paul	13/01/12	31/07/12	Master 1 Informatique	Université Paris Sud
Vincent	Matthias	13/01/12	31/05/12	Master 1 Informatique	Université Paris Sud
Lu	Jiaming	23/01/12	31/05/12	Master 1 Informatique	Université Paris Sud
Ben Messaoud	Fida	01/04/12	31/08/12	Master 2	Université Paris Descartes
Itoudj	Hamid	01/04/12	30/08/12	Master 2	UPMC
Amghar	Nassim	11/01/13	15/05/13	Master 1 Informatique	Université Paris Sud
Christophe	Julien	11/01/13	15/05/13	Master 1	Université Paris Sud
Issartel	Paul	05/03/13	06/09/13	M2	Université Paris Sud
Belkaid	Marwen	01/04/13	31/08/13	Master	ENSEA
Stratigi	Kalliopi	02/04/13	31/08/13	M2 Informatique Interaction	Université de Crête
Prokopiou	Ioannis	02/04/13	31/08/13	M2 Informatique Interaction	Université de Crête

INDICATORS OF SCIENTIFIC NOTORIETY

PRIZES AND AWARDS

Best paper awards:

- Sansonnet J. P., Modeling relational reactions in conversational topics, WACAI-12, pp 119-126, Grenoble, France, 2012
- Bouchet F., Sansonnet J. P., Influence of personality traits on the rational process of cognitive agents, 2011 IEEE/WIC/ACM International Conferences on Web Intelligence and Intelligent Agent Technology, pp 81-88, Lyon, France, 2011
- 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, 2010

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 2013.
- Ch. Jacquemin is Co-editor of a special issue of TSI "Art et Informatique" (to appear June 2013)
- J-P. Sansonnet is member of steering committee of national RTSI journals, 2008-2012
- J-P. Sansonnet is member of committee of national TSI journal, 2008-2012
- J-P. Sansonnet is member of scientific board of international journal Scientia, 2008-2013

- J-P. Sansonnet is member of scientific board of international journal JACR 2012
- 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
- M. Ammi is session chair of Joint Virtual Reality Conference, 2012M. Ammi is session chair IEEE Symposium on Haptic Audio Visual Environments and Games, 2011
- Y. Bellik is tutorials Co-Chair of IHM’09, 21ème conférence francophone sur l'Interaction Homme-Machine, 2009, Grenoble.
- Ch. Jacquemin is co-organizator of the workshop Audio-graphic Modeling and Interaction at NIME 2011
- Ch. Jacquemin is co-organizator of conference “Simulation technologique et matérialisation artistique” with Samuel Bianchini and Nathalie Delprat at Bétonsalon, 2009
- J-P. Sansonnet is president of scientific committee of national conference JFSMA’11
- J-P. Sansonnet is president of scientific 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

MEMBER OF PROGRAMME COMMITTEE IN INTERNATIONAL CONFERENCES AND WORKSHOPS:

- M. Ammi is reviewer of conferences IEEE ICRA, IEEE IROS, IEEE VR, ACM VRST, IEEE Haptics, WordHaptics, Eurohaptics, etc.
- Y. Bellik is reviewer for INTERACT 2013, CHI 2013, EICS 2013, IHM 2013, ERGO-IHM 2012, INTERACT 2011, IHM 2011, IHM 2010, EICS 2009.
- Y. Bellik is member of the program committee for the 4th Workshop on Speech and Language Processing for Assistive Technologies (SLPAT 2013), August 21-22, Grenoble, 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), during UBICOMP 2012, 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 (Sunway campus), 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.
- Y. Bellik is member of the Poster Program Committee of UBICOMP 2009, 11th International Conference on Ubiquitous Computing, Orlando, Florida, 30th September- 3rd October 2009.
- Y. Bellik is member of the international program committee of IE08, 4th International Conference on Intelligent Environments, 21—22 July 2008, Seattle, USA.

- Y. Bellik is member of the international scientific committee of PIT08, 4th Tutorial and Research Workshop on Perception and Interactive Technologies for Speech-Based Systems, Kloster Irsee, Germany, 16-18 June 2008.
- Ch. Jacquemin is reviewer of journals: TSI, Computers in Entertainment, Journal on Multimodal User Interfaces
- Ch. Jacquemin is reviewer and member of program Committees of conferences: ACM Multimedia 2009, 2010, 2011, 2012, IHM 2010, H2PTM 2011, SmartGraphics 2009, 2010, 2011, Web3D 2011, 2013, Workshop on Vision, Modeling and Visualization 2011, DaFx 2011, Computer Art Congress 2012, ACM Multimedia 2013 (long papers, shor papers & doctoral consortium), CHI Interactive 2013, H2PTM 2013, Mirage 2013, Laval Virtual 2013
- F. Vernier is member of scientific board of the 6th conference on Interactive Tabletops and Surfaces, Cambridge, USA 11-14 nov 2012

MEMBER OF PROGRAMME COMMITTEE IN NATIONAL CONFERENCES AND WORKSHOPS:

- Y. Bellik is member of the scientific committee of the Summer School on Ambient Intelligence, 06-10 juillet 2009, Villeneuve d'Ascq, France.
- W. A. Turner is member of the program committee of conference “Ingénierie des Connaissances”, Nimes, June 2010

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, Forum "Systèmes & Logiciels pour les NTIC dans le Transport: Intelligence Ambiante" de l’INRETS, 19 mai 2009.
- Y. Bellik, Journée Mondiale des Handicapés, Alger, Dec 3, 2009.
- Ch. Jacquemin, IMAL on “ activités arts/sciences ”, Bruxelles, 2009
- Ch. Jacquemin, La Maison Populaire de Montreuil on “les cultures digitales ”, 2009
- Ch. Jacquemin, e-Magiciens, Valenciennes, 2009
- Ch. Jacquemin, Le Dansoir (Karine Saporta), 2008

TUTORIAL AT WORKSHOPS OR CONFERENCES OR SUMMER SCHOOLS

- Y. Bellik, “Interaction Multimodale et Applications au Handicap Visuel”, International Workshop IHM 2012, Sousse, 15-18 Juin 2012
- J-P. Sansonnet, “Agents Conversationnels dans l'Internet”, at summer school on Web Intelligence, Lyon, july 8-10, 2010

INVITED TALK (NATIONAL OR INTERNATIONAL)

- Ch. Jacquemin, Conference Siggraph Finland Helsinki, 2008
- Ch. Jacquemin, Conference CLIC on “patrimoine numérique”, 2010
- J-P. Sansonnet, “Intelligent Virtual Agents in the Internet”, at Laboratory LITIS, Rouen, june 3, 2010

PARTICIPATION IN EXPERTISE AND ADMINISTRATION OF RESEARCH

INTERNATIONAL OR NATIONAL SCIENTIFIC NETWORKING

INTERNATIONAL NETWORKS

- M. Ammi is 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 Special Interest Group on Non-Visual Interaction (ACM SIGCHI).
- Y. Bellik is member of the Pervasive Adaptation Research Network (PerAda).

- Y. Bellik is member of the FOCAS (Fundamental of Collective Adaptive Systems) coordination action.
- 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)

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 MdT (Modèles de Tâches) working group of AFIHM (Association Francophone d'Interaction Homme-Machine).
- Y. Bellik is member of the CESAME working group, "Conception et Evaluation de Systèmes interactifs Adaptables et/ou MixtEs", working group of GDR-I3.
- N. Sabouret is co-animator of the working group "Agents, Companions, Affects, Interaction" (GT ACAI) of GDR I3, 2013--
- J-P. Sansonnet is co-animator of the working group "Animated Conversational Agents" (GT ACA) of GDR I3 (2006-2012).
- Ch. Jacquemin is member of the steering committee of "La Diagonale Paris-Saclay", pôle d'activités de médiation et de collaborations arts/sciences 2010 --
- Ch. Jacquemin is member of the network "Art Numérique", Enghien les Bains, 2007-2013

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
- W. A. Turner is president of CNRS Jury for "BAP 5 concours interne, Ingénieur de Recherche", 2012
- E. Frenoux is member of CCSU 27 of Paris-Sud University, 2008-2013

Expert for scientific evaluation committees

- N. Sabouret is expert for the CONTINT (Contenus et interactions) program of the ANR, 2013
- J-P. Sansonnet is co-evaluator for AERES (LISTIC lab, Annecy), 2010
- Most members are experts for various ANR programs.

Member of the administration or advisory board

- J-P. Sansonnet is president of the scientific committee of Cluster ISLE of région Rhône-Alpes, 2008 - 2011
- J-P. Sansonnet is member of the scientific committee of Supélec (section computer science), 2010 - 2013

Member of selection juries

- M. Ammi was member of the selection committee for the position MCF n° 4027 of Université Evry Val d'Essonne, 2012, for the position MCF n° 14140 of , University of Pierre et Marie Curie, 2013
- Y. Bellik is member of the selection committee for the position MCF n° 1356 of Univ. Joseph Fourier, Grenoble, 2010, for the position MCF n° 1356 of Univ. Joseph Fourier, Grenoble, 2010, for the position MCF n° 1690 of Université Paris-Sud, Orsay, 2010, for the position MCF n° 1643 of Université Paris-Sud, Orsay, 2009
- Y. Bellik is member of the selection committee for the PRAG positions of IUT d'Orsay, 2009 and 2010.
- E. Frenoux is member of the selection committee for the position MCF n°4160 Polytech'Paris-Sud, Orsay, 2013
- Ch. Jacquemin is member of CCSU 18 of University Marne-La-Vallée 2013

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
- M. Ammi is in charge of the 5th year of the Cooperative engineering computer program at Polytech'Paris-South.
- Y. Bellik is head of the Human-Machine Interaction course at Supélec engineer school, 3th Year
- Y. Bellik teaches in Master 2 of computer science research (Interaction) of Paris-Sud (Head of option: Interaction multimodale Intelligente)
- E. Frenoux is head of the "formation ingé 4 informatique" at Polytech'Paris Sud, 2007-2012 (in collaboration with A. Max)
- E. Frenoux is head of the "formation ingé 3 informatique" at Polytech'Paris Sud, 2007-2012 (in collaboration with A. Max)
- E. Frenoux is head of formations at Polytech'Paris sud: "Informatique Graphique", ingé 3 informatique, 2006-2013, "Programmation Objet, C++", ingé 4 informatique, 2006-2013.
- Ch. Jacquemin is head of formation « Rendu Graphique Avancé » Master 2 professional and Master research of Paris-South, 2004-1013
- 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
- Ch. Jacquemin is member of the Steering Committee of the Doctoral School in Computer Science at University Paris-South (2010-)
- N. Sabouret is vice-director of the Computer Science department of Paris-South University, 2013—
- N. Sabouret teaches in Masters M2 "IAC" and master M2 "Interactions" of Paris-South University, 2013—
- J-P. Sansonnet teaches in master 2 of computer science research (IAC) of Paris-Sud (option: Multi agent systems), 2010-2012
- J-P. Sansonnet teaches the course course « Architectures et Modèles pour l'Interaction » at Supélec engineer school, 3th Year, 2008-2012
- W. A. Turner teaches in master "Patrimoine immatériel et information scientifique, technique et économique" (PISTE), Université de Marne La Vallée
- F. Vernier participates in in Master 2 of computer science research (Interaction) of 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
- Y. Bellik has animated an exhibition stand during the PERADA (Pervasive Adaptation) day "La révolution des objets communicants & Intelligents pour la santé et le handicap", October 19th 2010, Télécom ParisTech, Paris.
- Ch. Jacquemin is animator of "Journées Arts/Sciences" of Université Paris-Sud, Orsay, may 2012
- Ch. Jacquemin is animator of Atelier "Visualisation de Particules", La Diagonale, Orsay, june 2012
- Ch. Jacquemin is coordinator of the CURIOSITas Paris-Saclay art-science festival to be held in October 2013
- Ch. Jacquemin is "chargé de mission arts et sciences" for the Art & Culture office at Université Paris-Sud 2010
- Ch. Jacquemin was selected at " Festival numérique Futur en Seine" for the presentation of a public installation entitled "Réalité augmentée mobile", 2009
- 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

ACADEMIC PARTNERSHIPS

- Ch. Jacquemin, invited researcher at TKK (Technological University of University of Helsinki), 3 months, 2008
- Ch. Jacquemin, invited researcher at Fraunhofer Institute, Berlin, 6 months, 2009

- F. Vernier is collaborator at Harvard with Professor Chai Shen, 2008-2013
- Y. Bellik, collaboration with ETS Montréal (École de Technologie Supérieure), co-supervision of a PhD thesis.
- Y. Bellik, collaboration with University of Essex (UK), University of Ulm (Germany), CTI (Greece) within the ATRACO European project.
- Y. Bellik, collaboration with Supelec (FR) within the IRoom project.

VALORIZATION

- Y. Bellik and G. Pruvost, Youpi: Open source UPNP software library, developed in the context of the ATRACO European project
- Ch. Jacquemin has developed the free software "Virtual Choreographer", Source Forge, 38000 hits et 1500 downloads
- J-P. Sansonnet has developed the free software toolkit "LitTalk" 2011,
  URL: http://perso.limsi.fr/jps/online/litetalkwebsite/litetalk.site.main.html
- J-P. Sansonnet has developed the free software toolkit "Divalite" with team ILE at LIMSI and University UNISINOS, Porto Alegre, Brazil 2012,
  URL: http://perso.limsi.fr/jps/online/divalitewebsite/divalite.site.html
- W. A. Turner: UNOPORUNO, a Free License Software, for computer supporting sociological research into the impact of talent mobility on socio-economic development

INDUSTRIAL RELATIONSHIPS

- Y. Bellik, collaboration with InAccess Networks (Greece) within the ATRACO European project.
- Y. Bellik, relationships with UbiSense.

