Curriculum Vitae

M. Garbey

1 Contact

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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

- Teacher in High School, 1978-1984.
- Maitre de Conference, Univ. of Valencienne, 84-87.
- Visiting Scientist, Argonne Nat Lab and Northwestern Univ. 87-88.
- Maitre de Conference, Ecole Normale Sup. of Lyon, 88-90.
- Professor in Applied Mathematic, Univ. of Lyon1, 90-

- Scientific Consultant, Inria of Lorraine, 95-97
- Professor in Computer Science, Univ. of Houston, 01-
- Adjoint professor in the dept. of Mathematic at Univ. of Houston, 02-
- Affiliated Professor in the dept. of Mechanical and Aerospace Engineering at University of Florida, Gainesville, 03-05
- 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.

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 Aposteriori 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 (cio-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. Berceli (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.

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 until now. 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:* Working in a department of computer science that has one of the strongest teams in the country in image analysis has been inspiring to me. There is a large avenue of work that can combine image analysis and numerical simulation into one single shot. My first attempt was to design a level set type of model to work on cancer tumors [39]. The lack of experimental data available ended this project. The situation was

rather different in thermal imaging, since I.Pavlidis, who is one of the main contributors in the field is in our department. He is also the designer and inventor of the Athemos system that can provide high-quality experimental data at will. 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 with the perspective of getting a system that works 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]. This work gives additional ground to address some more fundamental issues in drug deliveries for atherosclerosis deceases or vein graft procedures in collaboration with endovascular surgeons and medical imaging experts. This work in collaboration with various teams of doctors and biophysicists (S.Berceli, R.Tran Son Tay, C.Karmonik) has lead also to preliminary results on multi-scale hemodynamic to tackle interesting questions in drug delivery (atherosclerosis) or tissue plasticity (vein graft). 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.

• **SOFT** (Simulation, Optimisation, Fabrication and Testing): We study several design problems related to alternative energy. Our approach combine three components for the first time: iterated virtual design and physical testing, Volunteer Computing (VC), and evolutionary algorithms. Our goal is to make completely automatic the optimum design loop including testing so it can run 24/7 with volunteer computing. We build a general computational framework with VC that (i) allows a computer efficient sampling of extremely large design space to build surrogate models, (ii) combines domain decomposition and stochastic algorithm to solve optimum design problems with VC.

• **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 form 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. We use the same general framework as our project "SOFT" except that the Partial Differential Equation engine is replaced by an Hybrid Agent Base - PDE model.

• **SysBioMod** (System Biology Modeling of Vein Graft): This project on modeling and simulation of vein graft failures 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 by a factor three, visibility of the department, etc...). I did pay particular attention to develop team work and build a friendly working environment.

6 Teaching

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

7 Publication

7.1 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 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)

[19] M.Garbey and A.El Hamidi, *Using Maple for the Analysis of Bifurcation Phenomena in Gas Combustion,* Journal of Theoretical Computer Science Vol.187, 249-262 (1997)

[20] M.Garbey and D.Tromeur Dervout, *Massively Parallel Computation of Stiff Propagating Fronts,* Combustion Theory and Modelling, Vol.1, 271-294 (1997)

[21] M.Garbey and D.Tromeur Dervout, *A new parallel solver for non periodic incompressible Navier Stokes equations using Fourier basis: application to frontal polymerization flow,* J.Comp.Phys., Vol.145, 316-331 (1998)

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[23] G.Edjlali, M.Garbey and D.Tromeur Dervout, *Interoperability Parallel Programs Approach to simulate 3D Frontal Polymerization Processes,* J. Parallel Computing, Vol.25, pp.1161-1191, 1999.

[24] M.Garbey and H.Kaper, *Asymptotic-Numerical Study of Supersensitivity for Generalized Burgers Equations,* SIAM J. Sci. Comput., Vol.22-1, pp.368-385, 2000.

[25] M.Garbey, Yu.A.Kuznetsov, and Yu.V. Vassilevski, *A Parallel Schwarz Method*

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[27] M.Garbey and Yu.V.Vassilevski, *A Parallel Solver for Unsteady Incompressible 3D Navier-Stokes Equations,* J. Parallel Computing, 27, pp363–389, 2001.

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[33] M.Garbey and W.Shyy, *A Least Square Extrapolation Method for improving solution accuracy of PDE computations,* J. of Comput. Physic, 186, pp1-23, 2003.

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7.2 Publications in Conference Proceedings

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7.3 Technical Reports

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[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 Argnne Nat.Lab. 1990.

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[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)

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[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.

7.4 Journal Papers Submitted for Publication

• H.Ltaief, R.Keller, M.Garbey and M.Resch, *A Grid Solver for Reaction-Convection-Diffusion Operators,* submitted.

• C.Mony, M.Garbey, M.Smaoui and M.L.Benot, *Optimal Profiles Plant Growth: A Modeling Approach,* submitted.

7.5 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, to appear.

7.6 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).

8 Alumini

- Former PhD in Applied Math (Univ of Lyon): A.Taik (95) (Professor, FST Maroc), A.Elhamidi (96) (Maitre de Conference, Univ de La Rochelle), H.Outouzzalt (96) (National Educ. Marocco), A.Mansour (97),
- Master Students who graduated with me at UH in Math:

  C.Cussaguet, F.Dupros (Researcher BRGM-France), M.Voyes (02),

  Y.Jobic (Research Engineer, CNRS), E.Rougetet (03),

  A.Elkadi, C.Hamon, B.Hadri, H.Ltaief, M.Zerguine (04).
- PhD student who graduated with me at UH:

  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) postdoc at the innovative computing lab of Jack Dongarra at University of Tennessee starting January of 08.

  B.Hadri (COSC-UH-08) postdoc at the innovative computing lab of Jack Dongarra at University of Tennessee starting June of 08.

  Current PhD students M.Smaoui, G.Tran Son Tay, D.Thanoon, W.Rinsurongkawong .

9 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^{th} 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

10 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 Cruiz, 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 Computational Medicine.*

• 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://cdcsp.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