

# Curriculum Vitae

M. Garbey

## 1 Contact

Marc Garbey

Professor

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## 2 Education

- Maitrise (Mathematics) Univ. of Lyon1, 1977.
- Master in Teaching Mathematic (CAPES), 1979.
- Degree in Computer Science (licence), Univ. of Grenoble 1981.
- PHD (Applied Mathematics) Ecole Centrale de Lyon, 1984.
- Habilitation (Applied Mathematics) , Univ. of Lyon1, 1989.

## 3 Academic Position

- Professor in Computer Science, Univ. of Houston, 01-
- Senior Scientific Liaison - Methodist Institute for Technology Innovation and Education, 11-
- Adjoint professor in the dept. of Mathematic at Univ. of Houston, 02-
- Professeur, Laboratoire des Sciences de l'Ingénieur pour l'Environnement - LaSIE FRE-CNRS 3474  
Université de La Rochelle, 12-
- Adjoint Professor in the dept. of Engineering Technology, College of Technology, University of Houston, 04-

- Chairman of the department of Computer Science of UH, 09/04-08/09.
- Professor in Applied Mathematic, Univ. of Lyon1, 90-11
- Scientific Consultant, Inria of Lorraine, 95-97
- Maitre de Conference, Ecole Normale Sup. of Lyon, 88-90.
- Visiting Scientist, Argonne Nat Lab and Northwestern Univ. 87-88.
- Maitre de Conference, Univ. of Valenciennes, 84-87.
- Teacher in High School, 1978-1984.

## 4 Research

### 4.1 Grants since 2003

- *National Science Foundation, CISE 0305405, 02/01/2003-01/09/2006, \$ 300 K*

Role: PI

#### **Efficient Algorithm for Metacomputing of PDE**

*Abstract:* The objectives of this research are (1) to develop a family of hierarchic domain decomposition methods for elliptic solvers, for general discretization that are optimized according to the memory configuration of the distributed parallel system, (2) to provide algorithms that are efficient, robust, highly tolerant to low memory bandwidth and high latency when it is needed, and that scale with the memory.

- *DOE-Sandia Nat. Lab, 09/01/03 - 08/31/06, \$ 240 K*

Role: PI

#### **Robust A posteriori Error Estimate for Thermal Transport and Fluid Mechanics Applications**

*Abstract:* This grant addresses the challenge of solution verification and accuracy assessment for large scale parallel computing of thermal transport and fluid dynamic applications. We analyze and extend our new method for an a posteriori error estimate based on a least square extrapolation that is more robust and reliable than Richardson extrapolation.

- *National Space Biomedical Research Institute 02/01/04 - 01/31/07, \$ 150 K*

Role: Co-PI with I.Pavlidis (PI)

#### **Automated Physiological Monitoring at a Distance**

*Abstract:* The goal of this project is to develop a bio-heat transfer model in combination with thermal image analysis to compute, from a distance, metabolic indicators related to blood flow, speed and pressure.

- *NATO, 09/01/04 - 08/01/06, \$ 20 K*

Role: PI-M. Garbey, with co-PIs R. Keller (HLRS-Stuttgart), Y. Vassilevski (INM-Moscow), F. Hulsemann (Erlangen)

## **Improving the Reliability of Computer Simulations to Predict Environmental Risks**

*Abstract:* The proposed work concentrates on a feasibility study to demonstrate that fast, robust and fault tolerant elliptic and parabolic solvers can run efficiently on a heterogeneous grid of loosely coupled parallel computers. We have already proven the feasibility of the concept for efficient metacomputing of elliptic solvers with a dedicated network of Cray T3E distributed in Finland, Germany and the US.

- *Microsoft, e-science program, 10/01/04-10/01/05, \$ 20 K*

Role: PI-M. Garbey, with co-PIs I.Kakadiaris, H.Melki, I. Pavlidis and G.Zouridakis.

## **Large-Scale Integration of Different Data Modalities for Computational Medical Sciences**

*Abstract:* This seed money project was designed to obtain the preliminary results for the following MRI-NSF project.

- *National Science Foundation : Major Research Instrumentation (MRI) 08/01/05 - 07/30/08, \$ 900 K*

Role: Co-PI, with G.Zouridakis (PI) and Co-PIs I.Kakadiaris, I.Pavlidis and R.Vilalta all from CS@UH.

## **Acquisition of a Hybrid System and Research Infrastructure for Large-Scale Integration of Biomedical Data**

*Abstract:* This project, focusing on methodologies and architectures for extracting information and integrating heterogeneous information systems, and mining multimedia/multimodality data collected in real time, services a large community of users with common interests in the areas of biosignal analysis and biocomputation.

- *National Science Foundation: Tera Grid DAC 06/07/07 - 06/07/08*

Role: PI

## **Performance Analysis of Computational Fluid Dynamic Applications in Large Scale Environment**

*Abstract:* Three different solvers for Computational Fluid Dynamic (CFD) applications that combine algorithm tolerance to high latency network, load balancing and fault tolerance will be tested on high performance computers offering large resources (hundreds of processors) and fast network interconnects with the latest hardware technology evolution (multi-cores). Performance analysis will be done to validate the new algorithm design.

- *INRIA - "Equipe Associée to the project MC2 of Thierry Colin-Bordeaux", 01/01/08-12/31/10, Euro 60 K.*

Role: Pi as the US partner.

## **Parallel Computing for Biology and Medicine**

*Abstract:* The Team Inria/MC2 (Bordeaux - France) of Pr. Thierry Colin has developed innovative computational models for micro-fluidic applications as well as tumor cancer growth. The team of M.Garbey has an extensive experience in parallel computing for reaction-diffusion and fluid dynamic problems applied to computational medicine

problems. The objective of this international cooperation is to benefit the synergy of these two teams to make dramatic progress toward numerically efficient multiscale micro-fluidic and cancer tumor simulations.

- *Partner University Fund, Ministère des Affaires Etrangères, France, 09/01/08-09/01/11, \$ 240 K.*

Role: Pi as the US partner with B.Bass (co-Pi), M. de Mathelin (Pi as the French partner) and C. Collet (co-PI).

### **Computational Surgery and Dual Training**

*Abstract:* A partnership between the Department of Computer Science at University of Houston and the Department of Surgery at The Methodist Hospital Research Institute is proposed to liaison with the University of Strasbourg to develop a program in computational surgery with dual training. The intent of this program is to bring computer scientists together with surgeons to enhance the ability of both to improve interventional procedures surgeries.