TABLE OF CONTRACTS FOR AMI GROUP

Contracts on public fundings								
	Acronym	Funding agency/ partner	Program	General coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
ANR Basic science & JCJC	EVEILS	ANR	Blanc	Parisot Etienne (APC)	Vézien Jean-Marc	01/05/2009	31/08/2012	159 085
	FRESCO	ANR	JCJC	Auvray Malika	Auvray Malika	01/10/2011	30/09/2014	169 941
ANR with industrial partners	Topophonie	ANR	CONTINT	Cahen Roland (ENSCI)	Jacquemin Christian	01/10/2009	31/12/2012	185 695
	MoCA	ANR	CONTINT	Duhaut Dominique (Lab-STICC/ENIB)	Martin Jean-Claude	01/10/2012	31/03/2016	160 887
	BINGO	ANR	CSOSG	Karim Soudani (SODERN)	Osorio Sainz Angel	01/01/2008	31/12/2009	85 704
	SOUND DELTA	ANR	RIAM	Georges-François David (REMU)	Katz Brian	01/12/2006	30/11/2009	135 507
	VIRAGE	ANR	RIAM	Baltazar Pascal (GMEA)	Vernier Frédéric	01/12/2007	30/11/2009	84 467
	CARE	ANR	RIAM	De La Rivière Jean-Baptiste (Immersion)	Martin Jean-Claude	05/12/2007	04/12/2010	93 987
	SEVEN	ANR	RNTL	Nugier Sylvaine (EDF)	Jacquemin Christian	19/12/2005	19/05/2008	162 677
	WEBCONTENT	ANR	RNTL	Georges Grefenstette (CEA)	Jacquemin Christian	19/12/2005	30/06/2009	58 240
Research collaborations	Netsuds	CNRS	GDRI	Turner William	Turner William	07/10/2005	06/10/2009	0
	PEPS SHS-ST2I 2008	CNRS	PEPS	Jacquemin Christian	Jacquemin Christian	01/04/2008	31/12/2008	10 000
	SIMCoD	Digiteo	Plateforme	Bourdot Patrick	Bourdot Patrick	01/10/2007	30/09/2011	610 200
	IROOM	Digiteo	Projet Emergent	Bellik Yacine	Bellik Yacine	01/10/2007	31/12/2009	56 236
	WILD	Digiteo		Pietriga Emmanuel (INRIA)	Vernier Frédéric	15/07/2008	15/05/2012	17 160
	WILD PCRI	Digiteo	Projet Emergent	Beaudoin-Lafon Michel (LRI)	Vernier Frédéric	15/07/2010	14/07/2011	5 940
	FLUCTUS	Digiteo	Projet Emergent	Pastur Luc	Pastur Luc	01/09/2010	31/08/2013	112 788
	Human Touch	Digiteo		Ammi Mehdi	Ammi Mehdi	01/10/2012	30/09/2012	102 200
		ETS		Bellik Yacine	Bellik Yacine	20/01/2005	19/01/2008	0
		IRCAM		Jacquemin Christian	Jacquemin Christian	01/11/2009	31/10/2012	0
	SUSTAINS	OSEO	Pôle de compétitivité	Mahe Erwan (Artefacto)	Vernier Frédéric	10/12/2010	09/01/2014	122 300
	Canal Haptique	OSEO	AIMA	Ammi Mehdi	Ammi Mehdi	21/01/2011	21/02/2012	29 900
	Toute la lumière sur l'ombre	Région Ile de France	PICRI	Jacquemin Christian	Jacquemin Christian	27/11/2008	26/11/2011	74 500
	Futurs en Seine	Région Ile de France		Jacquemin Christian	Jacquemin Christian	27/11/2008	26/11/2010	35 716
	HD3D2	Région Ile de France	Pôle de compétitivité	Nicolas Blandine (HD3D)	Martin Jean-Claude	01/01/2010	30/06/2011	94 584
UE contratcs	ATRACO	EU	SMCP	Bellik Yacine	Bellik Yacine	01/02/2008	30/07/2011	361 320
	CIDESAL	IRD		Meyer Jean-Baptiste (IRD)	Turner William	01/03/2009	31/12/2012	120 232
PhD supervision		SUPELEC		Bellik Yacine	Bellik Yacine	01/11/2009	31/10/2012	0

Industrial contracts, contracts on private fundings...								
	Acronym	Funding agency/ Partner	Program	General Coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
Research collaborations	Prototype d'écran haut-parleur	Sonic Emotion		Katz Brian	Katz Brian	03/03/2008	02/09/2013	0
	AUTISME	Fondation de France		Grynszpan Ouriel (Centre Emotion)	Martin Jean-Claude	16/06/2008	15/06/2010	24 000
	Alicante	Fundacion de la Comunidad Valenciana		Osorio Sainz Angel	Osorio Sainz Angel	01/12/2008	01/12/2013	0
Other	Copperlan	KLAVIS		Vernier Frederic	Vernier Frédéric	01/07/2009	01/07/2011	0
Non-Disclosure agreement		EUROBRAILLE		Bellik Yacine	Bellik Yacine	11/05/1998	10/05/2008	0

Patents, software registrations, licence agreements...					
Technology transfer	Patent	LIMSI author	co-owner	Date	Comment
	Air jet haptic stimulation system.	Ammi Mehdi	_	01/04/2012	Patentability under review
	TVIZ tablet based 3D visualization	Ammi Mehdi	Université Pierre et Marie Curie	01/04/2013	Patentability under review
	Software registration (APP)	LIMSI author	Co-author	Date	Comment
	UNOPORUNO Meta search engine to identify groups of individuals to be interviewed within sociological surveys	Turner William	Garcia Flores J.	01/11/2012	

SCIENTIFIC PUBLICATIONS

DOCTORAL THESES AND HDR

1. Ajaj, R., TEAMViz : systèmes multi-dispositifs, multi-vues et multi-surfaces pour la visualisation interactive de scène 3D 2009, thèse de l'Université Paris Sud/LIMSI. Soutenue à Orsay, France, le 16 novembre 2009.
2. Asfari, O., *Personalized access to contextual information by using an assistant for query reformulation* 2011, thèse de l'Université de Paris-Sud. Soutenue à Orsay, France, le 19 septembre 2011, 167 p.
3. Besacier, G., *Interactions post-WIMP et applications existantes sur une table interactive* 2010, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 19 octobre 2010, 159 p.
4. Bouchara, T., Comparaison et combinaison de rendus visuels et sonores pour la conception d'interfaces homme-machine : des facteurs humains aux stratégies de présentation à base de distorsion 2012, thèse de l'Université Paris Sud. Soutenue à Orsay, France, le 29 octobre 2012, 196 p.
5. 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 Orsay, France, le 29 juin 2010, 317 p.
6. Chaboissier, J., *Interactions simultanées de plusieurs utilisateurs avec une table interactive* 2011, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 20 Décembre 2011, 169 p.
7. Dahdouh, S., *Filtrage, segmentation et suivi d'images échographiques : applications cliniques* 2011, thèse de l'Université Paris Sud. Soutenue à Orsay, France, le 23 septembre 2011, 207 p.
8. Fdili Alaoui, S., Analyse du geste dansé et retours visuels par modèles physiques : apport des qualités de mouvement à l'interaction avec le corps entier 2012, thèse de l'Université Paris Sud. Soutenue à Orsay, France, le 19 décembre 2012, 230 p.
9. Hasasneh, A., *Robot semantic place recognition based on deep belief networks and a direct use of tiny images* 2012, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 23 novembre 2012, 216 p.
10. Leray, D., D'une famille de composants dialogiques à une méthodologie de synthèse de modèles d'assistance pour un agent conversationnel assistant 2009, thèse de l'Université Paris Sud/LIMSI. Notes et Documents du LIMSI 2010-02. Soutenue à Orsay, France, le 17 décembre 2009.
11. Nauroy, J., *Traitements interactifs d'images radiologiques et leurs applications cliniques* 2010, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 26 novembre 2010, 264 p.
12. Pruvost, G., Modélisation et conception d'une plateforme pour l'interaction multimodale distribuée en intelligence ambiante 2013, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 11 février 2013, 269 p.
13. Simard, J., Collaboration haptique étroitement couplée pour la déformation moléculaire interactive 2012, thèse de l'Université Paris Sud. Soutenue à Orsay, France, le 12 mars 2012, 268 p

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2. Ammi, M., V. Fremont, and A. Ferreira, Automatic camera-based microscope calibration for a tele-micromanipulation system using a virtual pattern. IEEE Transactions on Robotics, 2009. **25** (1): pp.184-191.

3. 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.
4. Avril, M., M. Chetouani, and N. Sabouret, *Étude d'une collaboration socio--affective entre une personne et le robot Jazz.* Interfaces numériques, 2013. **2** (1): pp.57-76.
5. Awde, A., Y. Bellik, and C. Tadj, Complexity of mathematical expressions in adaptive multimodal multimedia system ensuring access to mathematics for visually impaired users. International Journal of Computer and Information Science and Engineering, 2008. **2** (2): pp.13p.
6. Awde, A., M. Dulva Hina, C. Tadj, and Y. Bellik, *Middleware for ubiquitous access to mathematical expressions for visually-impaired users.* Ubiquitous Computing and Communication Journal, 2008. **3** (5): pp.8-21.
7. Awde, A., M. Dulva Hina, C. Tadj, Y. Bellik, and A. Ramdane-Cherif, An adaptive multimodal multimedia computing system for presentation of mathematical expressions to visually- impaired users. Journal of Multimedia, 2009. **4** (4): pp.182-195.
8. 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.
9. Awde, A., C. Tadj, and Y. Bellik, Infrastructure of an adaptive multi-agent system for presentation of mathematical expression to visually-impaired users. ISAST Transactions on Computers and Intelligent Systems, 2009. **1** (1): pp.17-27.
10. Bouchara, T., C. Jacquemin, and B. Katz, *Cueing multimedia search with audio-visual blur.* ACM Transactions on Applied Perception, 2013. **10** (2): pp.7_1-7_21.
11. 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.
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13. 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.
14. 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, 2010. **29** (7): pp.777-806.
15. Buisine, S., G. Besacier, A. Aoussat, and F. Vernier, *How do interactive tabletop systems influence collaboration ?* Computers in Human Behavior, 2012. **28** (1): pp.49-59.
16. Campano, S., É. de Sevin, V. Corruble, and N. Sabouret, *Une approche pour la simulation de comportements émotionnels fondée sur la théorie de la conservation des ressources.* Technique et Science Informatiques, 2013. **32** (1): pp.111-136.
17. Delprat, N. and C. Jacquemin, *VIDA - Une thématique art-science dans un laboratoire de recherche scientifique.* Technique et Science Informatiques, 2013. **32** (3-4): pp.499-502.
18. 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.
19. Fang, X., C. Jacquemin, and F. Vernier, *A survey of 3D document corpus visualization.* Information Technology Journal, 2009. **8** (1): pp.1-15.
20. 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.
21. Ferey, N., G. Bouyer, C. Martin, A. Drif, P. Bourdot, M. Ammi, J. Nelson, J.M. Burkhardt, and L. Autin, *Docking de protéines en réalité virtuelle : une approche hybride et multimodale.* Technique et Science Informatiques, 2009. **28** (8): pp.983-1015.
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24. Gaffary, Y., M.V. Eyharabide, J.-C. Martin, and M. Ammi, *Clustering approach to characterize haptic expressions of emotions.* ACM Transactions on Applied Perception, 2013. **10** (4): pp.18p.
25. Gouiffès, M., B. Planes, and C. Jacquemin, *HTRI: High Time Range Imaging.* Journal of Visual Communication and Image Representation, 2013. **24** (3): pp.361-372.
26. 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.
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29. 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.
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31. Jacquet, C. and Y. Bellik, *Présentation ciblée d'informations dans les moyens de transports.* Génie Logiciel, 2009. (91): pp.27-34.
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33. Klein, T., F. Gueniat, L. Pastur, F. Vernier, and T. Isenberg, *A design study of direct-touch interaction for exploratory 3D scientific visualization.* Computer Graphics Forum, 2012. **31** (3): pp.1225–1234.
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35. Martin, J.-C., G. Caridakis, L. Devillers, K. Karpouzis, and S. Abrillian, Manual annotation and automatic image processing of multimodal emotional behaviors : validating the annotation of TV interviews. Personal and Ubiquitous Computing, 2009. **13** (1): pp.69-76.
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39. Rebai, I., E. Machrouh, Y. Bellik, G. Pruvost, and J.-P. Sansonnet, Influence des modalités de sortie d'un système sur les modalités de l'utilisateur. Cas des environnements ambiants de type pièces intelligentes. Technique et science informatiques, 2013. **32** (5): pp.575-604.
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CPU
Cognition, Perception and Use

JEAN-CLAUDE MARTIN - FRANÇOISE DARSES

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 study and 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 (perceptual studies, evaluation studies).

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 (before this date Françoise Darses was head of the CPU group). The resarch activity on this topic is only presented here to avoid redundancies, but has been developed until 2011 inside the AMI group.

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, emotion 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 ACTIVITIES

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 additionally 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.

Illustration 1: 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.

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.

TOPIC 2: IMAGE, LANGUAGE, SPACE

***M. Denis**, M.-P. Daniel, M. Auvray, M. Gallay, S. Caillou, C. Mores*

The focus of this topic of research is on the interactions between image, language and space. These topics were adressed in several 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.

Illustration 2: 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. The focus is the study of the cognitive processes underlying human spatial representations in wayfinding situations (it is mostly funded by the SPALIFE, an ANR-funded project). 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 (UPMCII). The aim of the project was 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. The point was examining whether the memory of routes would be affected by the richness of an environment in visual landmarks. Sixty participants were asked to describe verbally and to produce a sketch map of the route they had just traveled. 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. In another words, more is said when there is more to be said, and experiencing a richer environment increases the probability of reporting it in the form of richer descriptions. But larger numbers of items stored in memory do not impair their recall : 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 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.

Illustration 3: 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 has been 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 four experiments to investigate whether directional spatial relations encoded by reading narratives are updated following described protagonist rotations.

Participants memorized locations of objects described in short stories that placed them, as the protagonist, in remote settings. After reading a description that the protagonist rotated to the left or the right of the initial orientation, participants made judgments about object relations in the described environment (Experiment 1). Before making these judgments, participants were instructed to physically rotate to match (Experiment 2) or mismatch (Experiment 4) the protagonist's described rotation and in Experiments 3 and 4 to also visualize the changed relations following rotation. Participants' performance suggested that they relied on the initial representation they constructed during encoding rather than on the updated protagonist-to-object relations. Participants' physical movement to match the described rotation and additional visualization instructions did not facilitate updating through a sensorimotor process. In these respects, updating spatial relations in situation models constructed from narratives differs from updating in perceptually experienced environments.

FRAMES OF REFERENCE IN SPATIAL COGNITION. The FRESCO project, funded by the JCJC-ANR, involves a collaboration between Malika Auvray (Coordinator, LIMSI, UPR 3251), Sylvain Caillou (LIMSI, UPR 3251), Mehdi Ammi (LIMSI, UPR 3251), Jérôme Dokic (IJN, UMR 8129), Frédérique de Vignemont (IJN, UMR 8129), and Charles Spence (Oxford University). The aim of this project is to understand the mechanisms underlying spatial cognition when using tactile interfaces, and in particular sensory substitution devices. It belongs to the broad framework of investigation of the plasticity of bodily and external spaces. However, it states that within this context a fruitful approach should investigate in parallel the two reverse phenomena: self and distant attribution of objects. One crucial way of investigating jointly these two phenomena is to investigate the spatial content of the experience. Such spatial content can represent objects' location either within the bodily space or within the external space. Such characterization of the factors underlying the different frames of references adopted in spatial cognition is conducted both experimentally by means of tactile interfaces that are used to interrogate the coordinate systems exploited in perceiving stimuli received on the body surface and conceptually by clarifying the underlying mechanism of self and distant attribution. The experiments that are conducted focus on the following factors: training for an exteriorisation of the stimuli, location of the stimuli on the body surface, visual feedback on the body, simultaneous presentation of visual stimuli, prior visual experience, and intersubjectivity.

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. To continue this work and with the collaboration of D. Chainon, Master student in Psychology at Paris West University Nanterre La Défense, we developed a second study to understand how the medium filters and affects our representation of a partner during a mediated social interaction. We studied the referential choice (virtual referential versus real referential) of the participant when he selected the target designated by collaborative partner. This study demonstrated the original properties of multi-stereoscopic immersive device and explored user experience in terms of feeling of presence in the context of co-located collaboration tasks in virtual environments.

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, D. Gomez, F. Focone, C. Faur, M. Boukhris, J.-B. Dubuisson, C. Le Bail, S. Caillou, Y. Tsalamlal, C. Zakaria*

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, impact of feedback, social disorders, and the impact of realism and embodiement on perception and cognition.

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.

Bodily interaction is investigated in various interaction domains (artistic, sports, job interviews, public speaking task), with a variety of devices (haptics (in collaboration with Mehdi AMMI's team), force platform, video processing) and for the study of a variety of affect (stress, personality).

This on bodily interaction is being extended by considering intra and individual differences and motion-capture techniques (project ANR INGREDIBLE and PhD theses of Tom Giraud and Florian FOCONE co-directed with Brice Isableu from the UFR Sciences and Techniques of the Physical and Sporting Activities (STAPS).

AFFECTIVE COMPUTING. Individual differences and personality are also 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 assess the impact of a feedback provided by two humans (and later by a virtual character) on multiple tasks and its impact on regulation processes. We 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 collaboration with MIT MediaLab on job interviews and an experiment using our MARC agent as a virtual peer for teaching Java programming concepts.

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/).

There are strong connections between the « Virtual Agents and Emotion » topic and the topic « Cognitive Ergonomics ». The members of both teams work together on joint projects (e.g. INTELLILANGUE, ANR MOCA) in which both teams study the same research question but from different perspectives: computer science (models, corpora, automatic processing, design of virtual agents, …) and psychology (ergonomics, theories of emotions, learning, …).

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 (Jean-Paul Sansonnet within the ACAI funded by CNRS STIC-AmSud program), theory of mind (Nicolas Sabouret) and expressions of emotions in the haptic modality (Mehdi Ammi).

The ANR project ARMEN in collaboration with the TLP group (Devillers) involves a contribution from the CPU group (design and experiment using the MARC virtual agent for emotional 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).

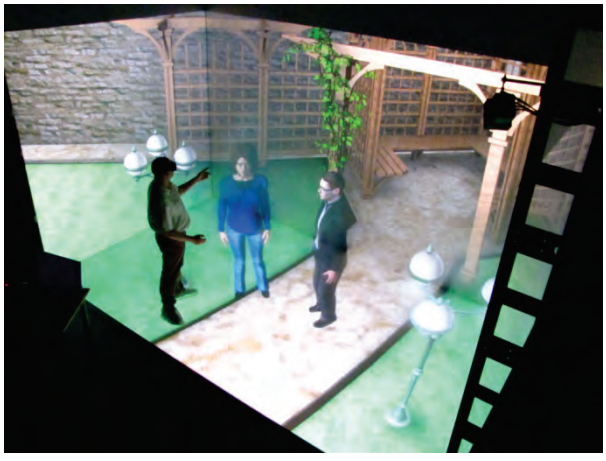

Illustration 4: Integration of several MARC expressive virtual characters (Courgeon, Martin, Jacquemin) in the immersive system EVE (P. Bourdot, J.-M.Vézien).

Highlights

- J.-C. Martin appointed as the Editor-in-Chief of the Springer Journal on Multimodal Interaction (JMUI)
- 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

Last name	First name	Position	Employer	HDR	Arrival date	Departure date
Auvray	Malika	CR	CNRS		Hired as of 01/10/2008	
Boccara	Vincent	Ass.Prof.	Université Paris-Sud		Hired as of 01/09/2013	
Caillou	Sylvain	Res. Eng.	CNRS		Hired as of 01/12/2008	
Carite	Luc	Technician	CNRS			Retired on 01/04/2009
Clavel	Céline	Ass.Prof.	Université Paris Sud		Hired as of 01/09/2011	
Daniel	Marie-Paule	Ass.Prof.	Université Paris Sud	HDR		
Darses	Françoise	Prof.	Université Paris Sud	HDR	Hired as of 01/10/2008	Left on 01/06/2011
Demulier	Virginie	Ass.Prof.	Université Paris-Sud		Hired as of 01/09/2013	
Denis	Michel	DR (Emeritus)	CNRS	HDR		
Liénard	Jean-Sylvain	DR (Emeritus)	CNRS	HDR		
Martin	Jean-Claude	Prof.	Université Paris Sud	HDR		
Rossi	Jean Pierre	Prof. (Emeritus)	Université Paris Sud	HDR		Retired on 31/08/2011

NON PERMANENT STAFF

Last name	First name	Contract	Arrival date	Departure date
Afonso	Amandine	Post-Doc	01/11/2006	30/06/2008
Arnold	Gabriel	Post-Doc	01/10/2012	30/06/2014
Courgeon	Matthieu	CDD	01/12/2011	31/03/2013
Coussinet	Cédric	CDD	01/10/2007	30/09/2008
Coussinet	Cédric	CDD	01/08/2009	30/06/2012
Dianoux	Camille	CDD	01/08/2013	30/11/2013
Dubuisson	Jean-Baptiste	CDD	01/01/2013	31/12/2013
Gallay	Mathieu	Post-Doc	01/09/2009	31/08/2011
Gomez Jauregui	David Antonio	Post-Doc	01/10/2012	31/07/2014
Gras	Doriane	CDD	01/03/2013	31/03/2013
Guillaume	Hervé	Post-Doc	01/11/2009	31/12/2009
Hartcher-O'Brien	Jessica	Post-Doc	01/11/2012	30/11/2014
Kessous	Loïc	CDD	01/10/2007	31/05/2008
Machrouh	Edyta	Post-Doc	01/03/2007	30/09/2008
Mayeur	Anaïs	Post-Doc	01/02/2010	30/06/2011
Signol	François	CDD	01/10/2009	30/09/2010

PHD STUDENTS

Last name	First name	Thesis director	Arrival date	Date of defense
Abbassi	Sarwan	Michel Denis	01/12/2006	26/11/2010

Chevallier	Sylvain	Philippe Tarroux	01/10/2005	04/06/2009
Courgeon	Matthieu	Jean-Claude Martin	01/10/2008	21/11/2011
Dubois	Mathieu	Philippe Tarroux	01/10/2007	20/02/2012
Guillaume	Hervé	Philippe Tarroux	01/10/2004	17/07/2009
Hasasneh	Ahmad	Philippe Tarroux	02/11/2009	23/11/2012
Signol	François	Jean-Sylvain Liénard	01/10/2005	14/12/2009
Tan	Ning	Jean-Claude Martin	01/12/2008	31/01/2012
Arnold	Ludovic	Philippe Tarroux	01/01/2010	
Boukhris	Mehdi	Jean-Claude Martin	02/05/2012	
Brunet	Lucie	Françoise Darses	01/10/2011	
Faur	Caroline	Jean-Claude Martin	01/10/2012	
Focone	Florian	Jean-Claude Martin	01/12/2012	
Giraud	Tom	Jean-Claude Martin	01/10/2011	
Jaber	Ghazal	Philippe Tarroux	01/10/2010	
Kueviakoe	Kangni	Philippe Tarroux	01/10/2010	
Philip	Léonor	Jean-Claude Martin	01/02/2012	
Tsalamlal	Mohamed Yacine	Jean-Claude Martin	01/10/2012	

INTERNSHIPS

Last name	First name	Arrival date	Departure date	Prepared degree	School / University
Jaite	Mohamed	12/01/09	30/06/09	Master 1	Université Paris Sud
Brunet	Lucie	01/02/10	30/06/10	Master Ergonomie	Université Paris Sud
Garcia	Lourdes	02/03/10	30/06/10	Master 2 ITIAM	UPMC
Aimé	Jonathan	08/03/10	31/07/10	4ème Année Ingénieur	Association Léonard De Vinci
Elavumoottil	Christophe	05/01/11	31/08/11	M1	Université Paris Sud
Forma	Vincent	15/02/11	15/07/11	STAPS M2	Université René Descartes
Ebert	Coralie	14/06/11	14/09/11	Master 1 Informatique	Université Paris Sud
Carminati	Sarah	06/02/12	06/09/12	Master 2 Ergonomie	Université Paris Sud
Tsalamlal	Mohamed Yacine	01/03/12	31/08/12	Master 2	Université de Metz
Chainon	David	10/04/12	30/09/12	Master 2 Recherche SETI	Université Paris Ouest
Francisco Delagis	Yohan	15/10/12	27/03/13	Master 1	Université Paris Ouest
Ouibrahim	Kahina	15/04/13	15/09/13	Master	ENS

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
- 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: CAAD Futures Conference, 4-8 July 2011, Liège, Belgique
- 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
- M. Denis: Co-organizer of the International Symposium "From Action to Concepts: Behavioural and Neural Basis of Embodied Cognition" (Lille, 2013).
- 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)
- 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.

MEMBER OF PROGRAMME COMMITTEE IN INTERNATIONAL CONFERENCES AND WORKSHOPS:

- F. Darses: ECSCW 11, European Conference on Computer-Supported Cooperative Work Aarhus University, DK, 24-28 September 2011
- 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

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

TUTORIAL AT WORKSHOPS OR CONFERENCES OR SUMMER SCHOOLS

- F. Darses: Introduction à l’école d’été du GDR Psycho Ergo, Le Croisic, juin 2010

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.
- Auvray, M. (2013). spatial cognition and sensory substitution. Research Conference on ‘Sensory Substitution, Brain Plasticity and Visual Rehabilitation’, 6-9 June 2013, Israel Institute for Advanced Studies, The Hebrew University of Jerusalem, Israel.
- Auvray, M. & Deroy, O. (2013). Audio-visual substitution. Sensory Substitution and Augmentation Conference, 26-28 March, British Academy, London.

- Auvray, M. (2012). Spatial cognition and sensory substitution. Mind and Perception Research Seminar, 23 April, Glasgow, Scotland.
- Auvray, M. (2012). Interactions crossmodales. Séminaire du Laboratoire Vision, Action, Cognition, Université Paris Descartes, 26 March, Boulogne Billancourt, France.
- Auvray, M. (2012). Interactions crossmodales: L'exemple de la cécité aux changements. Séminaire de l'ETIS, Université de Cergy-Pontoise, 16 March, Cergy-Pontoise, France.
- 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. (2012) "Virtual Humans", invited talk as an invited professor during one month at Human Centered Multimedia, Institute of Computer Science, Octobre 2012, 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

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) http://emotion-research.net/

NATIONAL NETWORKS OR WORKING GROUPS

- M. Denis: Co-organizer of the International Symposium "From Action to Concepts: Behavioural and Neural Basis of Embodied Cognition" (Lille, 2013).
- M. Denis: Member of the international Scientific Board of the European Congress of Psychology (Rome, 2015).
- M. Denis: Member of the International Advisory Board and member of the Scientific Program Committee of the International Congress of Psychology (Yokohama, 2016).
- 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), Expert (President of Comités de Sélection) for the CCSU in Psychology (16ème)
- 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: Member of the Committee of Expert Evaluators of the Marie Curie Action "Industry-Academia Partnerships and Pathways" (IAPP), Panel "Economic Sciences and Social and Human Sciences" (ECO-SOC), European Commission, FP7 (2013).
- M. Denis: Member of the Jury Senior of the Institut Universitaire de France (2013).
- M. Denis: President of the Evaluation Committee of the Program "Apprentissages" of the Agence Nationale de la Recherche (2013).
- 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 and 2012: 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
- J.C. Martin: evaluation of a European proposal ERC
- 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[13] (re-elected in 2011 for 6 years)

MEMBER OF SELECTION JURIES

- F. Darses : Univ. Bretagne Sud (poste PR en Ergonomie) 2010, Univ. Paris Sud (poste MC en Psychologie) 2011, Univ. Lille (poste MC en Ergonomie) en 2011
- J.C. Martin : President of the selection juries for UFR STAPS, Orsay, 2011 ; IUT de Sceaux (2013) and UFR Sciences Master Ergonomie (2013)
- 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

[13] http://emotion-research.net/

DISSEMINATION AND VULGARIZATION

C. Clavel and J.C. Martin: Reportage « Les avatars sont partout! », Journal 20h TF1, 22 février 2010

RESEARCH CONVENTIONS AND CONTRACTS

TABLE OF CONTRACTS FOR CPU GROUP

Contracts on public fundings								
	Acronym	Funding agency/ partner	Program	General coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
ANR Basic science & JCJC	OTIM	ANR	Blanc	Blache Philippe (LPL)	Martin Jean-Claude	10/10/2008	30/06/2012	54 916
	SpaLife	ANR	Blanc	Gyselinck Valérie (LPNCog)	Daniel Marie-Paule	01/10/2009	31/03/2013	82 380
	MoCA	ANR	CONTINT	Duhaut Dominique (Lab-STICC/ENIB)	Martin Jean-Claude	01/10/2012	31/03/2016	160 887
	COMPARSE	ANR	EMCO	Martin Jean-Claude	Martin Jean-Claude	01/01/2012	31/12/2014	165 468
	PADE	ANR	JCJC	Rilliard Albert	Rilliard Albert	15/12/2010	30/11/2014	163 513
	FRESCO	ANR	JCJC	Auvray Malika	Auvray Malika	01/10/2011	30/09/2014	169 941
ANR with industrial partners	GV-Lex	ANR	CONTINT	Gelin Rodolphe (Aldebaran)	D'Alessandro Christophe	15/12/2008	14/06/2012	202 807
	INGREDIBLE	ANR	CONTINT	De Loor Pierre (Lab-STICC/ENIB)	Martin Jean-Claude	20/08/2012	19/02/2016	165 600
	AFFECTIVE AVATARS	ANR	RNTL	Devillers Laurence	Devillers Laurence	01/12/2007	31/03/2010	297 704
	NAVIG	ANR	TecSan	Jouffrais Christophe (IRIT)	Katz Brian	01/01/2009	31/10/2012	263 802
	ARMEN	ANR	TecSan	Devillers Laurence	Devillers Laurence	01/02/2010	30/07/2013	160 051
Research collaborations	Spatial Memory	University of Cyprus	DESMI 2008	Avraamides Marios (Dpt. Of Psychology, Univ of Cyprius)	Denis Michel	01/12/2008	30/11/2012	6 870
	AUTO EVAL	Digiteo	Projet Emergent	Gaussier Philippe (CEA-LIST)	Tarroux Philippe	01/10/2010	30/09/2013	16 000
	STIC Amsud ACAI	CNRS	Programme STICAmSud	Donzeau-Gouge Véronique (CNRS)	Martin Jean-Claude	01/01/2011	31/12/2012	10 000
	Nomoseed	OSEO	AIMA	Tarroux Philippe	Tarroux Philippe	21/01/2011	21/07/2012	30 000
	ADN-TR	Région Ile de France	Pôle de compétitivité	Guiard Cédric (ADN)	Martin Jean-Claude	01/10/2011	30/09/2014	531 140
	Intellilangue	Investissement d'avenir		Martin Jean-Claude	Martin Jean-Claude	01/01/2012	31/12/2013	136 429
UE contracts	WAYFINDING	EU	STREP	Postma Albert (Psy. Lab. Utrecht Univ.)	Denis Michel	01/04/2005	31/03/2008	169 918
	ATRACO	EU	SMCP	Bellik Yacine	Bellik Yacine	01/02/2008	30/07/2011	361 320
PhD supervision	Roboteo-Handler	Digiteo		Tarroux Philippe	Tarroux Philippe	01/10/2010	30/09/2013	97 200

Industrial contracts, contracts on private fundings…								
	Acronym	Funding agency/ Partner	Program	General Coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
Research collaborations	Autisme	Fondation Orange		Grynszpan Ouriel (Centre Emotion)	Martin Jean-Claude	01/09/2012	31/08/2013	0
		Nékoé		Martin Jean-Claude	Martin Jean-Claude	10/09/2012	13/09/2013	0
Prestation of services	Prestation PIA-OSEO	TESTAPIC	PIA	Martin Jean-Claude	Martin Jean-Claude	01/12/2012	31/01/2014	52 174

Patents, software registrations, licence agreements…					
	Start-up	Director		Date	Comment
Technology transfer	Nomoseed	Coussinet Cédric, PhD	_	01/05/2012	

SCIENTIFIC PUBLICATIONS

DOCTORAL THESES AND HDR

1. Abbassi, S., Human-computer interaction in 3D object manipulation in virtual environments: a cognitive ergonomics contribution 2010, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 26 novembre 2010, 208 p.
2. Chevallier, S., *Implémentation d'un système préattentionnel avec des neurones impulsionnels* 2009, thèse de l'Université Paris Sud/LIMSI. Soutenue à Orsay, France, le 25 juin 2009.
3. 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 à Orsay, France, le 21 novembre 2011, 200 p.
4. Daniel, M.-P., *Les descriptions de configurations spatiales*, 2012, HdR Université Paris Sud Orsay, soutenue à Orsay, France, le 12 octobre 2012. 82p p.
5. Dubois, M., *Méthodes probabilistes basées sur les mots visuels pour la reconnaissance de lieux par un robot mobile* 2012, thèse de l'Université Paris Sud. Soutenue à Orsay, France, le 20 février 2012, 291 p.
6. Guillaume, H., *Explorer pour reconnaître : approche probabiliste pour la reconnaissance de lieux par un robot mobile* 2009, thèse de l'Université Paris Sud/LIMSI. Soutenue à Orsay, France, le 17 juillet 2009.
7. Signol, F., Estimation de fréquences fondamentales multiples en vue de la séparation de signaux de parole mélangés dans un même canal 2009, thèse de l'Université Paris Sud/LIMSI. Soutenue à Orsay, France, le 14 décembre 2009.
8. Tan, N., Posture and space in virtual characters: application to ambient interaction and affective interaction 2012, thèse de l'LIMSI CNRS. Soutenue à Orsay, France, le 31 janvier 2012, 199p p.