- *DOD, 09/01/08-09/01/09, \$ 140 K.*

Role: co-Pi with S.Shah (Pi), E.Gabriel (co-Pi) and R.Zeng (co-Pi)

### **DURIP: Heterogeneous Smart Camera Networks for Collaborative Missions,**

*Abstract:* The goal of this Defense University Research Instrumentation Program (DURIP) proposal is to acquire hardware equipment to enable research projects and to enhance the research related education capabilities in three scientific areas: wireless networking, computer vision, and parallel processing. The overall research goal enabled by this equipment infrastructure is to develop a smart camera network system for collaborative automated object recognition and tracking across large geographical spaces.

- *CNRS & Cemagref, 09/01/08-09/01/09, Euro 25 K.*

Role: co-Pi with C.Mony (Pi - Univ. of Rennes 1) and A.El Hamidi (co-Pi - Univ. of La Rochelle)

### **Computational ecology applied to the optimum engineering design of unfertilized grass strip**

*Abstract:* Grass strip have demonstrated their positive benefit to limit pollution in agriculture. Systematic modeling of clonal plant growth has been done with a collaboration between C.Mony specialist in Ecology and myself. The new contribution of my group is to perform the individual base model optimum design with volunteer computing. This project will require the computation of thousand of computers for several months. Reduced model based on differential equation, that can be used in the field, will be then best fitted by A.El Hamidi's research group.

- *NSF, 08/01/08-08/31/10, \$ 446 K.*

Role: co-Pi with I.Pavlidis (Pi) and B.Bass (co-Pi - Chair Dept of surgery, Methodist Hospital)

### **Do Nintendo Surgeons Defy Stress?**

*Abstract:* The primary hypothesis of this proposal is that the best way to study stress

is through unobtrusive quantification of facial physiology and while people are engaging in critical and challenging tasks, such as surgeon training. The proposed project aims to: 1) Develop an integrated computational suite of unobtrusive stress quantification methods that are anchored on facial physiology. 2) Correlate physiological manifestations of stress on the face with observation of expressions to reveal the linkage between stress and a palette of emotions. 3) Understand the role of stress in performance of critical human tasks, starting with surgeon training.

My contribution is on Infrared image base simulation and bioheat modeling.

- *ANR-INRIA System Complex, 2009-2011, UH part \$21K*

Role: US Partner, with C.Mony (Pi).

### **Using mathematical MODELing to improve ECOLogical services of prairial ecosystems (MODECOL).**

see ViP Project.

- *CNRS, Program PICS, 01/01/09-12/31/11, 15 K Euro*

Role: Pi as the US partner, with C. Mony (Pi in France)

### **Development of an hybrid model for simulating a Virtual Prairie: application to the creation of herbal strips in agricultural landscapes consequently to the new agroenvironmental policy,**

see ViP project.

- *NIH, R01, HL095 508-01, 04/15/09-04/15/13, \$ 1000 K,*

Role: co-Pi with S. Berceci (Pi, Department of Surgery, University of Florida) and R. Tran Son Tay (co-PI MAE, University of Florida),

### **Multiscale Network Modeling of Hemodynamic Driven Vascular Adaptation**

*Abstract:* Using state-of-the-art techniques in mathematics, engineering, and computer science to integrate fundamental biologic and physical data, development of a predictive model of vascular adaptation following acute intervention. Our multidisciplinary team approach uses both experimental data and computational models to understand these dynamic phenomena, and most importantly to predict outcomes to specific perturbations. Such information is vital for translation to effective clinical strategies to enhance revascularization durability.

- The Methodist Hospital - Department of Surgery, \$65 K/year since 09/01/2008

Role: Pi.

### **Computational Framework for Breast Conservative Therapy**

Collaboration with Barbara Lee Bass, M.D., John F. and Carolyn Bookout Distinguished Endowed Chair, The Methodist Hospital Department of Surgery.

- Methodist DeBakey Heart and Vascular Center & Weill Cornell Medical College, \$19 K/year since 09/01/2009

Role: Pi.

### **Modeling and Simulation for Femoral artery interventions**

Collaboration with Mark G. Davies, M.D., Ph.D., M.B.A., Professor of Cardiovascular Surgery.

- *Atlantis - P116J10-0067*, , 09/01/10-09/01/15, \$ 456 K + Euro 428 K,

US Partner: Marc Garbey (Pi) and Roger Tran Son Tay (co-Pi, UF)

Project's director in Surgery: Barbara Bass (The Methodist Hospital) and Scott Berceli (UF and Veteran Hospital)

European Partner: Christophe Collet (Pi) and Giuseppe Baselli (co-Pi)

### **International Dual Degree in Computing, Robotics and Imaging for Surgery Platform (CRISP)**

*Abstract:* the project aims at producing a new breed of engineers and scientists who can work with physicians and surgeons to develop innovative medical practice. This curriculum will take students with a solid theoretical background in mathematics, computer science and engineering, and master them in information technology in medicine. This includes the fields of modeling and simulation methods for surgery, medical image analysis and medical robotics. The students will work in a multicultural-multidisciplinary environment provided by a consortium of educational institutions closely cooperating with medical centers that have a unique experience and network of resources.

- VEF U.S. Faculty Scholar Grants - Academic Year 2011 - 2012, \$ 60K

Role: Pi, co-PI B.Bass and R.Tran Son Tay.

### **Curriculum Program in Computational Surgery with the International University of Vietnam National University-Ho Chi Minh City**

- NSF - Planning Grant for an Industry Academic NSF Center: Academic Year 2011-2012, \$ 26 K

Role Pi, co-PI B.Bass, Pi UF node S. Berceli co-pi R.Tran Son Tay.

### **I/UCRC for Cyber-Physical Systems for the Hospital Operating Room**

*Abstract:* The University of Houston and the University of Florida are collaborating to establish the proposed center, with the University of Houston as the lead institution.

The Center for Cyber-Physical Systems for the Hospital Operating Room (CPSOR) vision is to provide the forum for industry/hospital/university cooperative research on the further development, validation, and industrial implementation of the emerging concepts in the design of operating room, and in the optimization of procedural and surgical interventions. This center will be the strong arm of Modern Surgery enabled by computational science and technologies. The center will catalyze large-scale technology projects that request inter-disciplinary efforts between surgeons and computational science in a broad sense.