ARTICLES IN PEER REVIEWED SCIENTIFIC JOURNALS

1. Abbassi, S., J.M. Burkhardt, and M. Denis, *Spatial problem solving : assembling three-dimensional puzzles in real and virtual environments.* Cognitive Processing, 2009. **10** (suppl. 2): pp.179-181.
2. 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.
3. 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.
4. 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.
5. Auvray, M. and E. Myin, Perception with compensatory devices : from sensory substitution to sensorimotor extension. Cognitive Science, 2009. **33** (6): pp.1036-1058.
6. Auvray, M. and M. Rohde, *Perceptual crossing: the simplest online paradigm.* Frontiers in Human Neuroscience, 2012. **6**: pp.181_1-181_14.
7. Avraamides, M., A. Galati, F. Pazzaglia, C. Meneghetti, and M. Denis, *Encoding and updating spatial information presented in narratives.* Quarterly Journal of Experimental Psychology, 2013. **66** (4): pp.642-670.
8. Castellano, G., L. Riek, C. Peters, K. Karpouzis, J.-C. Martin, and L.-P. Morency, *Introduction to the special issue on affective interaction in natural environments.* ACM Transactions on Interactive Intelligent Systems (TiiS), 2013. **2** (1): pp.1-4.
9. Clavel, C., L. Devillers, J. Plessier, L. Ach, B. Morel, and J.-C. Martin, *Combinaisons d'expressions vocales, faciales et posturales des émotions chez un agent animé. Perception par les utilisateurs.* Technique et Science Informatiques, 2012. **31** (4): pp.533-564.
10. 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.
11. Daniel, M.-P., Effet du vieillissement sur la mémorisation d'itinéraires réels : l'importance de la mémoire de travail et de la mémoire épisodique. Gériatrie et Psychologie Neuropsychiatrie du Vieillissement, 2012. **10** (4): pp.463-470.
12. Daniel, M.-P., E. Przytula, and M. Denis, *Spoken versus written route directions.* Cognitive Processing, 2009. **10** (suppl. 2): pp.201-203.
13. Daniel, M.-P. and B. Tversky, *How to put things together.* Cognitive Processing, 2012. **13** (4): pp.303-319.
14. Darses, F., *Résolution collective des problèmes de conception.* Le Travail Humain, 2009. **72** (1): pp.43-59.

15. Defays, A., S. Safin, F. Darses, A. Mayeur, S. Ben Rajeb, C. Lecourtois, F. Guéna, and P. Leclercq, *Invisible computer for collaborative design: evaluation of a multimodal sketch-based environment.* Work : A Journal of Prevention, Assessment and Rehabilitation, 2012. **41** (1): pp.3494-3503.
16. Denis, M., Assessing the symbolic distance effect in mental images constructed from verbal descriptions : a study of individual differences in the mental comparison of distances. Acta Psychologica - International Journal of Psychonomics, 2008. **127** (1): pp.197-210.
17. Denis, M., Prof. Michael I. Posner, first recipient of the Mattei Dogan Foundation Prize in Psychological Science. International Journal of Psychology, 2008. **43**: pp.997-1002.
18. Denis, M., *Jean-François Le Ny : un parcours cognitif.* L'année psychologique, 2008. **108**: pp.169-183.
19. Gaffary, Y., M.V. Eyharabide, J.-C. Martin, and M. Ammi, *Clustering approach to characterize haptic expressions of emotions.* ACM Transactions on Applied Perception, 2013. **10** (4): pp.18p.
20. 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.
21. Grynszpan, O., J. Nadel, J.-C. Martin, J. 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, 2012. **42** (8): pp.1642–1650.
22. 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.
23. Grynszpan, O., J. Simonin, J.-C. Martin, and J. Nadel, *Investigating social gaze as an action-perception online performance.* Frontiers in Human Neuroscience, 2012. **6** (94): pp.1-8.
24. 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.
25. Kammoun, S., G. Parseihian, O. Gutierrez, A. Brilhault, A. Serpa, M. Raynal, B. Oriola, M. Macé, M. Auvray, M. Denis, S. Thorpe, P. Truillet, B. Katz, and C. Jouffrais, *Navigation and space perception assistance for the visually impaired: The NAVIG project.* IRBM, 2012. **33** (2): pp.182-189.
26. Katz, B., F. Dramas, G. Parseihian, O. Gutierrez, S. Kammoun, A. Brilhault, L. Brunet, M. Gallay, B. Oriola, M. Auvray, P. Truillet, M. Denis, S. Thorpe, and C. Jouffrais, *NAVIG: Guidance system for the visually impaired using virtual augmented reality.* Technology and Disability, 2012. **24** (2): pp.163-178.
27. Katz, B., S. Kammoun, G. Parseihian, O. Gutierrez, A. Brilhault, M. Auvray, P. Truillet, M. Denis, S. Thorpe, and C. Jouffrais, *NAVIG: augmented reality guidance system for the visually impaired.* Virtual Reality, 2012. **16** (3): pp.253-269.
28. Kueviakoe, K., P. Tarroux, and A. Lambert, *Comparison of interval constraint propagation algorithms for vehicle localization.* A journal of Software Engineering and Applications, 2012. **5** (12B): pp.157-162.
29. Leroux, C., O. Lebec, M.W. Ben Ghezala, Y. Mezouar, L. Devillers, C. Chastagnol, J.-C. Martin, V. Leynart, and C. Fattal, *ARMEN: Assistive robotics to maintain elderly people in natural environment.* IRBM, 2013. **34** (2): pp.101-107.
30. Rossi, J.P. and N. Campion, *Inférences et compréhension de textes.* Rééducation orthophonique, 2008. **46** (234): pp.47-62.
31. Simard, J., M. Ammi, and M. Auvray, *Collaborative strategies for the search of 3D targets in molecular environments.* IEEE Transactions on Systems, Man, and Cybernetics, Part C: Applications and Reviews, 2012. **42** (6): pp.1555-1565.
32. 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.
33. Vanhala, T., V. Surakka, M. Courgeon, and J.-C. Martin, *Voluntary facial activations regulate physiological arousal and subjective experiences during virtual social stimulation.* ACM Transactions on Applied Perception, 2012. **9** (1): pp.1-12.

BOOKS & CHAPTERS IN BOOKS

1. 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*, Bellot Patrice, Editor. 2011, Hermès. pp. 1-26.
2. Chastagnol, C., C. Clavel, M. Courgeon, and L. Devillers, Designing an emotion detection system for a socially-intelligent human-robot interaction, in Towards a Natural Interaction with Robots, Knowbots and Smartphones, Putting Spoken Dialog Systems into Practice, J. Mariani, et al., Eds. 2013, Springer.
3. 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.

4. 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, Marc de Rosnay, and Pierre-André Doudin, Eds. 2010, Aalborg Universitetsforlag. pp. 175 - 202.
5. 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.
6. Denis, M., Interdisciplinary crossovers, in The New Waver: France's cutting edge. Vol. 4: Cognitive science: Leading researchers and top labs., C. Baker and G. Oliver, Eds. 2011, Editions Autrement. pp. 112-115.
7. Denis, M., Decades of images: Reminiscences of a shared scientific journey, in From mental imagery to spatial cognition and language: Essays in honour of Michel Denis., V. Gyselinck and F. Pazzaglia, Eds. 2012, Hove, UK: Psychology Press. pp. 203-254.
8. Denis, M., *La psychologie dans le concert des sciences cognitives*, in *La psychologie cognitive*, M. Denis, Editor. 2012, Editions de la Maison des Sciences de l'Homme. pp. 11-38.
9. Denis, M., *La cognition spatiale*, in *La psychologie cognitive*, M. Denis, Editor. 2012, Editions de la Maison des Sciences de l'Homme. pp. 101-142.
10. Denis, M. and S. Donikian, Navigation et cognition spatiale : de l'étude de l'humain réel à la simulation de l'humain virtuel, in Le traité de la réalité virtuelle. Vol. 5 : Les humains virtuels, S. Donikian, Editor. 2009, Presses de l'École des Mines de Paris. pp. 285-301.
11. Denis, M. and G. Fernandez, The processing of landmarks in route directions, in Representing space in cognition: Interrelations of behaviour, language, and formal models, J. Wiener T. Tenbrink and C. Claramunt, Eds. 2013, Oxford University Press. pp. 42-55.
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13. Gallay, M., M. Denis, and M. Auvray, Navigation assistance for blind pedestrians: Guidelines for the design of devices and implications for spatial cognition, in Representing space in cognition: Interrelations of behaviour, language, and formal models, J. Wiener T. Tenbrink and C. Claramunt, Eds. 2013, Oxford University Press. pp. 244-267.
14. 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*, Paolo Petta, Catherine Pelachaud, and Roddy Cowie, Eds. 2011, Springer. pp. 349-368.
15. Martin, J.-C. and T. Schultz, *Multimodal and speech technology*, in *Handbook of Technical Communication*, A. Mehler and L. Romary, Eds. 2012. pp. 189-254.
16. Tversky, B., J. Heiser, P. Lee, and M.-P. Daniel, Explanations in gesture, diagram, and word, in Spatial language and dialogue, K. R. Tenbrink T. Bateman J. A. Coventry, Editor. 2009, Oxford University Press. pp. 119-131.

CONFERENCES WITH PROCEEDINGS AND REVIEW COMMITTEE

1. Abbassi, S., J.M. Burkhardt, and M. Denis. Assister le montage d'objets en réalité virtuelle: Etude préliminaire de la résolution de problèmes tri-dimensionnels en environnement réel. in Colloque de Psychologie Ergonomique. 2009. Nice, France. 65-72.
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3. 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.
4. Charlet, D., C. Barras, and J.-S. Liénard. Impact of overlapping speech detection on speaker diarization for broadcast news and debates. in IEEE International Conference on Acoustics, Speech and Signal Processing. 2013. Vancouver, Canada. 5p.
5. Chevallier, S. and S. Dahdouh. Difference of Gaussians type neural image filtering with spiking neurons. in International Joint Conference on Computational Intelligence. 2009. Madeire, Portugal. 6p.
6. Chevallier, S. and P. Tarroux. Visual focus with spiking neurons. in European Symposium on Artificial Neural Networks, Computational Intelligence and Machine Learning. 2008. Bruges, Belgium. 385-389.
7. Chevallier, S. and P. Tarroux. Covert attention with a spiking neural network. in International Conference on Computer Vision Systems. 2008. Santorini, Greece. 56-65.

8. Chevallier, S. and P. Tarroux. Implémentation d'un mécanisme de "covert attention" avec un réseau de neurones impulsionnels. in Conférence Francophone de Neurosciences Computationnelles. 2008. Marseille, France. 78-81.
9. 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.
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11. Courgeon, M., O. Grynszpan, S. Buisine, and J.-C. Martin. Interactive expressive virtual characters: challenges for conducting experimental studies about multimodal social interaction. in International Conference on Disability, Virtual Reality and Associated Technologies. 2012. Laval, France. 447-449.
12. 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.
13. Dubois, M., P. Tarroux, and E. Frenoux. Using n-grams models for visual semantic place recognition. in International Joint Conference on Computer Vision Theory and Applications. 2013. Barcelona, Spain. 239_1-239_8.
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VENISE
Virtual ENvironment for Immersive Simulation and Experiments

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 purely virtual worlds or in virtual worlds coupled to real environments. 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 ubiquitous, because we systematically need to justify the added value of V&AR with respect to 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 centre 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 environments to illustrate and convey the physical concepts at the heart of relativistic physics. The PhD thesis of *Tony Doat* was defended on this subject 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 renowned invited keynote speakers, such as Pr. *Doug Bowman* (Viginia Tech), Pr. *Paul Milgram* (Univ. of Toronto), or Pr. *Hideo Saito*. (Keio University).

At the local level, the members of the team were 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). This Interaction Master speciality has now been running for the last two years and some students have subsequently begun a PhD in the team. 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 Netherland). 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 ACTIVITIES

TOPIC 1: INTERACTION MODELS FOR V&AR

***P. Bourdot*, N. Férey, D. Touraine, J.-M. Vézien**, *P. Cazaux, W. Chen, P. Martin, B. Ménélas, F. Picon, C. Prat, A. Tseu, S. Villien, W. Zhan,. J. Zhao.*

INTERACTIVE PARADIGMS FOR VIRTUAL NAVIGATIONS

This first subtopic addresses a basic problem for any V&AR application, i.e. how to travel within immersive environments. During this period, we focused our work on a navigation system based on 6DoF tracking and on a driving paradigm with sensorimotor feedback.

Research on virtual navigation controlled by 6DoF tracking was initiated 10 years ago during the PhD of *D. Touraine*. We proposed a very powerful interactive paradigm that can exploit any 6 DoF tracker attached anywhere on the user body. This signal is used like a 6 DoF wheel for the speed control of a virtual vehicle in translation and rotation. From the beginning we applied this intuitive technique to the hand or the head of users, hence the acronym HCNav (Hand/Head Controlled Navigation system) was chosen. Previous ergonomic studies had already demonstrated that applying HCNav to the head rather than the hand was more suitable, providing a concrete vestibular stimulation to the users during their virtual navigation tasks. The current work, accomplished in collaboration with ergonomists *Céline Clavel* (CPU group) and *Julien Nelson* (Paris Descartes University), aims to study the added value of this configuration in terms of presence and cybersickness.

Research was also conducted on a sensorimotor feedback based on haptics to propose a realistic driving paradigm. This work concerns a virtual simulator dedicated to learn how to drive a specific vehicle, i.e. a forklift, which requires a physical involvement in order to manipulate it. Taking in account the physical behaviour of the real forklift (inertia, damping, turning radius), we first haptically simulated the mechanical hinge constraints of the forklift handle to control the forklift direction. Secondly, a specific haptic push/pull technique has been designed to control the forklift velocity. This technique consists in coupling the HCNav technique introduced earlier – but reduced to one translational DoF - with an elastic force feedback provided by the haptic device. Such a sensorimotor control of the velocity allows the user to be physically involved in the driving task of the vehicle, but only thanks to his/her relative motions, which makes it possible for the user to stay within the work area of the haptic device. Again, with the collaboration of *Céline Clavel, we* conducted an ergonomic study on a driving task, and we concluded that our paradigm is more realistic compared to classical interactive techniques, such as joystick without force feedback. The realistic features of this haptic driving paradigm have been especially observed in performance transfers between real and virtual situations, and on some transfers in terms of behaviour and psychological processes.

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*. The first part of this work consisted in studying the role of haptics in the exploration of large data sets, from which we proposed different multimodal methods (combining haptics and 3D audio) dedicated to facilitate the exploration process. 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 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 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. 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).

SOFTWARE PLATFORM FOR SENSORIMOTOR IMMERSION

For the last two years, the VENISE group has led the LIMSI involvement in the European network developing BlenderCave, a system based on the 3D animation Open Source Software Blender 3D and the Blender Game Engine (BGE). Launched by *Jorge Gascòn Pérez* (King Juan Carlos University, Madrid, Spain), in association with *Fabrizio Bazzurri* (Nu.m.i.d.i.a. Srl, Rome, Italy) and *Julian Adenauer* (Zentrum Mensch-Maschine-Systeme - Technische Universität Berlin, Germany), BlenderCave aims at the real-time rendering of Blender scenes into CAVE-like environments.

Thanks to the collaboration of the VENISE and AA groups, BlenderCave now aggregates most features of LIMSI's Virtual Environments (i.e. EVE system and SMART-I^2). First, VENISE integrated multi-user stereoscopic visual rendering and, with the help of the AA group, spatialized sound through ambisonic, binaural and Wave Field Synthesis methods. In addition, as BlenderCave also uses VRPN to provide VR device interactions, VENISE developed several drivers for VRPN, mainly for Linux input devices, the

SPHINX voice recognition system a 3D tracking simulator. Our main interest for contributing to BlenderCave, is to leverage this Open Source framework for prototyping various interaction paradigms designed for immersive interactions.

With the BlenderCave platform novel experiments to evaluate the HCNav system were performed (see above). Moreover, BlenderCave is used by *Weiza Chen* for his PhD work to study the management of several users during co-localized immersive collaboration. Finally, the integration of haptic feebacks is planned to enable experiments on remote multisensory collaborations in the context of the DIGISCOPE project.

SUPERVISION OF 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. Actually, the reconfigurability of our software engine (via XML files) enables a broad spectrum of experiments on the contribution of multimodal management of immersive interactions for collaborative tasks. 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 (Multimodal and Co-localized Multi-user Interactions for Immersive Collaborations), 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 the 3DUI 2011 one.

Apart from multimodal supervision of immersive collaborations, the group initiated work on a number of problems linked to co-localised immersions. This is one of the main focuses of the PhD that *Weiya Chen* started in September 2013. A first class of problems is how to manage the cohabitation of users in the immersive setup. We are currently designing a specific manager of the users' viewpoints, in charge of avoiding mutual occlusions of the stereoscopic views. In addition, this manager must also prevent physical collisions between users when they don't look at each other. A second class of problems is the possible visual-audio incoherencies the users can experience between the real world and its virtual counterpart. A study was initiated by the VENISE group with ergonomists (*Céline Clavel* of the CPU group, and *Françoise Darses* from IRBA, the French Army Biomedical Research Institute) to analyze how two subjects, cooperating 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 medium term, we plan to study the systemic and ergonomic differences which may exist in immersive collaboration between co-localised users and remote ones.

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. While the vehicle itself is developed at the Institut d'Electronique Fondamentale (IEF), an UMR of the CNRS and the Paris-Sud University, the VENISE team focuses on the interactive aspects of remote supervision with an immersive setup. The earlier years of the project were dedicated to the design and implementation of the system architecture. Cognitive studies were carried out to compare different systems for audio-visual capture and rendering in a telepresence context, as well as designing proper interaction techniques for the control and supervision of a vehicule in a large immersive setup.

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*. Then we started work 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.

During the same year, 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 started in 2012 (Masters internship of *Mohammed Hadjam*), in conjunction of the work of IEF on the automated extraction of pre-attentional visual cues in real image sequences.

TOPIC 2: DATA MODELS AND SIMULATIONS

***N. Férey*, *J.-M. Vézien*, *S. Boivin*[14], *P. Bourdot*, *T. Isenberg*[15],** *D. Aurat, J.-N. Chiganne, T. Doat, X He, J. Zhao, T. Klein, P. Martin, B. Ménélas, S. Noury, M. Trellet, 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 modalities traditionally used in Virtual Reality. This approach was published in an international conference a high impact factor journal and a book chapter published in 2012.

Finally, *Mikael Trellet* was hired in September 2012 as a PhD student on the 4 years ANR project ExaViz which started in September 2011. His research work focuses on the storage, analysis, and visualization of molecular simulation data of large-scale molecular simulation results (Exascale) in a virtual context.

INTERACTIVE CFD SIMULATION

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13 INRIA Researcher within VENISE until March 2010

15 RTRA Digiteo Chair Researcher (Sept. 2010 – Dec. 2012)

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 Boivin*[2] and *O. Le Maître*. This work required the acquisition of advanced skills and involved a heavy research work to parallelize existing codes. 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, second on haptic and audio feedbacks especially designed to study CFD simulation data (see *B. Menelas* Ph.D work reported in topic 1)

INTERACTIVE AND ILLUSTRATIVE SCIENTIFIC VISUALIZATION

This subtopic is based on the work of *Tobias Isenberg* supported by the DIGITEO chair project named AVENIR (Advanced Visual Exploration with Non-photorealisitic and Interactive Rendering). As part of this work, he has focused on non-photorealistic rendering, illustrative visualization, interactive exploration of scientific visualization, human-computer interaction, 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 as well as the use of line-based visualizations to clearly depict the spatial aspects of fluid flows. 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. 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.

SIMULATION OF PHYSICAL PHENOMENA INACCESSIBLE TO DIRECT EXPERIENCE

Started in 2008, 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 was to explore situations that are inaccessible to direct experience – and hence, difficult to learn because of their counterintuitive nature. The ANR project "EVEILS" (Virtual Spaces for Education and Scientific Illustration) focused on two disciplines: Relativity and Gravitation (large scale gravitational phenomena). Within the team, the topic of *Tony Doat*'s PhD thesis was the design of a simulation engine for relativistic physics. This 4D simulation engine is based on 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 of the observer. This calculation is performed in real time thanks to a GPU implementation, and exploits the notion of space-time invariant. Furthermore a novel model for relativistic interactions between solid objects was developed and implemented within the same framework. 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 misjudgement mistakes on the part of physics students at all levels.

In the summer of 2011, the work of EVEILS led to the design of the first evaluation experiments. They consisted in semi-structured interviews around a VR 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 session of experiments carried out in 2012. We completed the immersive assessment of VR relativity experiments with the addition of haptic interaction techniques. Force feedback rendering is especially interesting in this context because some dynamic aspects of Relativity physics are hard to understand solely based on visuals. Using the same billiard simulation framework, several mappings of the relativistic momentum transfer between the billiard cue and a ball were designed and tested. Specifically, a dedicated technique based on visuo-haptic illusions increased both law understanding and user efficiency within the carom billiard simulator.

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). 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.

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.

Conclusion

In terms of publications, the results of this period are very positive for the VENISE group. Our production, relative to the number of faculty members, is significant, both in terms of journal articles as well as articles in international conferences with reviewing committees.

Beyond publications, the national and international outreach of the VENISE group is quite remarkable with regard to its size. Founding member (as secretary) of the French Association for Virtual Reality (AFRV) and member of the Executive Board of its European counterpart (EuroVR), we held two scientific conferences during the period considered: EuroVR EVE-2010 (held in May 2010) brought together 12 nations and 93 participants for the inauguration of the EVE system. The other one, the 5th AFRV meeting days (in December 2010) brought together 167 participants and welcomed three foreign invited speakers. Following these successes, we have been selected to co-organize the 5th Joint Virtual Reality Conference of EUROGRAPHICS and EuroVR (http://jvrc2013.sciencesconf.org/), in December 2013.

In terms of interaction with the social, economic and cultural environment, the VENISE group actively contributes to the outreach of the laboratory and CNRS in general. Although small, the team is frequently solicited for demonstrations (2-3 per month) for a large variety of audiences: researchers in other academic areas, students from other disciplines (STAPS, Physics, Biology, Design, etc.). Thus innovative ideas are spread to a wide audience due to the very tangible nature of our research, but we also contribute greatly to the popularization of our domain in printed material and on the web (Youtube movies, interviews, Digiteo or ANR symposiums). As noted earlier, our work interests industrial companies (EADS, PSA), and since the EVE system is almost a prototype for several of the technologies of our suppliers (BARCO, Haption, Mechdyne ...) it serves as a showcase for them as well. Finally some of our activities aim at disseminating knowledge through recognized academic channels (didactics). For instance, the goal of a follow-up to the EVEILS project is the creation and evaluation of pilot classes using Virtual Reality technologies for teaching physics to high school students.

In terms of organization, the VENISE group is a tight team with a clear division of labor on voluntarily limited issues related to the expertise of each senior member. From this point of view, the central topic is "collaborative and immersive multi-sensorimotor interaction" with a few key targets. However, our scientific project is more ambitious given the platform we designed and built (EVE system). The scope and versatility of this equipment could address many more problems that we cannot investigate due to the lack of human resources.

Regarding the involvement in research training, we actively participate in the Computer Science Doctoral School, by managing a compulsory module and contributing to several elective courses in the “Interaction” Masters program of Université Paris-Sud. Permanent members of the group also teach Masters classes in other universities or Engineering Schools in the Paris area. In parallel, the teacher-researcher of the team is involved in a very active approach for identifying Internships well in advance of M1. The team was also the initiator and one of the main players in the creation of a practical training room dedicated to Virtual Reality. Another important element of implication is the dissemination of young researchers, both in academia (MoC and postdoc, 30% of them hired abroad) and in the industrial world (3 of our doctors were recruited by EADS as R & D engineers in our field of research). However, if our training of doctoral students is greatly appreciated, this success paradoxically highlights our lack of tenured researchers, because our scientific contributions penetrate the industrial environment without us having the numerical capacity to develop partnerships with these teams.

A specific document will be dedicated to the scientific perspectives of the VENISE research group, so we will not develop them here. Let us simply conclude with the main priorities of the group in the coming years:

1. Develop our research activities in immersive collaborative interaction within the DIGISCOPE project, studying both multi- sensorimotor interactions (Scale 1 haptic device) as well as co-localized or remote collaborations (linking with heterogeneous equipments of other nearby labs).
2. Amplify our collaborations with ergonomists on issues of perception and cognition in VR : presence and cybersickness in virtual navigation, providing physical and vestibular implications, inconsistencies in visual/audio multi-stereoscopy, awareness of others in collaborative immersion ...
3. Evaluate our pre-attentional paradigms with actual remote driving experiences on the SACARI platform, taking advantage of high-bandwith wireless protocols (4G/LTE) to improve immersion. This will contribute to ongoing studies on remote collaboration and telepresence in DIGISCOPE.
4. Pursue further research on the exploration and analysis of data and scientific simulations (multi-sensorimotor exploration, content-aware navigation, Visual Analytics ...), that we intend to develop in the ANR ExaViz project.
5. Capitalize on the achievements of the EVEILS project towards the field deployment of our research in science education (main target : high school physics students).
6. Deploy our original approach in VR for Design and Engineering with new industrial partners, and strengthen our collaboration with PSA.

*Illustration 1: **MalCoMIICs** (**M**ultimod**al** and **Co**-localized **M**ulti-user **I**nteractions for Immersive **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).*

*Illustration 2: **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)*

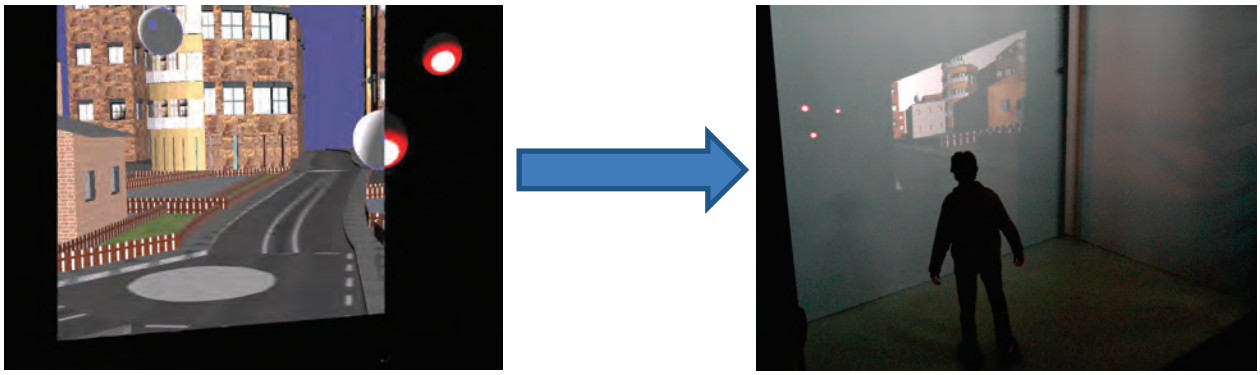

*Illustration 3: **Experimenting pre-attentive vision in a telepresence environment** : the user's visual focus is monitored while presenting him attentional audio-visual stimuli in the EVE system. Note that because of the actual teleoperation setup, no peripheral vision is transmitted back from the remote vehicle to the subject. Nevertheless on-board processing can detect such "early warnings" and send them back to the VR supervisor.*

STAFF

PERMANENT STAFF

Last name	First name	Position	Employer	HDR	Group	Arrival date	Departure date
Boivin	Samuel	CR	INRIA		Venise		Left on 31/07/2009
Bourdot	Patrick	DR	CNRS	HDR	Venise		
Gherbi	Rachid	Ass.Prof.	Université Paris Sud	HDR	AT-Bioinfo		Left on 01/01/2009

Touraine	Damien	Res. Eng.	CNRS		Venise		
Vézien	Jean-Marc	Res. Eng.	CNRS		Venise		

NON PERMANENT STAFF

Last name	First name	Contract	Arrival date	Date of defense
Bertoux	Vincent	CDD	19/05/2008	25/07/2008
Bouyer	Guillaume	Post-Doc	01/11/2007	31/08/2008
Drif	Abdelhamid	Post-Doc	01/09/2007	31/08/2008
Isenberg	Tobias	CDD	01/09/2010	02/12/2012
Kooli	Amani	CDD	01/10/2013	31/05/2015
Ladeveze	Nicolas	CDD	01/10/2013	31/12/2014
Pillias	Clément	CDD	05/12/2011	30/06/2012
Tezier	Gabriel	CDD	01/06/2012	31/05/2015
Thorpe	Jonathan	CDD	01/10/2013	31/05/2015