This collaboration should advance technology, discovery, understanding and training in the operating room. It will utilize the facilities in Houston and spread technology coupled with medical skills which will benefit society. The center will operate at the core of the Texas Medical Center that is the largest medical center in the world, and benefit from the site in University of Florida Gainesville that has been a champion to encourage business startups in bioengineering and technology transfer. The center will also benefit from the forty million dollar infrastructure of the Methodist Institute for Technology Innovation

and Education (MITIE) that trains about 2000 surgeons per year coming from all over the world. The center will benefit from a new established unique international dual curriculum in computational surgery.

## 4.2 Main Accomplishment

- *Stability Analysis in Combustion:* I have been working with H.G.Kaper, B.J.Matkowsky, G.Leaf, A.Bayliss, V.Volpert and others on the asymptotic analysis and numerical simulation of combustion front. The main focus of this research was on pattern formation and bifurcation analysis. My main first accomplishment here was to formalize the nonlinear stability analysis to the point that it can be done automatically with a symbolic manipulation language such as Maple [8]. This was a difficult problem since, in asymptotic analysis, the gauge functions and formalism of the expansion are not known in advance. Further, at that time it was a major challenge to do the computation for 3D problems. My *Maple* code was distributed on a network of workstations to save on memory and speed up the computation. My second main accomplishment was to introduce a multi-scale domain decomposition with adaptive mapping driven by the boundary layer location and thickness [12]. This work leads to a robust and accurate parallel code that has been used on a number of parallel systems to compute extensively cellular flames with a thermo-diffusive model, as well as instabilities of high energy reactive fronts in liquid [15,18,20].

- *Asymptotic Induced Numerical Scheme:* My original PhD work was on the matched asymptotic method developed by W.Eckhaus (co-advisor along with C.M.Brauner). It gave, later on, the idea that this asymptotic method was nothing more than the analytic analogue of the domain decomposition methods that became popular in the numerical community in the 80's. My main contribution was to combine asymptotic analysis and numerical domain decomposition into a single framework of methods for solving singular perturbation problems. The paper co-authored with H.G.Kaper gives a fairly good synthesis of this stream of thoughts [16].

- *Local Fourier Basis Technique:* Fourier expansions are marvelous tools to understand numerical and physical phenomenon. Combined with modern FFT they can be numerically efficient. However, Fourier techniques have a problem with irregular geometry and data dependencies in parallel computing. I have developed domain decomposition along with immersed boundary types of methods to use Fourier on complex PDE problems. The papers [22] and [31] show that not only one can eventually use Fourier expansion efficiently for non periodic problems with complex geometry, but one can also obtain an efficient parallel implementation. A by-product of this work has been a new postprocessing algorithm that can stabilize explicit time stepping for reaction-diffusion process [38]. This new method leads to a very efficient numerical implementation that works well with distributed computing.

- *Domain Decomposition Algorithm for Grid Computing:* Grid is a buzz word for many kind of activities in parallel computing. My main interest has been to take the challenge of developing new numerical algorithms that can work on a broad network of computers interconnected by a slow network. It is, needless to say, that standard modern multi-level or Krylov algorithms have very poor performance on such computer environments. The

first step in my research was to develop domain decomposition techniques that can work with high latency/low bandwidth networks and stay numerically efficient. This activity needs to rethink completely the algorithm and is more than adapting existing techniques. I began this work with my collaborators in University of Lyon1 and pursued it at UH for a number of years. A large amount of the grid computing experimental activity was done thanks to our cooperation with HLRS led by M.Resch. The first successful attempt was done in the context of multi-physic, combining Navier Stokes and a Thermo-diffusive model with a new time stepping scheme so called  $C(p, q, j)$  schemes [26]. Later on I came up with the idea of accelerating the standard Additive Schwarz algorithm with an Aitken like acceleration. I particularly like this idea of combining two simple and very old ideas into something really innovative. It turns out to produce the first efficient numerical algorithm that can solve a Poisson problem on a Cartesian grid with high parallel efficiency on a network of parallel system distributed in Europe and the USA with no special requirement on the internet connection [34]. It seems at first sight that the Aiken-Schwarz algorithm is a simple nice property of the Poisson problem very much linked to Fourier analysis [32]. It is not! The idea is much deeper and asks the question of what is the best representation of the trace transfer operator that can lead to optimal acceleration. I have developed this theory with a number of collaborators such as J.Baranger, F.Oudin Dardun, D.Tromeur Dervout, and my PhD students (B.Hadri, H.Ltaief and F.Pacull) for various operators, discretization, and applications. More recently D.Tromeur Dervout and his collaborators have extended the method somehow to general meshes and flow in porous media.

- *A General Tool for Solution Verification:* I gave a lecture at the Von Karman institute on solution verification in the context of parallel computing, in a special European course organized by J.Periaux and others in year 2000. William Oberkampf from Sandia Nat. Lab was the main speaker and gave an overview on the state of the art. I was amazed by the gap that exists between numerical analysts who believe only in an a posteriori estimate and practitioners who care only about mesh refinement, sensitivity analysis, manufactured solutions and extrapolation methods. I then got the idea of embedding the extrapolation method that practitioners use into an optimization framework that can reuse a posteriori error estimates if any are available, or rationalize, at a minimum, the choice of the weight in the extrapolation formula. In my collaboration with W.Shyy and others [33,36], I have developed the concept and applied successfully our new a posteriori error estimate tool to stiff heat transfer problems and Navier Stokes flow. The method is extremely general and can be seen as a post-processing step that does not even need the detailed knowledge of the code that produces the solution to be verified. In its most general form, the a posteriori estimate procedure is computer intense, but can take full advantage of grid computing. We have developed a web computing system [63] that can be attached to a commercial software such as ADINA, Fluent etc.... This work has benefited greatly from my collaboration with V.Subramaniam, who is a first class specialist in software design, and C.Picard, who was my PhD student.

- *Image Base Simulation for medical applications:* I have been working with I.Pavlidis, who is a well known specialist of thermal imaging and computer vision. Thermal imaging gives the external boundary condition of the bio-heat transfer model. Pattern recognition of arteries proximal to the skin and simulation of bioheat transfer can be combined into

a unique optimization loop. The first result, somehow simpler, was to detect, from a distance, the heart beat pulse of a person by post-processing the thermal imaging video. This team work [41] has given, to my knowledge, the first existing technology that can achieve heart beat detection with a passive sensor from a distance of 6 feet.