PHD STUDENTS

Last name	First name	Thesis director	Arrival date	Date of defense
Doat	Tony	Patrick Bourdot	01/06/2009	20/09/2012
Martin	Christine	Rachid Gherbi	01/10/2005	05/12/2008
Menelas	Bob	Patrick Bourdot	01/10/2007	30/07/2010
Picon	Flavien	Patrick Bourdot	01/10/2006	29/06/2010
Tarault	Antoine	Patrick Bourdot	01/10/2003	06/02/2008
Zhang	Weize	Patrick Bourdot	01/09/2007	30/06/2010
Chen	Weiya	Patrick Bourdot	01/10/2012	
Martin	Pierre	Patrick Bourdot	01/05/2011	
Trellet	Mikaël	Patrick Bourdot	01/10/2012	

INTERNSHIPS

Last Name	First name	Arrival date	Departure date	Prepared degree	School / University
Settet	M'Hamed	10/03/08	30/09/08	M2R	Université Paris Sud
Sallé	Thomas	17/03/08	14/09/08	5ème Année Ingénieur	IFIPS
Martin	Pierre	21/04/08	30/09/08	2ème année Ingénieur	IFIPS
Berrabah	Youcef	01/10/08	31/03/09	Master Miage	Université Paris Sud
Li	Yinpeng	01/10/08	31/03/09	Master 1	IFIPS
Tek	Alex	19/01/09	30/06/09	M2R	Université Paris Diderot
Noury	Sébastien	23/03/09	04/09/09	3ème Année Ingénieur	IFIPS
Noury	Sébastien	23/03/09	04/09/09	Master 2	Université Paris Sud
Martin	Pierre	30/03/09	11/09/09	3ème Année Ingénieur	IFIPS
Cazaux	Pierre	08/02/10	11/06/10	4ème Année Ingénieur	Ecole des Mines d'Albi
Weiya	Chen	09/05/11	05/08/11	2ème année Ingénieur	Université Paris Sud
Villien	Sylvain	01/06/11	31/10/11	M2	ENSAM Angers
Aurat	David	06/06/11	26/08/11	2ème année Ingénieur	ENSIIE Evry
Chen	Weiya	15/03/12	30/09/12	3ème Année Ingénieur	Université Paris Sud
Hadjam	Mohammed	01/04/12	30/09/12	Master 2 informatique	Université Paris 8
Hadjam	Mohammed	02/04/12	30/09/12	Master 2 informatique	Université Paris 8
Delmas	Jean	20/02/13	30/04/13	Master	Université Paris Sud
Capel	Benjamin	20/02/13	30/04/13	Master	Université Paris Sud
Audeoud	Yannick	20/02/13	30/04/13	Master Informatique	Université Paris Sud
Tseu	Anthony	15/04/13	29/09/13	Ingénieur	EFREI

INDICATORS OF SCIENTIFIC NOTORIETY

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

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.

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 & co-chair 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

- 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 2010,2011, 2012 and 2013.
- S. Boivin : « Synthèse d'Images Avancées » module in third year of Polytech Paris-Sud Engineering School, 2010.
- 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.
- J-M. Vézien : « Augmented Reality » introductory course of third year of PolyTech Orleans Engineering school 2011 and 2012.
- J-M. Vézien : « Augmented Reality and Computer Graphics» course of the Biometrics Master of Université Paris-Est Créteil, 2012 and 2013.
- J.-M. Vézien : « Vision by Machine » Course of the Master Professional of the École Doctorale d'Informatique of Université Paris-Sud, in 2009, 2010 and 2011.
- J.-M. Vézien : « Vision par ordinateur et Reconnaissance des Formes » Course of « Automatic » section of 3rd year of École Supérieure d'Electricité (Supelec), in 2009 and 2010.

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
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- 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.
- Patrick Bourdot : Conférence « Forum Annuel Digiteo » SIMCoD : a V&AR platform for research on immersive, multimodal, collaborative and remote simulations", 21 octobre 2009, École Polytechnique.
- Tony Doat : Presentation of the EVEILS project at the Grand Colloque STIC 2012, 4-6 january, 2012, Lyon 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)

TABLE OF CONTRACTS FOR VENISE GROUP

Contracts on public fundings	Acronym	Funding agency/ partner	Program	General coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
ANR Basic science & JCJC	EVEILS	ANR	Blanc	Parisot Etienne (APC)	Vézien Jean-Marc	01/05/2009	31/08/2012	159 085
ANR with industrial partners	PERF-RV2	ANR	RNTL	Gelin Rodolphe (CEA-LIST)	Bourdot Patrick	19/12/2005	19/06/2009	70 070
	CoRSAIRe	ANR	ARA MDMSA	Bourdot Patrick	Bourdot Patrick	06/05/2006	05/11/2009	131 700
	ExaViz	ANR	Modèles Numériques	Baaden Marc IBPC)	Ferey Nicolas	01/09/2011	31/08/2015	120 536
Research collaborations	SIMCoD	Digiteo	RV Plateform	Bourdot Patrick	Bourdot Patrick	01/10/2007	30/09/2011	610 200
	BQR 2008	Université Paris XI	BQR	Ammi Mehdi	Ammi Mehdi	01/01/2008	31/12/2008	16 000
	Toute la lumière sur l'ombre	Région Ile de France	PICRI	Jacquemin Christian	Jacquemin Christian	27/11/2008	26/11/2011	74 500
	AVENIR	Digiteo	Chaire de T. Isenberg	Bourdot Patrick	Bourdot Patrick	01/09/2010	31/08/2013	294 964
	SuCRADe	CNRS	PEPS	Vézien Jean-Marc	Vézien Jean-Marc	25/05/2011	31/12/2012	13 000
	DIGISCOPE	Investissement d'avenir	Equipex	Beaudoin-Lafon Michel (LRI)	Bourdot Patrick	01/03/2011	31/12/2019	687 383
	DIGIPODS	Région Ile de France	SESAME	Beaudoin-Lafon Michel (LRI)	Vézien Jean-Marc	09/01/2012	08/01/2027	147 500
Other	EuroVR- EVE	Digiteo	Conference support	Bourdot Patrick	Bourdot Patrick	01/12/2009	30/11/2010	8 000
	AFRV	Digiteo	Conference support	Bourdot Patrick	Bourdot Patrick	01/12/2009	28/02/2011	7 000
UE contract	INTUITION	EU	NOE	Bourdot Patrick	Bourdot Patrick	01/09/2004	31/10/2008	48 649
Research support	portage du code PPLC3D	GENCI/CAPS		Ferey Nicolas	Ferey Nicolas	01/09/2010	31/08/2011	0
PhD supervision		Université de Gênes		Bourdot Patrick	Bourdot Patrick	01/07/2007	30/06/2010	0

Industrial contracts, contracts on private fundings…	Acronym	Funding agency/ Partner	Program	General Coordinator	Responsible for LIMSI	Starting date	Ending date	LIMSI share €
Non-disclosure agreement	SIMCoD	PCA		Bourdot Patrick	Bourdot Patrick	22/01/2010	21/01/2015	0
	EuroVR & AFRV			Bourdot Patrick	Bourdot Patrick	22/01/2010	21/01/2015	0
Research collaboration	RV	PCA		Bourdot Patrick	Bourdot Patrick	01/12/2010	30/04/2011	33 476
PhD supervision		PCA	CIFRE	Bourdot Patrick	Bourdot Patrick	02/05/2011	01/05/2014	53 626
Licence agreement	logiciel ESPIONS	HAPTION		Bourdot Patrick	Bourdot Patrick	27/06/2007	05/05/2009	0

SCIENTIFIC PUBLICATIONS

DOCTORAL THESES AND HDR

1. Doat, T., Espaces virtuels pour l'éducation et l'illustration scientifiques : contribution à l'appréhension de la théorie de la relativité restreinte par la réalité virtuelle 2012, thèse de l'Université Paris Sud. Soutenue à Orsay, France, le 20 septembre 2012, 256 p.
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6. Zhang, W., *Learning Simple Local Features for Object Detection* 2010, thèse de l'University of Zhejiang/LIMSI. Soutenue à Zhejiang, China, le June 2010.

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1. Boukhelifa, N., A. Bezerianos, T. Isenberg, and J.-D. Fekete, *Evaluating sketchiness as a visual variable for the depiction of qualitative uncertainty.* IEEE Transactions on Visualization and Computer Graphics, 2012. **18** (12): pp.2769-2778.
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VIDA
Virtuality, Interaction, Design, & Art

NATHALIE DELPRAT - CHRISTIAN JACQUEMIN

INTRODUCTION

The VIDA (Virtuality, Interaction, Design, & Art) Action 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 Christian Jacquemin as a theme of VENISE, hosted during 2010-2011 by AMI group, VIDA has become a transverse action since March 2012. VIDA gathers members of various groups at LIMSI 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 sciences.

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 activities (such as the Interferences_VIDA or the participation to the Diagonale Paris-Saclay) 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 ACTIVITIES

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 UMR 3495 CNRS/MCC*), 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. The project has been shown in summer 2011 at La Chartreuse during the Avignon Theater Festival and was very well received by the public.

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 library (*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.

Illustration 1: Rendering of stylized graphics for Genius Loci at La Chartreuse-lèz-Avignon, France (photo credit : Aurélie Favre-Brun)

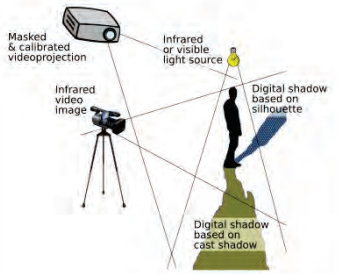

Illustration 2 : Capture and projection set-up fo Toute La Lumière Sur L'Ombre

SOUDDELTA 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.

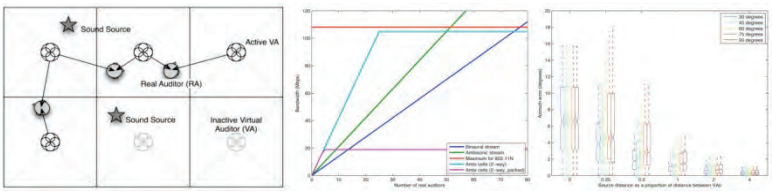

Illustration 3: Ambisonic cell approach concept (left). Bandwidth simulations for different approaches as a function of user numbers (center). Estimated perceived angular error for the Ambisonic cell system as a function of source distance, normalized by cell size (right).

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*** (2007-2011) project, emotions recognized through dance gesture analysis were used to augment a dance performance with a digital face expressing emotions. ***Tophophonie*** (2009-2012) was 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.

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 4: The installation of Canal Haptique during Futur en Seine 2011.

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).

BEAUTIFUL 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-CNRS. It has been awarded the Banff New Media Institute, Beautiful Lives prize in August 2010.

TOPIC 3 : VIRTUAL MATERIALITY FOR COGNITIVE EXPERIMENTS IN ARTS AND SCIENCES

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 (CLOU*D*) addresses 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*), the project has begun through an interdisciplinary approach (CLOU*D* workshop and ESIEA-ARNUM participation in 2010). The K1_CLOUD prototype using a Kinect has been implemented in 2011 and 2012 at *LIMSI-CNRS*. It allows for the investigation of several 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 6: Beautiful Beasts performance. (photo credit IMAL)

Ilustration 7: Interaction with a stratus-avatar. CLOUD prototype K1, (photo credit N. 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.

INDICATORS OF SCIENTIFIC NOTORIETY

EDITORIAL BOARD

- TSI, Special issue on art and Computer Science, June 2013, Christian Jacquemin and Alain Lioret editors.
- Samuel Bianchini Nathalie Delprat, Christian Jacquemin, co-editors of the STMA Proceedings, Harmattan Edition, Paris, January 2012

ORGANIZATION OF INTERNATIONAL OR NATIONAL SCIENTIFIC EVENTS

MEMBER OF THE SCIENTIFIC, TECHNICAL PROGRAM AND / OR ORGANIZATIONAL COMMITTEES FOR INTERNATIONAL / NATIONAL CONFERENCES OR WORKSHOPS

- Technological Simulation and Artistic Materialization (PEPS-CNRS), organization of an art-science workshop in collaboration with Samuel Bianchini (ENSAD and Valenciennes University), 2009
- International Workshop on Movement qualities and physical models visualization organized by S. Fdili Alaoui at Ircam-Centre Pompidou and LIMSI-CNRS, Paris, France. March 1 & 2, 2012.

MEMBER OF PROGRAMME COMMITTEE IN INTERNATIONAL CONFERENCES AND WORKSHOPS:

- 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

INVITED WORKSHOP SPEAKER

- Nathalie Delprat at Workshop of the Studio Lab Project "*Water is in the air*", in collaboration with LEONARDO/OLATS, IMERA Marseille, June 2012

INVITED TALK (NATIONAL OR INTERNATIONAL)

- Art.on.wires festival, Oslo, Christian Jacquemin, Norway, May 2011

PARTICIPATION IN EXPERTISE AND ADMINISTRATION OF RESEARCH

INTERNATIONAL OR NATIONAL SCIENTIFIC NETWORKING

INTERNATIONAL NETWORKS

- National networks or working groups GDR ESARS (Christian Jacquemin member of the scientific committee), 2013
- Contribution to the SEAD (International Network for Science, Engineering, Arts and Design), 2013
- Participation to the Diagonale Paris-Saclay project (as representatives In both the Steering Committee and the Scientific Committee)
- PEPS-CNRS, Simulation Technologique et Matérialisation Artistique, 2008-2009.

TEACHING ACTIVITIES AND DUTIES IN RELATION TO RESEARCH

- Virtual Humans (TER in Master 1st year, and option in Master 2nd year at Université Paris-Sud), Computer Graphics course at Polytech and GPU programming for Image Processing (option in Master 2nd year at Université Paris-Sud)

DISSEMINATION AND VULGARIZATION

ART-SCIENCE MEDIATION

- Festival CuriositAS, U-PSUD, September 2013
- Art-science days, Festival CréaRecherche, U-PSUD, May 21-24th 2012
- Presentation of VIDA, art-science round table, festival CréaRecherche, U-PSUD, may 2012
- Art-science doctoral missions, Sarah Fdilli Aloui 2012 and Alexander Stekov 2013
- Presentation and workshop during “Dance Notation Series”, Amsterdam 2011
- Workshop Dans les Nuages, Researcher's Night at École Polytechnique, September 2011, Palaiseau
- Presentation of NUAG*E*, art-science round table, fête de la Science, 13 October 2011, Créteil

ART-SCIENCE EXHIBITIONS OR PERFORMANCES

- Genius Loci, La Chatreuse-lèz-Avignon, Avignon Theater Festival, July 2012
- Memoires d'Ombres, installation, Médiathèque Taverny, November 2011, and Mediathèque Les Ulis, January 2011.
- Encounter, Interactive Art Exhibition, ACM Multimedia, Florence, October 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.
- 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.

ART-SCIENCE WORKSHOPS OR SEMINARS

- Technological Simulation and Artistic Modelization, January 8-9th at BétonSalon, Paris, 2009

- Particular interactions and vizualisations, first art-science workshop of La Diagonale Saclay, may 2012
- Interferences_VIDA, octobre 2012, february and may 2013

SCIENTIFIC PUBLICATIONS

ARTICLES IN PEER REVIEWED SCIENTIFIC JOURNALS

1. 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.
2. 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.
3. Delprat, N. and C. Jacquemin, *VIDA - Une thématique art-science dans un laboratoire de recherche scientifique.* Technique et Science Informatiques, 2013. **32** (3-4): pp.499-502.
4. 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.
5. 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.
6. 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

1. Ajaj, R., N. Delprat, and C. Jacquemin, Le brouillard comme objet de simulation :la question du sensible et de l'imaginaire, in Simulation technologique et matérialisation artistique - une exploration transdisciplinaire arts/sciences, N. Delprat C. Jacquemin Editeurs S. Bianchini, Editor. 2012, L'Harmattan. pp. 145-155.
2. Bianchini, S., N. Delprat, and C. Jacquemin, Simulation technologique et matérialisation artistique - une exploration transdisciplinaire arts/sciences 2012: L'Harmattan. 194p.
3. d'Alessandro, C., *Orgues, musiques et musiciens à Sainte-Élisabeth*. Vol. 91. 2011: Association Aristide cavaillé-Coll. 224p.
4. 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. Eds Wardman, Eds. 2011, Musica Antica à Magnano. pp. 83-90.

CONFERENCES WITH PROCEEDINGS AND REVIEW COMMITTEE

1. 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.
2. 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. 4p.
3. 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.
4. Favre-Brun, A., L. de Luca, C. Jacquemin, and V. Caye. Revealing the "spirit of the place": Genius Loci, a spatial augmented reality performance based on 3D data and historical hypotheses. in International Conference on Virtual Systems and Multimedia. 2012. Milan, Italy: IEEE. 103-108.
5. 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. 4p.
6. Hung, H. and C. Jacquemin. *Encounter (Resonances)*. in *ACM International Conference on MultiMedia*. 2010. Firenze, Italy. 1421-1424.
7. 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. 1353-1362.
8. 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. 173-182.
9. Jacquemin, C. and B. Martin. Interactive animation of a largescale crowd for art installations. in International Symposium on Electronic Art. 2010. Ruhr, Germany. 5p.
10. 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.

11. 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

1. Ajaj, R., N. Delprat, and C. Jacquemin. The fog as a simulation object : from sensorial perception to imaginary aspects. in Journées d'études sur Simulation technologique et matérialisation artistique. 2009.
2. Delprat, N. Imagination matérielle et images virtuelles. in colloque Bachelard 2012. 2012: ENS-ULM.

IMMI
Institute for Multilingual and Multimedia Information

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 (IMMI-Labs (LEA 547)), which conducts the research investigations, and an International Joint Unit (IMMI (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, speech, 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 those of the European Commission[16].

IMMI's mission is to support the coordination of research conducted in the partner laboratories. Its staff is therefore intentionally reduced to a few core 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 160 people, on the three sites. This is probably nowadays the largest public research task force on Language Technologies worldwide. Consistent with its role of supporting research on LT for multilingualism internally and within Quaero, IMMI is also involved in coordinating activities and promoting the field at local, national, European and international levels, as we will describe.

IMMI was launched in December 2007 and inaugurated in July 2009. It has been evaluated by the CNRS Comité National de la Recherche Scientifique in September 2011. The conclusions of the visiting committee mention: “Altogether, the balance is highly positive. IMMI and IMMI-Labs have succeeded in gathering an extraordinary amount of funding through their clever positioning and activity, their ability to invent and adapt structures and organisation. They have very well succeeded in developing high level research and producing breakthroughs and progresses.”. Following the evaluation, IMMI was renewed for 4 years (2012-2015).

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 32 partners nowadays, from France and Germany, with a budget of € 198 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. Therefore, 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 of a technology to the needs of an application. IMMI is part of the Quaero Integrated Management Team, together with Technicolor and the DGA, where Martine Garnier-Rizet is responsible for the dissemination of scientific and technical information[17]. Research activities in Automatic Speech Recognition and in Machine Translation are respectively

[16] http://www.immi-labs.org/
[17] http://www.quaero.org

coordinated by LIMSI and RWTH. The funds provided to the IMMI partners amount to about € 20 million over the 5 years of the program, and most of the collaborative research activities are conducted in this framework.

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 on 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 (also called "coopetition"). 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 improvements.

These results have been published in more than 770 communications and publications, including 142 joint publications, since the beginning of the program in 2008 up to July 2013. More than 50 theses have been conducted and the Quaero partners participated in at least 70 technology evaluation campaigns worldwide. 75 technology modules have been delivered by the CTC project to the application projects, while 12 corpus have been made available to the research community, and 31 patent applications have been filed. IMMI maintains the list of publications and the Web site, which has been completely redesigned in 2013. It produced a catalogue of technology modules and a set of videos demonstrating the Quaero results. It organized the biannual Plenary meetings and the Quaero TechDay in March 2013 in Paris, including the publication of a Press kit, a Quaero White Paper and four videos to showcase

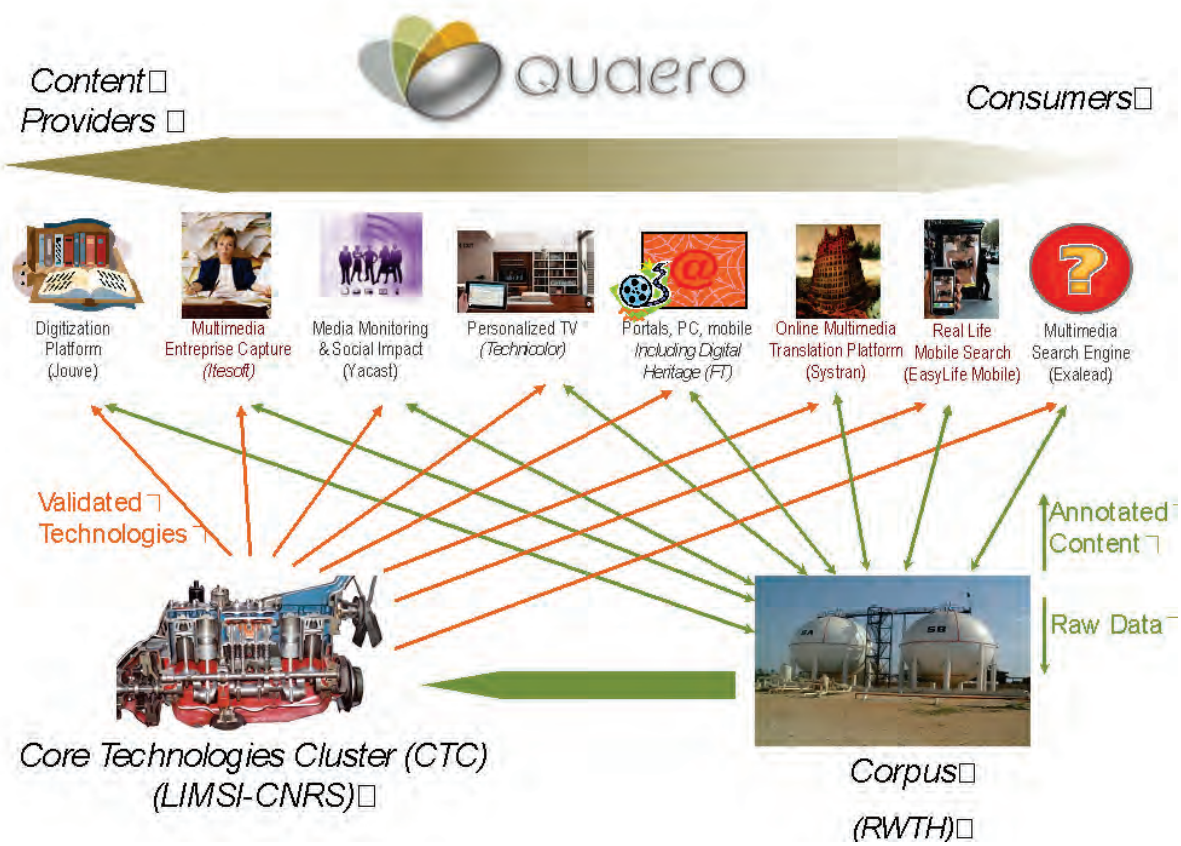

Illustration 1: Quaero Program Architecture

(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 deployed into a service that makes lectures and transcripts available, Voxalead Education, and on applications related to media monitoring and social impact analysis by Yacast. Also, thanks to the automatic transcription of the past President of Republic

speeches, it was possible to navigate through the videos on the Elysée site. Current developments address the increase of the number of languages covered, targeting the 24 European Union languages, 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 within the Mobile Technologies company, which was bought by Facebook in August 2013.

LOCAL

Locally, IMMI is involved in the Digiteo RTRA[18]. 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 years Digiteo Chaire d'Excellence senior was obtained by Hermann Ney from RWTH in 2009. A University Paris Sud PhD thesis on handwriting recognition has been initiated under H. Ney's supervision in 2011, in collaboration with the A2IA company, while T. Fraga da Silva conducts his thesis at LIMSI in Orsay and RWTH in Aachen.

As a representative of CNRS, J. Mariani participated in the Executive Board and the Advisory Council of the Systematic competitiveness cluster, and in the Pilot committee of the IdEx Paris Saclay Institute for a Digital Society (ISN) where it is planned to create an Infolab. Discussions are underway regarding the participation of IMMI in the Security and Multimedia program of the IRT Systemix.

In the dynamics associated with the French-German collaboration and with the Quaero program, the construction of a 2,700 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 € 2.3 million. The architect Franck Vialet was selected in March 2013 for the design and construction of the building, which will gather in a rational way the various places presently hosting LIMSI and IMMI activities.

NATIONAL

Nationally, IMMI is involved in the promotion of Language Technologies with various ministries. J. Mariani 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, etc.)). IMMI was a partner in the « Towards a Multilingual Citizenship: a Translation Turn for Europe » (TTE) EC submitted proposal, together with DGLF2 (Xavier North) and CNRS-Centre Léon Robin (Barbara Cassin).

J. Mariani also intervened with 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 Multimédia) annual DGA seminar, and with the Ministry of Foreign Affairs (MAE), which conducted a survey on the effect of Machine Translation on the status of the French language worldwide.

As co-chair of the Pilot Committee of the ANR CONTINT program, J. Mariani promoted the launching of the REPERE Multimodal Person Identification Challenge. M. Garnier Rizet chaired the "Knowledge" Commission of the Cap Digital competitiveness cluster, and is now in charge of the CONTINT Program within ANR.

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

EUROPE

On the European plan, IMMI was a partner of FlaReNet[19] (the Fostering Language Resources Network) (2008-2011), which aimed at promoting the production and dissemination of Language Resources (data, tools and services) and had 99 institutional members and 398 research associates. J. Mariani was a member of the Steering Committee of the network and was responsible for the Evolving Roadmap Workpackage on the linguistic and topical diversity of Language Resources. In this context, he directed an international overview of Language Resource programs after having established a network of 103 national contact points in order to provide reliable information. This report is available online as a wiki, which can be updated continuously. J. Mariani 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 participated in the organization of the Vienna (2009), Barcelona (2010) and Venice (2011) Forums, and of 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 was also part of the EC T4ME (Technologies for a Multilingual Europe) project (2010-2013), which has established the Network of Excellence META-NET[20] (Multilingual Europe Technology Alliance Network). As of July 2013, this network comprises 60 research centers in 34 countries, and has strong links with three EC PSP projects (METANET4U, META-NORD and CESAR). J. Mariani was a member of the T4ME META Council and of the META-NET Executive Board. He is a founding member of the META-TRUST association.

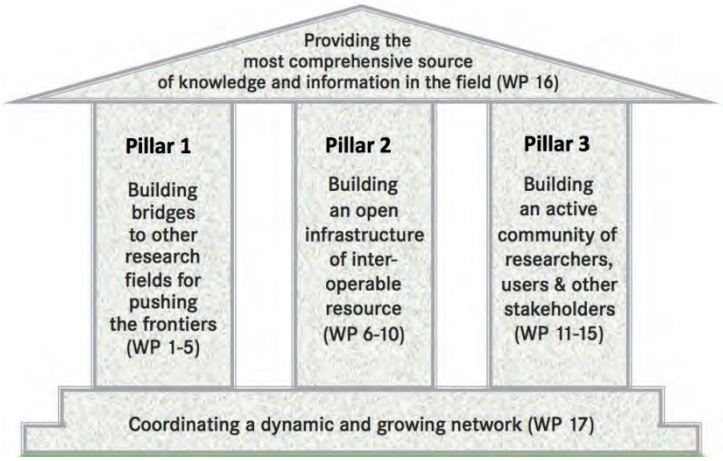

Illustration 2: Architecture of the T4ME EC project.

IMMI through LIMSI and RWTH, participated in the Pillar 1 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 was involved in the establishment of the Pillar 2 Open Resource Infrastructure for sharing Language Resources ("META-SHARE"), where Gil Francopoulo especially brought his expertise in metadata. It finally strongly intervenes in activities related to the promotion of this research area and to its organization for the coming years (Pillar 3 "META-VISION").

[19] http://www.flarenet.eu/
[20] http://www.meta-net.eu/

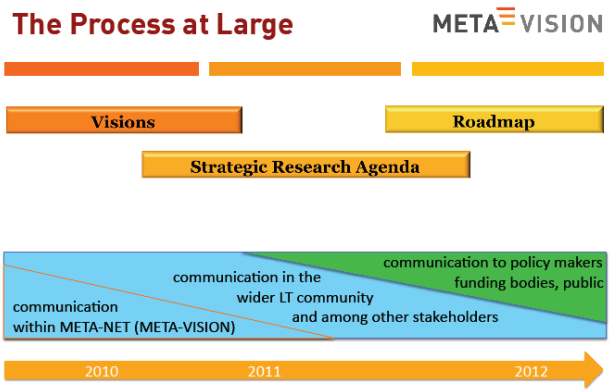

Illustration 3: The META-Vision process

Here, it had 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 that has been published by Springer in September 2012.

Figure 4: The White Paper on the French Language and the Strategic Research Agenda LT2020

J. Mariani and A. Waibel coordinated the Interactive Systems Working Group, respectively as convenor and as chairman, and contributed to the drafting of the Strategic Research Agenda (especially on the "Socially Aware Interactive Assistants" theme) which was also published by Springer in January 2013 and 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, and the Connecting Europe Facility (CEF) program, which includes Automated Translation and Language Resources to support pan-European digital services. In continuation of META-NET, J. Mariani is a member of the Planning Panel of the EC QTLaunchPad project and in the Roadmap Board of the EC Rockit project, and was invited to participate in the Unity in Diversity conference on European languages organized by the Lithuanian presidency of the EU in September 2013.

IMMI is a member of the CAMOMILE (Collaborative Annotation of Multimodal, Multilingual and Multimedia Documents) project (2012-2016) supported by ANR within the CHIST-ERA program supported by the EC. CAMOMILE regroups 6 partners from 4 European countries (France, Luxembourg, Spain and Turkey). IMMI is in charge of the "Annotation Guidelines" and "International Guidance" tasks, within the "Collaborative Annotation" Workpackage. Prof. S. Tamura from Gifu University (Japan) visits us in this framework on Fall 2013.