A second natural stream of work is my activity on blood flow simulation to construct a system that can work efficiently in clinical conditions, synchronized, for example, with an angiogram procedure. In my team, we have developed a fast Navier Stokes solver combined to an image segmentation technique that can quickly provide shear stress and pressure indicators directly from MRI or x-ray data. Our approach uses an imaginative way of combining level set and immersed boundary techniques [40]. Along with the simulation aspect, we have developed in collaboration with V.Hilford a data base system with a GUI to manage each computation and medical data set into one single general easy to use framework.

A third stream of work that benefits from all of the above experience, is on breast cancer in collaboration with B.Bass chair of the depart. of Surgery at Methodist Hospital. This project combined into a common framework thermal imaging (in collaboration with I.Pavlidis) for detection and surgery guidance, tissue mechanic to plan breast conserving therapy, and finally tumor dynamic (in collaboration with T.Colin).

### 4.3 New Projects

Most of the new projects I am working on can be found on the web site of my *Modelization and Computational Science Lab* at <http://mcs.cs.uh.edu/> These projects are all highly interdisciplinary and are listed below for completeness.

- **BCT-Modeling** This project in computational surgery is done in partnership with B.Bass, chair of the depart. of surgery at Methodist Hospital. Breast conserving therapy (BCT) comprised of complete surgical excision of the tumor (partial mastectomy) with post-operative radiotherapy to the remaining breast tissue, is feasible for most women undergoing treatment for breast cancer. The goal of BCT is to achieve local control of the cancer as well as to preserve a breast that satisfies the woman's cosmetic concerns. While most women undergo partial mastectomy with satisfactory cosmetic results, in many patients the remaining breast is left with major cosmetic defects including concave deformities, distortion of the nipple areolar complex, asymmetry and changes in tissue density characterized by excessive density associated with parenchymal scarring. There are currently no tools, other than surgical experience and judgment, that can predict the impact of partial mastectomy on the contour and deformity of the treated breast. The objectives of this study are to determine if a computational model can allow prediction of the breast contour, surface features and tissue density after partial mastectomy and potentially identify targets for intervention to improve cosmetic results.

- **IDV-desk:** The Intelligent Data and Visualization (IDV) desk is a system which combines numerical simulation with high-definition visualization and large data storage into a single desk. These three sub-systems are interdependent. They are connected to the network to get external information from various imaging systems, and to provide data mining and data processing. The IDV desk is used in endovascular applications. The challenge is to provide to surgeons an interface to access all the data of interest at once on multiple displays. The core engine is our image base Navier Stokes solver.

- **ViP** (Virtual reconstitution of a Prairie): This project in computational ecology is based on our collaboration with Pr. Cendrine Mony from the Department of Ecology of University of Rennes1 and Pr David Andersen from the space lab at Berkeley. This project uses extensively volunteer computing and is actually the first Green project of this kind. Our goal is to study the dynamics of a prairie in response to disturbance (recurrent mowing, grazing). This has several applications, such as the design of prairies, with high agronomical values or the preservation of ecological systems with high biodiversity. New insights have also been developed recently on new ecological uses of such systems (see for instance the recent study sponsored by NSF Mixed Prairie Grasses are better a source of biofuel than corn ethanol and soybean biodiesel.) Through the ViP project - <http://vcsc.cs.uh.edu/virtual-prairie/> -, the effects of management practices on plant competition and genetic structure of the prairie can be forecast. The project outreach has been quite remarkable with more than 10 000 volunteers around the world computing for us. Up to my knowledge, ViP has achieved the largest simulation ever for the ecology of plant [54]. The web site of the project has been referenced by about 200 other web sites at least.

- **SysBioMod** (System Biology Modeling of Vein Graft): This project on modeling and simulation of vein graft failures sponsored by NIH is done in collaboration mainly with Pr. S.Berceli from the department of surgery at University of Florida, and Pr. R. Tran Son Tay from MAE at the same University. My goal is to combine Fluid-Structure Dynamic Model, Tissue Dynamic at the cellular level, and Genes activation network into a coherent multiscale model that embraces the system biology dynamic and can explain Vein graft failure or success. This interdisciplinary effort companion a program of extensive experiments with small animal models in the Lab of Scott, and benefit from multiple cross fertilization between applied mathematic, computer science, bioengineering and surgery research fields.

#### 4.4 Patent

- Role Principal Inventor, co-Inventor C.Picard, **Interactive Hyperwall for Visualization, Simulation, Gaming**, Patent 2483-00501 pending (filed by University of Houston).

Abstract: *The interactive Hyperwall is a combination of hardware and software that allows the manipulation of multidimensional data interactively in order to have a broader perspective of a given context. The visualization is performed by the means of multiple monitors controlled by independent workstations. The salient feature of our invention is our innovative way of combining off the shelf hardware and public domain softwares to interactively drive the hyperwall with a SINGLE remote device.*

## 5 Service

- Director "Laboratoire d'Analyse Numerique" - University of Lyon 1, 1990- 92, This lab (about 15 faculties) was the main component of the research team associated to CNRS UA 740 devoted to applied mathematic.
- Director and founder "Centre pour le Developement du Calcul Scientifique Parallele" (CDCSP), 1992-2001: I started a parallel computing facility following the famous

example of ACRF in Argonne Nat. Lab. which I was visiting regularly in the early 90's. Our main mission was to participate to the development of parallel computing in France, *starting from the application*. We were offering access to state of the art parallel systems and regular tutorial on parallel computing to a broad community of scientists (far beyond University of Lyon1) within a very constrained budget. Half of the budget was provided by the National Ministry of Education. Other sources were Region Rhone Alpes, and the industry. All parallel systems we bought were operational within a couple of months and used by a broad variety of scientist.

- Director of CISM 1996-2000, - CISM was the largest IT service in academia for Lyon. Our first mission was to provide a state of the art network for University of Lyon 1, and several other schools (several 10 thousands of IP addresses). Our second mission was to develop along with our customers, new information technology tools for both research and education. Among the main achievements of CISM, one can refer to the development of the first academic network for all three Universities in Lyon and about ten engineering schools in partnership with France Telecom, as well as the largest data base in the country on breast cancer.
- Director of MCS Lab ("Jeune equipe" co-funded with A.Bourgeat) University of Lyon1, 1997-2001. This was the first and only lab associated with the engineering school ISTIL. It was essentially a multidisciplinary team of 6 tenured faculty members, with a strong background in applied mathematic, computer science, and mechanic driven by computational science challenging problems. This lab was the research team behind the CDCSP service activity described above.
- Chairman of the Department of Computer Science at University of Houston. - see <http://www.cs.uh.edu> - September 2004- August 2009.