INTERNATIONAL

Internationally, IMMI is particularly active in the European Language Resources Association (ELRA)[21], in which J. Mariani was elected honorary president in 2010, and in the organization of the LREC (Language Resources and Evaluation Conference) series, which gathers every two years over 1,200 people. IMMI organized the International Workshop on Spoken Language Translation (IWSLT'10) in Paris in December 2010 (J. Mariani and A. Waibel co-chairs of the workshop, François Yvon co-chair of the Program Committee and M. Garnier-Rizet President of the Organizing Committee) and participated in the organization of IWSLT'11 (San Francisco, chaired by A. Waibel) and IWSLT'13 (Heidelberg, A. Waibel and J. Mariani co-chairs). It organized the International Workshop on Spoken Dialog Systems (IWSDS'12) in November 2012 in Paris, which resulted in a book published by Springer. It now organizes an international workshop on Machine and Human Error Analysis in Multimedia Data Processing (Errare) in November 2013 in Paris.

IMMI also helped organizing the first Tralogy[22] (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. Following its success, a second conference Tralogy II "Finding the way: where are our shortcomings and our individual needs?" took place also at CNRS in January 2013, including the same partners, and a third one "Translation Fitted for Purpose" is being organized in Strasbourg in 2015, including German participation (DFKI, KIT and RWTH).

J. Mariani participated in several initiatives of the global network for language diversity MAAYA[23] 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 (January 2009), where a manifesto on Language Diversity was drafted, and at the International Symposium on Multilingualism in Cyberspace (SIMC) in November 2011 in Brasilia and in November 2012 in Paris. He wrote a chapter in the "Towards the Multilingual Cyberspace" bilingual book released in March 2012. Alex Waibel, IMMI associate director, runs InterACT, an international network of laboratories supporting an exchange program on interactive systems that brings together seven universities all over the world. IMMI is a member of the TAUS and ELRA associations, and of the META-NET, CLARIN and LT-Innovate EC networks.

PERSPECTIVES

IMMI is now preparing its future, according to the reduction of the collaboration momentum due to the end of the Quaero program in December 2013. 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. The exchange program of German researchers will be developed in the context of joint research. The collaboration area will stay on 3M (Multilingual, Multimedia and Multimodal) document processing, possibly also covering visual information processing, character recognition and sign languages, and may be extended to other countries, through the Interact initiative. It is planned to strengthen the activities on Language Resources, through the participation in the CAMOMILE project and the study of the ethical dimension of data production and sharing, and on Technology Evaluation, developing the analysis of machine and human errors, in order to improve the Language Resources and Technology Evaluation paradigms in various areas. The construction of a new building and the acquisition of computer facilities will allow for benefiting from enhanced infrastructural means at LIMSI.

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.

[21] http://www.elra.info/
[22] http://www.tralogy.eu/
[23] http://www.maaya.org/

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), S. Lévy (Communication), A. Azhar (Computer Systems), G. Francopoulo (Expert Researcher), G. Adda (Expert Research Engineer), J. Temem (Short Term Engineer for Web Communication).

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- KIT (2008) "EBF European Research Award 2008" for Hazim Kemal Ekenel - Brussels, Belgium, October 2008
- J. Mariani and H. Ney (2009) Fellows of the International Speech Communication Association (ISCA), September 2009
- LIMSI (2009) Most Practical presentation at the ACM Multimedia Grand Challenge 2009 – Beijing, China, October 2009
- RWTH (2009) Best student paper award at ASRU'09 – Merano, Italy, December 2009
- LIMSI (2010) Médaille de Cristal CNRS 2010 for Gilles Adda – Paris, France, February 2010
- J. Mariani (2010) Honorary President of the European Language Resources Association (ELRA)
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PARTICIPATION IN EVALUATION CAMPAIGNS AND RESULTS

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- LIMSI (2008) 1st in QA@CLEF'08 (main track and audio track – QAST evaluation), Aarhus, Denmark, September 2008
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- LIMSI (2008) Darpa Gale 2008, part of the Agile team led by BBN
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- LIMSI/Vocapia (2008) NBest 2008 with Vocapia (top ranked results for all submissions)
- RWTH (2009) 3rd at the ICDAR'09 Arabic Handwriting Recognition Competition, Barcelona, Spain, July 2009
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- LIMSI (2009) Ester2 evaluation campaign 2009 (segmentation, speaker diarization, STT, top ranked results for all submissions)
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- LIMSI (2010) 2010 NIST Speaker Recognition Evaluation
- LIMSI (2011) WMT 2011: Best MT system for English to French translation, Edinburgh, UK, July 2011
- LIMSI (2011) Darpa Gale 2011, part of the Agile team led by BBN
- LIMSI Etape Speaker diarization and Named entities Evaluations
- LIMSI/RWTH/KIT/Systran (2011) Jointly (with Aachen, KIT and Systran) best German/English system at WMT 2011, Edimbourg, UK, July 2011
- LIMSI (2011) 2011 NIST Language Recognition Evaluation
- LIMSI/Vocapia (2011) 1st rank at ASR benchmark task of Evalita 2011
- LIMSI (2011) IWSLT 2011: Best MT system for English to French translation, San Francisco, USA, December 2011
- KIT (2011) IWSLT Talk Task ASR Evaluation, 2011 second place, MT first place, San Francisco, USA, December 2011
- LIMSI (2012) ANR REPERE dry run, January 2012
- LIMSI (2012) 2012 NIST Speaker Recognition Evaluation
- KIT (2012) WMT 2012, 4times constrained winner, Montreal, Canada, June 2012
- LIMSI (2012) WMT 2012: 1st French/English MT system, Montreal, Canada, June 2012
- LIMSI/RWTH/KIT/Systran (2012) Jointly (with Aachen, KIT and Systran) Best German/English system at WMT 2012, Montréal, Canada, June 2012
- KIT (2012) IWSLT Talk Task Evaluation, 2012, second place, SLT-Task first place, Hong Kong, December 2012
- RWTH (2012) IWSLT 2012: RWTH best system (Ar->En), Hong Kong, December 2012

CONTRACTS (MANAGED BY LIMSI OR IMMI)

QUAERO

Funding Agency: Oséo Innovation

Partners: France: Technicolor (Coord.), France Telecom, Jouve, Exalead, Yacast, Bertin Technologies, LTU Technologies, Synapse, Vecsys, Vocapia Research, Itesoft, Movea, Systran A2IA, Bibliothèque Nationale de France (BNF), Institut National de l'Audiovisuel (INA), Laboratoire National de Métrologie et d'Essais (LNE), Direction Générale de l'Armement (DGA), Institut Télécom, INIST-CNRS, INRA, INRIA, IRCAM, IRIT, LIMSI-CNRS, CNRS–GREYC, CNRS–IMMI, LIPN, UJF, Germany: RWTH Aachen University , Karlsruhe Institute of Technology (KIT)

Topic: Multilingual and Multimedia Document Processing

Duration: 5 years (May 2008 – December 2013)

Total budget/funding: 199/99 M€

IMMI budget/funding: 1.7/1.7 M€

LIMSI budget/funding: 16.6/8.3 M€

RWTH budget/funding: 10.3/5.1 M€

KIT budget/funding: 10.3/5.1 M€

FLaReNet (Fostering Language Resources Network)

Funding Agency: European Commission

Main Partners: CNR-ILC (Italy, coord.), Univ. Vienna (Austria), Univ. Pompeu Fabra (Spain), CNRS LIMSI & IMMI (France), ELDA (France), ILSP (Greece), Univ. Utrecht (The Netherlands). Other partners: Max Planck Institute for Psycholinguistics, Bielefeld University, DFKI, Linguatec, Langenscheidt, Siemens (Germany), University of Antwerp (Belgium), Bulgarian Academy of Sciences (Bulgaria), University of

Copenhagen (Denmark), Universitat Politècnica de Catalunya (Spain), CEA LIST (France), Sheffield Univ., The Open University, University of Manchester (UK), Morphologic.(Hungary), Fondazione Bruno Kessler (Italy). Vrije Universiteit Amsterdam (The Netherlands), Adam Mickiewicz University (Poland), Romanian Academy of Science (Romania), Jožef Stefan Institute (Slovenia), Charles Univ. (Czech Republic).

Topic: Fostering Language Resources

Duration: 3 years (September 2008 – August 2011)

Total Budget: 900 K€

IMMI Budget: 36 K€

T4ME (TECHNOLOGIES FOR A MULTILINGUAL EUROPE)

Funding Agency: European Commission

Partners: DFKI (Germany, Coord.), RWTH (Germany), Barcelona Media (Spain), Aalto Univ. (Finland), CNRS-LIMSI & IMMI (France), ELDA (France), ILSP (Greece), CNR-ILC (Italy), Utrecht Univ. (The Netherlands), Charles University (Czech Republic), Jožef Stefan Institute (Slovenia), Fundazione Bruno Kessler (Italy), Dublin City University (DCU) (Ireland).

Topic: Launching a Network of Excellence on Language Technologies to support Multilingualism.

Duration: 3 years (February 2010 – January 2013)

Total budget: 7.6 M€

IMMI budget/funding: 714.3/536.5 K€

CAMOMILE (COLLABORATIVE ANNOTATION OF MULTIMODAL, MULTILINGUAL AND MULTIMEDIA DOCUMENTS)

Funding Agency: ANR, within the EC funded CHIST-ERA program

Partners: LIMSI (France, Coord.), IMMI (France), CRP-Lippman (Luxemburg), ITU (Turkey), UPC (Spain), LIG (France)

Topic: Designing an infrastructure for the collaborative annotation of multimodal, multilingual and multimedia documents

Duration: 4 years (October 2012 – March 2016)

Total budget: 600 K€

IMMI budget/funding: 241.4/120.6 K€

SCIENTIFIC PUBLICATIONS

ARTICLES IN PEER REVIEWED SCIENTIFIC JOURNALS

1. 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.

BOOKS & CHAPTERS IN BOOKS

1. 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.
2. Mariani, J.-J., P. Paroubek, G. Francopoulo, A. Max, F. Yvon, and P. Zweigenbaum, *The French language in the digital age / La Langue française à l'ère du numérique* 2012: Springer. 102p.
3. 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.

CONFERENCES WITH PROCEEDINGS AND REVIEW COMMITTEE

1. Calzolari, N., R. Del Gratta, G. Francopoulo, J.-J. Mariani, F. Rubino, I. Russo, and C. Soria. *The LRE map. Harmonising community descriptions of resources*. in *International Conference on Language Resources and Evaluation*. 2012. Istanbul, Turkey. 1084-1089.

2. Fraisse, A., P. Paroubek, and G. Francopoulo. L'apport des Entités Nommées pour la classification des opinions minoritaires. in Conférence sur le Traitement Automatique des Langues Naturelles. 2013. Les Sables d'Olonne, France. 588-595.
3. Gavrilidou, M., P. Labropoulou, E. Desipri, S. Piperidis, H. Papageorgiou, M. Monachini, F. Frontini, T. Declerck, G. Francopoulo, V. Arranz, and V. Mapelli. *The META-SHARE metadata schema for the description of language resources*. in *International Conference on Language Resources and Evaluation*. 2012. Istanbul, Turkey. 8p.
4. Mariani, J.-J., P. Paroubek, G. Francopoulo, and M. Deleborde. Rediscovering 25 years of discoveries in spoken language processing: a preliminary analysis of the ISCA archive. in Annual Conference of the International Speech Communication Association. 2013. Lyon, France. 33p.
5. Soria, C., N. Bel, K. Choukri, J.-J. Mariani, M. Monachini, J. Odijk, S. Piperidis, V. Quochi, and N. Calzolari. *The FLaReNet strategic language resource agenda*. in *International Conference on Language Resources and Evaluation*. 2012. Istanbul, Turkey. 1379-1386.

CONFERENCES WITHOUT PROCEEDINGS, WORKSHOPS

1. 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.
2. Calzolari, N. and J.-J. Mariani. Introduction of the international cooperation session. in FLaReNet Forum 2010. 2010. Barcelona, Spain.
3. Calzolari, N. and J.-J. Mariani. *The FLaReNet Community: the Way Forward*. in *FLaReNet Forum 2011*. 2011. Venice, Italy.
4. 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.
5. Mariani, J.-J. International Language Resources Mapping. in Oriental COCOSDA. 2010. Katmandhu, Nepal.
6. 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.
7. Mariani, J.-J. *Opening Remarks*. in *Oriental COCOSDA*. 2011. Hsinchu, Taiwan.
8. Mariani, J.-J. The Future European Multilingual Society. in International Conference on Powerful Technologies for the Multilingual European Information Society. 2011. Budapest, Hungary.
9. Mariani, J.-J. European Activities in Language Technology, in the Perspective of FP8. in Speech Processing Conference 2011. 2011. Tel Aviv, Israel.
10. Mariani, J.-J. A Journey from the LRE Map to the Language Matrixes. in FLaReNet Forum 2011. 2011. Venice, Italy.
11. Mariani, J.-J. Introduction of the Identification and Tracking of Language Resources Session. in FLaReNet Forum 2011. 2011. Venice, Italy.
12. Mariani, J.-J. L'apport des technologies de la langue au multilinguisme. in Etats Généraux du Multilinguisme dans les Outre Mer. 2011: Ministère de la Culture.
13. 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: Ministère de la Culture.
14. Mariani, J.-J. Language resources and evaluation for a multilingual Europe. in Language Technology Workshop. 2012: Academy of Science.
15. Mariani, J.-J. Pour une éthique de la recherche en sciences et technologies de l'information et de la communication. in Agents Autonomes et Ethique. 2012: LIRIS/Université Claude Bernard Lyon 1/AFIA/AFRIF.
16. Mariani, J.-J. and C. Soria. Identifying and Networking Forces: An International Panorama. in FLaReNet Forum 2011. 2011. Venice, Italy.

LIMSI Organization- 2013

(The names of the heads appear in italics)

Central Services Group
K. Bassoulet

AMIC (Computers): *J.C. Barbet*, A. Azhar, A. Depauw, O. Lassalle, E. Piotelat, N. Rajaratnam
Library : *M. Roserat*, I. Lollia
Infrastructure, Logistics & Audiovisual : *P. Desroches*, D. Bellande (CDD), G. Bélizon, R. Poirot (CDD)
Training : *I. Lollia*
Secretary : B. Daly

Advisory Council

Security
L. Pointal
A. Choisier

Management

Director : P. Le Quéré (until 06/30/2013)
F. Yvon (from 07/01/2013)
Deputy Directors : C. Tenaud, A. Vilnat
Administrator : K. Bassoulet
Secretary : S. Pageau-Maurice

Administrative coordination
K. Bassoulet

HMC dpt : *C. Hoint*, L. Rostaing
Mechanical dpt : *V. Ronflé*
Central Services Group : *S. Pageau-Maurice*, B. Daly

Mechanics & Energetics department

C. Tenaud, Secretary : *V. Ronflé*

CIGITA (Computer Graphics & Thermoaeraulic Engineering Support) Y. Fraigneau, J. Chergui
Experimental Support : *V. Bourdin*, D. Caqueret, V. Gautier, Y. Maire

Unsteady Aerodynamics: Turbulence & Control
B. Podvin

High performing numerical methodologies
O. Le Maître

Unsteady flows
F. Lusseyran

Manipulation and flow control
L. Mathelin

Convection & Rotation
C. Nore

Convection
A. Sergent

Free surface flows
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
S. Kouidri

Heat transfer from solid to superfluid helium
J. Amrit

Applied convective transfers
M. Pons

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
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Ambient & Interaction
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Haptic interaction & communication
M. Ammi

Interaction on tactile surfaces
F. Vernier

Cognition, Perception & Uses
J.C. Martin

Perceptual systems & models
Ph. Tarroux

Image, language, space
M. Denis

Cognitive ergonomics
C. Clavel

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