During my service as department chair, this department has enjoyed a rapid growth on all fronts (quality of the curriculum, PhD graduation by a factor three, publication, funding, visibility of the department, etc...). I did pay particular attention to develop team work and build a friendly working environment. To be more specific according to the NSF data base - <http://www.nsf.gov/statistics/rdexpenditures/> - the funding of my department in 2003 was 3709 (federal 2391) (dollars in thousands). In 2009, the funding of the department was 8752 (federal 4478) (dollars in thousands). Meanwhile the ranking went up from 69 to 45, while the total number of faculty progresses from 20 to 22!

## 6 Teaching

- Numerical Analysis (both at undergraduate and graduate level)
- Parallel Computing (both at undergraduate and graduate level)
- Computational Surgery (graduate level)

## 7 Editorial work and Others

- Editor of the International Journal of Mathematical Modelling and Numerical Optimisation (IJMMNO) since 2009.
- Editor of the Frontiers Journal in Physiology since 2011
- Co-founder and co-editor in chief with Barbara Bass of the Journal of Computational Surgery - on line access journal of Springer Verlag, 2012.
- Co-founder with Barbara Bass of the Computational Surgery International Network (Cosine) - see <http://www.computationalsurgery.org> - This network was founded in 2009.

## 8 Publication

### 8.1 Publications in Refereed Journals

[1] C.M.Brauner, W.Eckhaus, M.Garbey and A.van Harten, *A Non Linear Singular Perturbation Problem with some Unusual Features*, *Lecture Notes in Applied Mathematics*, Vol. 23, pp. 275-310 (1986)

[2] C.M.Brauner, W.Eckhaus, M.Garbey and A.van Harten, *Asymptotic of a rather unusual type in a free boundary problem*, *SIAM J. Math. Anal.* Vol.18, 812-841 (1987)

[3] M.Garbey, *Quasilinear hyperbolic singular perturbation problems: Study of shock layer*, *Mathematical Methods in Applied Sciences*, Vol.11, 237-252 (1989)

[4] M.Garbey, H.G.Kaper, G.Leaf and B.J.Matkowsky, *Linear stability analysis of cylindrical flames*, *Quarterly of Applied Math.* Vol. 47, 691-704 (1989)

[5] W.Eckhaus and M.Garbey, *Asymptotic analysis on large time scales for singular perturbation problems of hyperbolic type*, *SIAM J. Math. Anal.* Vol 21, No 4, pp867-883, (1990)

[6] M.Garbey and D.Levine, *Massively parallel computation of conservation laws*, *Parallel Computing* Vol.16, 293-304 (1990)

[7] A.Bourgeat and M.Garbey, *Computation of viscous (or nonviscous) conservation law by domain decomposition based on asymptotic analysis*, *Num. Methods for PDEs*, Vol.8, 127-142 (1992)

[8] M.Garbey, H.G.Kaper, G.Leaf and B.J.Matkowsky, *Using Maple for the analysis of bifurcation phenomena in condensed phase surface combustion*, *Journal of Symbolic Computation*, Vol.12, 89-113 (1991)

[9] M.Garbey, H.G.Kaper, G.Leaf and B.J.Matkowsky, *Nonlinear analysis of condensed phase surface combustion*, *European Journal of Applied Math.*, Vol.1, 73-89 (1990)

[10] M.Garbey, H.G.Kaper, G.Leaf and B.J.Matkowsky, *Quasi-periodic waves and the transfer of stability in condensed phase surface combustion*, *SIAM J.Appl.Math.*, Vol. 52, 384-395 (1992)

- [11] F.Desprez and M.Garbey, *Direct numerical simulation of a combustion problem on the Paragon machine, Parallel Computing*, Vol.21, 495-508 (1995)
- [12] M.Garbey, *Domain Decomposition to Solve Layers and Asymptotic, SIAM J.Scientific Computing*, Vol.15-4, 866-891 (1994)
- [13] M.Garbey, *A Schwarz Alternating Procedure for Singular Perturbation Problems*, SIAM J. Scientific Computing, Vol.17, 1175-1201 (1996)
- [14] M.Garbey, A.Taik and V.Volpert, *Linear Stability Analysis of Reaction Fronts in Liquids*, Quart. Appl. Math., No.2, 225-247 (1996)
- [15] A.Bayliss, M.Garbey and B.J.Matkowsky, *Adaptive Pseudo-Spectral Domain Decomposition and the Approximation of Multiple Layers*, J. Comp. Phys., Vol.119, 132-141 (1995)
- [16] M.Garbey and H. G. Kaper, *Heterogeneous Domain Decomposition Methods for Singular Perturbation Problems*, SIAM J. Num. Anal., Vol.34, 1513-1544 (1997)
- [17] M.Garbey, A. Taik and V. Volpert, *Linear Stability of Liquid-Liquid Reaction Fronts*, Quart. Appl. Math., Vol.1, pp1-35, (1998)
- [18] G.Bowden, M.Garbey, V.M.Ilyashenko, J.Pojman, S.Solovyov, *A.Taik and V.Volpert, The Effect of Convection on a Propagating Front with a Solid Product: Comparison of Theory and Experiments*, J.Chem.Phys., Vol.101B, 678-686 (1997)
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[84] M.Garbey and M.Davies, *Remarks on Solution Verification and Model Validation of Hemodynamic Simulations*, Pumps and Pipes, Proceedings of the annual conference, Springer Verlag, pp 45-54, 2011

[85] D. Thanoon, M.Garbey and B. Bass, *Computational Modeling of Breast Conserving Surgery: a Cosmetic Outcome Indicator from Virtual Surgery*, Conference Proceedings at the ISCA 3rd International Conference on Bioinformatics and Computational Biology (BICoB-2011).

[86] G. Tran Son Tay, M.Garbey and M.Davies, *Hemodynamic: Uncertainties on Wall shear Stress in Main Arteries*, Conference Proceedings at the ISCA 3rd International Conference on Bioinformatics and Computational Biology (BICoB-2011).

[87] W. Rinsurongkawong, M.Garbey and R. Zinner, *Drug Combination, The Design and Problem Landscape*, Conference Proceedings at the ISCA 3rd International Conference on Bioinformatics and Computational Biology (BICoB-2011).

[88] M.Garbey, M.Smaoui, W.Rinsurongkawong and C.Mony, *The Virtual Prairie Project*, Invited Plenary Lecture, The 2<sup>sd</sup> Int. Conf. on Parallel, Distributed, Grid and Cloud Computing for Engineering, Computational Science, Engineering and Technology Series: 27, Edt P.Iványi and B.H.V.Topping, Saxe-Coburg Publications, 2010, pp 49-82.

### 8.3 Technical Reports

[1] M.Garbey, *Quasi Linear Parabolic-Hyperbolic Singular Perturbation Problem: Application to 2-Phase Flow in Porous Media Equation*, Preprint UA740 no 70, 1988.

[2] M.Garbey, *Asymptotic Analysis of Singular Perturbation Problems Governed by a Conservation Law*, Argonne Nat. Lab., MCS-P107-10-(89)

[3] M.Garbey, H.G.Kaper and M.K.Kwong, *Symbolic Manipulation Software and the Study of Differential Equation*, preprint Argonne Nat.Lab. 1990.

[4] M.Garbey, H.G.Kaper, *Asymptotic Analysis: Basic Concepts and Definitions*, Argonne Nat.Lab., MCS-TM-179 (93)

[5] M.Garbey, H.G.Kaper, *Approximation of Integrals*, Argonne Nat. Lab., MCS-TM-180 (93)

[6] M.Garbey, *Quelques Schemas Numeriques deduits de l'Analyse Asymptotique pour Problemes a Petits Parametres*, Rapport Technique DRET (93)

[7] M.Garbey, H.G.Kaper, *Boundary Layers*, Argonne Nat.Lab., MCS-TM-181 (93)

[8] Y.Boudeville and M.Garbey, *Simulation d'un Catalyseur sur Architectures Paralleles*, Rapport Technique DRET (97)

[9] M.Garbey, L.Viry and O.Coulaud, *Non Overlapping Domain Decomposition for Singularly Perturbed Elliptic Boundary Value Problem*, Rapport INRIA 3137 (1997)

[10] A.L. Colomb Reinmann, M.Garbey and L.Flory, *Nouvelles Technologies de l'Apprentissage en Medecine et Science pour l'Ingenieur*, Chassey Le Camp, 90pp, Avril 1998.

[11] M.Garbey, D.Sappey Marinier, *Nouvelles Technologies de l'Apprentissage en Medecine et Science pour l'Ingenieur*, Le Champ Fleury, 80pp, Mai 1999.

[12] M.Garbey, *Domain Decomposition and Multi-Physic Coupling for the Power-Temperature Nuclear Reactor Problem*, Note Technique NT-DER-SSTH-2008-061, CEA.

## 8.4 Journal Papers Submitted for Publication

- M.Garbey, D.Thanoon and B.Bass, *Modeling and Simulation for the Lumpectomy of Breast Cancer* submitted.
- C.Picard, T.Colin and M.Garbey *On the solution of the Poisson problem with non-uniform diffusion coefficient* submitted.
- M.Garbey, R.Salmon, D.Thanoon and B.Bass, *Multiscale Modeling and Distributed Computing to Predict Cosmesis Outcome After a Lumpectomy*, submitted.
- W. Rinsurongkawong, M. Garbey and R.G. Zinner, *Algorithm Search and Problem Landscape Investigation of Cancer Drug Combinations*, submitted.

## 8.5 Books

[1] H.G.Kaper and M.Garbey, *Asymptotic-induced Numerical Methods*, in: *Asymptotic Analysis and the Numerical Method of PDEs*, Lect. Notes in Pure and Applied Math., Vol.130 Dekker (1991)

[2] M.Garbey and H.G.Kaper, *Numerical Methods for PDEs with Critical Parameters*, Kluwer, Dordrecht (1992)

[3] N.Debit, M.Garbey, R.Hoppe, D.Keyes, Y.Kuznetsov and J.Periaux, *Domain Decomposition in Science and Engineering*, CIMNE Barcelona, 2002.

[4] M.Garbey, *Special Issue on Computational Medicine*, Journal of Algorithms and Computational Technology, Vol2 No 4 2008.

[5] M.Garbey, B. Bass, M. De Matelin, C. Collet and R. Tran Son Tay, *Computational Surgery and Dual Training*, Springer Verlag, 2010, XVI, 315 p., Hardcover, ISBN: 978-1-4419-1122-3

ch1: B.Bass and M.Garbey, *Breast-Conserving Therapy for Breast Cancer: Targets for Investigation to Improve Results*, pp3-12,

ch12: S.A.Berçeli, R. Tran Son Tay and M.Garbey, *Emerging Mechanisms of Vein Graft Failure: The Dynamic Interaction of Hemodynamics and the Vascular Response to Injury*, pp 209-220.

ch15: D. Thanoon, M. Garbey, N.Kim and B. Bass, *A Computational Framework for Breast Surgery: Application to Breast Conservative Therapy*, pp249-268.

[6] M.Garbey, B.Bass, S.Berceli, C.Collet and P.Cerveri, *Computational Surgery and Dual Training: Computing, Robotic and Imaging for the Surgery Platform*, Springer Verlag, 2012, to appear.

## 8.6 Chapter in Book or Publication in French with Review Committee

[1] G.Eljlali, M.Garbey and D.Tromeur Dervout, *Chapitre Analyse Numerique* dans le Livre OFTA, Serie ARAGO 19,pp169-182, Ed. Masson (1997).

[2] M.Garbey and D.Tromeur Dervout, *Méthodes Numériques et Couplage de Codes pour le Calcul Distribué Distant*, Calculateur Parallele (2001).

## 9 PhD student and Alumini from UH since 2002

- F.Pacull (Math-06) (Research engineer, Fluorem - Ecully - France)
- C.Picard (COSC-UH-07 and University of Bordeaux in Math, co-advisor Pr T.Colin) assistant professor - department of applied mathematic, Univ. of Grenoble.
- H.Ltaief (COSC-UH-07) Research Faculty at Kaust - Saoudi Arabia
- B.Hadri (COSC-UH-08) Sr. Research Associate, Innovative Computing Laboratory, University of Tennessee.
- W.Rinsurongkawong (COSC-UH-11) staff at MD Andersen.
- Current PhD students: M.Smaoui, G.Tran Son Tay, D.Thanoon, R.Salmon, R. Mahbubur.

## 10 Recent Conference/Minisymposium/Event Organized

- Workshop for the 60st birthday of Dr. L.Johnsson, Fall 2004
- Workshop on Parallel Computing, UH, April 8-9, 2005. <http://www.cs.uh.edu/shortcourses/workshops/workshopfiles.shtml>
- Mini-symposium on Domain Decomposition at the SIAM Annual Meeting, New Orleans, July 11-15, 2005,
- The Amazing Journey of CS@UH: Algorithms, Computers, and Design - UH, January 27, 2006  
<http://www.cs.uh.edu/events/2006\0127\journey.shtml>
- Computational Science 2006 Workshop , UH - March 3-4, 2006 <http://www.cs.uh.edu/conferences.shtml>

- The first Open House of the Department of Computer Science at UH, April 8 2006. <http://www.cs.uh.edu/conferences.shtml>
- Minisymposium *grid computing for complex CFD problems*, 7<sup>th</sup> World Congress on Computational Mechanics, July 16-22, LA 2006.
- Third Annual Workshop on Interdisciplinary Computational Science, UH, March 22-24, 2007. <http://www.cs.uh.edu/conferences.shtml>
- UH Biomedical Expo hosted by SUN at SC06. (This demo was combining a face recognition system, EEG, thermal imaging and demo with a video wall of 16 displays; this was the result of a team work with all partners of the MRI-NSF grant quoted above)
- Workshop Mathematic and Image organized with Abdallah El Hamidi, Michel Berthier (Université de La Rochelle), May 14th-15th 2007, La Rochelle.
- The Second Open House of the Department of Computer Science at UH, Oct 20th 2007. <http://www.cs.uh.edu/conferences.shtml>
- International Workshop in Computational Surgery with M. De Matelin and C.Collet (Université de Strasbourg) and B.Bass (methodist Hospital), Dec 1-3 2008, Strasbourg, see <http://master-isti.u-strasbg.fr/puf>
- Workshop on Computational Surgery for Cancer: Interdisciplinary Research in Modeling, Simulation and Surgery of tumors, with B. Bass and T.Colin, Methodist, December 3rd-4th, 2009 -see [www.computationalsurgery.org](http://www.computationalsurgery.org)
- International Workshop Modeling plant growth: from ecological concepts to mathematics, with C.Mony, A.Elhamidi and F.Campillo, Rennes June7-9 2010, <http://ecobio.univ-rennes1.fr/modecol/workshop/>
- Third annual international conference in computational surgery, The Methodist Hospital Institute for Technology, Innovation and Education, January 26-29 of 2011, with Barbara Bass - see <http://www.computationalsurgery.org>

## 11 Recent Talks since January 05

- DD16 New York City, January 12-15, 2005: <http://www.dm.org>  
*1st Talk on Image Analysis and Domain Decomposition, 2sd Talk on Fault Tolerant Algorithm*
- Feb 2sd 2005, seminar in Mathematic at Texas A&M,  
*Recent Development on the Aitken-Schwarz Method*
- NSF/SNL Program Workshop to be held on Thursday and Friday, February 10-11, 2005, in Albuquerque, NM.  
*The Least Square Extrapolation Method: Application to CFD and Heat Transfer*
- Workshop on Parallel Computing, UH, April 8-9, 2005.

*Fault Tolerant Algorithm for Time Stepping*

- Fourth International Conference on Computational Heat and Mass Transfer,  
*Plenary Invited Lecture on the LSE method*

- European Workshop on Coupled Problems, Santorini, May 25th-28th 2005,  
*Multiscale Hemodynamic*

- Cerfacs, Toulouse, June 28rd,

*Few Algorithm to Compute PDEs on the Grid*

- Marseille, L3M, Mechanical Engineering, June 30st, 2005,

*Efficient Numerical Algorithm for Grid Computing*

- Bordeaux, Applied Math, July 1st, 2005,

*the Least Square Extrapolation Method: Application to Error estimate.*

- SIAM Annual Meeting, New Orleans, July 11-15, 2005,

*Recent Progress on the Aitken Schwarz Method*

- Eurodyn'05 Paris, 4-7 September 2005,

*A Least Square Extrapolation Method for the a priori Error Estimate of CFD and Heat Transfer Problem*

- eScience Workshop, Microsoft, Redmond Washington, Oct. 6-7 2005,

*Computational Data Grid for Scientific and Biomedical Applications*

- University of Illinois, Mechanical Engineering, November 8th 2005.

*Algorithm to Compute PDEs on the Grid*

- Livermore Sandia January 2006,

*Recent Progress on the LSE method*

- The Amazing Journey of CS@UH: Algorithms, Computers, and Design - UH, January 27, 2006,

*The Way Computers Reshape Science*

- VIP Seminar Series, Computer Science and Electrical Engineering, UCF, Feb 02 2006,

*On a Computational Framework for Multi-scale Blood Flow Applications*

- Computational Science 2006 Workshop , UH - March 3-4, 2006

*Fast Prototyping of Blood Flow Simulation with Matlab-MPI*

- ParCFD 06, Busan, South Korea May 15th-18th 2006, <http://www.parcfd.org>

*Three talks respectively on Blood Flow Simulation, Solution Verification and Fault Tolerant Algorithms.*

- Sun - California, June 13th,

*Activity of CS@UH in Computational Medicine*

- University of Vera Cruz, Mexico, June 18th 2006,  
*Immersed Boundary Technique for Blood Flow*
- WCCM 2006, World Congress on Computational Mechanics, Los Angeles, California, USA, July 16-22, 2006,  
*Algorithm for PDEs on the Grid*
- WoCo 09, Grid-Based Problem Solving Environments: Implication for Development and Deployment of Numerical Software, Prescott Arizona Jul 17th-21th 2006, <http://www.woco9.org/objectives.cfm>  
*Design of Efficient DD Schemes for PDES on the Grid*
- The seventeenth DD meeting in St. Wolfgang-Strobl, Austria (July 3-7 2006)  
<http://www.ddm.org>  
three talks on Hemodynamic, Fault Tolerant Algorithm for Parabolic Problems, and a New Asynchronous Parallel Algorithm in Space-time.
- Livermore sept. 26th 2007  
*Distributed Computing Algorithm for PDEs.*
- AIAA Nat. Meeting - Reno Jan.8-11 2007,  
*first talk: Toward a General Solution Verification Method for Complex PDE Problem with Hands off Coding,*  
*second talk: Image Base CFD for Blood Flow*
- Visual Numeric - <http://www.vni.com/> - Houston, Jan 07.  
*Method, Algorithm and Tools in Computational Medicine*
- Innovative Computing Center - <http://icl.cs.utk.edu/> - University of Tennessee. Jan 07,  
*Innovative Computational Medicine*
- Workshop "Mathematic and Image", La Rochelle May 14th-15th, *Image Base CFD, Application to Hemodynamic*
- Keynote lecture, 5th International Conference on Heat Transfer, Canmore Alberta Canada June 18-22 2007, *A General Solution Verification Method for Complex Heat and Flow problem with Hands off Coding*
- HLRS, Univ. of Stuttgart, June 26th and 27th, two seminars on (1) *A Computational Environment for Hemodynamic*, (2) *A General Postprocessing Solution Verification Method for Commercial Code*
- SEDE'07, 16th internat. Conf. on software engineering and data engineering July 2007, Las Vegas, *Parallel Implementation for Solution Verification of CFD code*
- Workshop IEEE EMBC/NSF Workshop on "Physiological Monitoring 24/7" organized by I.Pavlidis and N.Diakides, *On the feasibility of contact-free measurement of the blood pressure based on the analysis of thermal imaging.*
- Workshop of the GDR Modelization, Mathematic in Biology and Medecine December 6-7 2007 in Bordeaux, Invited talk, *Parallel Processing for Open Problems in*

- Invited Seminar CEA/DEN/DER, Cadarache 12/19/07, *Multiphysics Modeling Domain Decomposition: the Happy Hour of Parallel Computing?*.
- The 18th International Conference in Domain Decomposition Jerusalem 01/12-17/08, <http://www.cs.huji.ac.il/conferences/dd18/>, two contributed talks: *A Numerically Efficient Scheme for Elastic Immersed Boundaries* and *Computational Tool for a Mini-Windmill Study with SOFT*.
- Invited Talk, Brauner 60's, 02/20-21/08 Bordeaux, <http://www.sm.u-bordeaux2.fr/guyonne/Brauner/index.html>, *Immersed Boundary Simulation*.
- Parallel CFD, Lyon 05/19-22/08, *Parallel Simulation and Optimization of a Mini Vertical Axis Turbine* and *Parallel Multiscale Software for Fluid Flow- Agent Based Hybrid Models* with C.Mony. <https://cdosp.univ-lyon1.fr/parcfd/>
- Invited Presentation, The 4th Pan-Galactic BOINC Workshop, September 11-12, 2008 ,INRIA Grenoble, Virtual Prairies with Boinc, see <http://boinc.berkeley.edu/trac/wiki/WorkShop08>.
- Workshop Computational Surgery and Dual Training Dec 1st-2sd 2008, Strasbourg *first talk with Barbara Bass (Dept. of Surgery - The Methodist Hospital): Breast Conserving Therapy for Breast Cancer: Targets for Investigation to Improve Results, second talk: A Computational Desk for Surgeons*, see <http://master-isti.u-strasbg.fr/puf>
- Invited Seminar, CEA Cadarache Dec. 2008, *Domain Decomposition and Multiphysic Coupling for the Power-Temperature Nuclear Reactor Problem*.
- Invited Talk Workshop Bio-Math Bordeaux 8-10 Dec. 2008, *Computational Surgery Framework for Breast Cancer II: Bioheat Transfer*. <http://www.math.u-bordeaux.fr/saut/wsbio08/index.html>
- Invited Talk, BOINC October 22sd-23rd, 2009, Barcelonna *Updates on the Virtual Prairie Project*. <http://boinc.berkeley.edu/trac/wiki/WorkShop09>.
- Second PUF Workshop: Focus on Cancer, The Methodist Hospital Houston 3-4 of december 2009, *Image Base Simulation of Breast Cancer Conservative Therapy* - <http://www.computationalsurgery.org>
- The 3rd int. conf on the development of biomedical engineering in Vietnam Ho Chi Minh City, January 11 - 14th, 2010, Talk 1: *Computational Framework and Image Base Simulation of Breast Conservative Therapy*, Talk 2: *IMED a Computational Desk for Surgeons*. - [www.hcmiu.edu.vn/BME2010](http://www.hcmiu.edu.vn/BME2010)
- International Workshop Modeling plant growth: from ecological concepts to mathematics, with C.Mony, A.Elhamidi and F.Campillo, Rennes June7-9 2010, Talk 1: Large Scale Simulation of Virtual Prairie with Volunteer Compting, Talk2: Spatially Extensive Digital Mapping of Clonal Plant Communities.
- Third annual international conference in computational surgery, The Methodist Hospital Institute for Technology, Innovation and Education, January 26-29 of 2011, Talk 1: Multiscale modeling of postsurgery recovery: application to breast conservative therapy, Talk2: Image Base Hemodynamic Simulation.
- 20th International Conference on Domain Decomposition Methods, 7-11 February 2011, UC San Diego in La Jolla, California. Talk 1: *Simulation of Breast Conservative Therapy*, Talk 2: *From Ultrasound Video to Hemodynamic Simulation with Moving Walls*.

- Invited Seminar Rutgers University - Department of Computer Science March 3rd 2011, *Multiscale Modeling of Breast Lumpectomy outcome*
- Invited Seminar New Jersey Institute of Technology - Department of Mathematics March 4th 2011, same as above.
- Invited Seminar Talk, The Moffitt Cancer center - Tampa - Florida, March 21st. Talk on *Modeling Breast Conservative Therapy*
- Invited Plenary Talk, PARENG2011: Corsica: 12-15 April 2011, *The VIP project*.
- Invited Seminar Talk, Polytechnic Milano, Depart. of Bioengineering, June 6th 2011, *Computational Surgery and Example of Test Studies*.
- Invited Seminar Talk, Barcelona Supercomputing Center and CASE, June 10th 2011, same as above.
- Invited Talk on Computational Surgery I, Serbian Academy of Sciences and Arts, Biomedical Engineering for Human Health, Oct.24th
- Invited Talk on Computational Surgery II, Kragujevac, Serbia, Oct 25th.
- Invited Talk - BME Distinguished Seminar A Road Map for Computational Surgery, Hong Kong University of Science and Technology, Feb 27th 2012
- Invited Seminar - Department of Mathematics, National Taiwan University, Feb 29th 2012.
- Invited Seminar - Chang Bing Show Chwan Hospital and Ircad Taiwan, March 1st 2012.