ACTIVITY REPORT

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CERMICS

Centre d'Enseignement et de Recherche en Mathématiques et Calcul Scientifique

ECOLE NATIONALE
DES PONTS ET CHAUSSÉES

CENTRE D'ENSEIGNEMENT ET DE RECHERCHE EN MATHÉMATIQUES ET CALCUL SCIENTIFIQUE

CERMICS
ENPC laboratory hosting joint project-teams with INRIA
Laboratoire de l'ENPC participant à des projets communs avec l'INRIA

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Director: Serge PIPERNO
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14 researchers
11 associate researchers (5 researchers of INRIA, 3 of University of Marne-la-Vallée, and 2 of University Nice - Sophia Antipolis)
13 external collaborators
34 PhD students

2 administrative assistants
5 post-docs, 1 engineer
7 invited researchers
10 internship students

CERMICS is a laboratory of ENPC, formerly joint with INRIA, and hosting INRIA project-teams. It is located mainly at ENPC in Champs-sur-Marne and for a small part at INRIA Sophia Antipolis. The scientific activity of CERMICS covers several domains in scientific computing, modelling, and optimization.

Three teams deal with modelling and scientific computing: «Fluid Mechanics» (leader: A. Ern), «Molecular and multiscale simulations» (leader: E. Cancès), and «CAIMAN» (joint project-team with INRIA Sophia Antipolis and UNSA; leader: S. Piperno). Three other teams cover several important domains of applied mathematics: «Optimization and Systems» (leader G. Cohen), «Applied Probability» (leader: J.-F. Delmas) with applications of probability theory to numerical models and methods, and «PDE and materials» (leader: R. Monneau) devoted to mathematical modelling of material behaviour at the cristalline level.

It can be pointed out that three teams are or take part to joint project-teams with INRIA: the team «Molecular and multi-scale simulations» hosts INRIA project team MICMAC (leader: C. Le Bris), the team «Applied Probability» hosts INRIA project-team MATHFI (leader: A. Sulem) and CAIMAN has the same contours for INRIA and ENPC.

Staff changes. In 2005, Serge Piperno, has been nominated at the direction of the laboratory and joined the laboratory at Champs-sur-Marne (in the team «Fluid Dynamics»). In this context, the project-team CAIMAN, will be reformulated and redesigned, in order to fit the aims chosen and proposed by INRIA and UNSA researchers. A new INRIA-UNSA project-team should be proposed soon. B. Lapeyre, the former director, is now only half-time in the laboratory. J.-F. Delmas was nominated as vice-director of the laboratory. Finally, returning from a post-doctoral stay at Montréal (Canada), Tony Lelièvre joined the laboratory in a permanent researcher position.

Publications and prizes. The CERMICS laboratory has sustained a high scientific activity: over sixty articles have been accepted or published in journals, approximately forty presentations in conferences have been made and three books have been published. Tony Lelièvre was awarded two scientific prizes for his PhD thesis defended last year: the 2005 ENPC PhD prize and the 2005 ParisTech PhD prize in the category “contribution to progress in scientific knowledge”.

Industrial impact. The activities of industrial transfer in the laboratory are strongly linked to research activities. Scientific results are mostly obtained in collaboration with Research and Development Departments of large industrial firms through research contracts (Alcan, EdF, CEA, EADS, Calyon, Suez, etc). An emerging part of our financial supports is granted by the “Agence Nationale de la Recherche” (ANR), the french equivalent of the American NFS, which proposes scientific program calls and grants. The overall research contracts have reached a record in 2005, not far form 450kE for ENPC (100kE via INRIA) which should be compared to last year’s 360kE (for ENPC). Expectations for next year meet a similar level.

Teaching and supervising. Teaching is an important activity of CERMICS members, both at ENPC and other first rank engineering schools (Ecole Polytechique) and in graduate courses (M2R) around Paris. At ENPC, the members of Cermics are strongly contributing to the mathematical and computer engineering department, in the first year (scientific computing, probabilities, analysis) as well as in the second year (modelling-implementation-simulation, frequency analysis, non-linear analysis, etc). Moreover, a third year in mathematical finance has been set up. In addition to organizing and giving courses, the global activity of the laboratory also includes accompanying and supervising students throughout their education, for their projects, internships, as well as PhD theses (more than thirty PhD students).

International collaborations. The different teams in Cermics have many national and international collaborations with other scientific centres and institutions meeting the highest standards. The main international relations are listed in the following.
The fluid dynamics team has collaboration links with the University of Heidelberg, EPFL, Politecnico di Milano, and the University of Texas A&M.
The “Molecular and multi-scale simulations” team worked on the design of domain decomposition methods as an alternative to diagonalization for Kohn-Sham calculations, in collaboration with W. Hager (University of Florida). In numerical statistical physics, the calculation of free energy differences has been examined from both mathematical and numerical viewpoints by C. Le Bris, T. Lelièvre and G. Stoltz, in collaboration with M. Rousset (University of Nice) and E. Vanden-Eijnden (Courant Institute, New York). Also, concerning laser control of molecular processes, the team focused on the very practical issues of the laboratory implementations of closed loop optimal control, in collaboration with the group of H. Rabitz (Princeton University) Finally, in laser control of molecular processes, the so-called monotonically convergent search procedures were studied in collaboration with Y. Maday and J. Salomon (Paris 6), H. Rabitz (Princeton) and Y.Ohtsuki (Tohoku Univ. Japan). Concerning polymeric fluids, a joint study has been conducted by C. Le Bris, B. Jourdain and T. Lelièvre, in collaboration with Felix Otto (University of Bonn).
The “EDP and materials” team has ongoing collaborations with the universities of Santiago (Chile) and Tokyo (Japan), and the Royal Institute of Technology in Stockholm (Sweden). Recently H. Ibrahim started a PhD thesis on the study of dislocations density models with scale effects. He is co-directed by M. Jazar (Beyrouth University).
The “optimization and systems” team works on topics pertaining to stochastic optimization, in particular on problems with constraints in probability in collaboration with R. Henrion and W. Roemisch (Berlin).

RESEARCH TEAMS

Applied probabilities

(A. Alfonsi, M. Ben Alaya, S. Blunck, M. Ciuka, J.-F. Delmas, J. Foki, J. Guyon, B. Jourdain, B. Lapeyre, R Laviollette, J.Lelong, N. Moreni, S. Scotti, E. Voltchkova, A. Zanette)

This team is interested in the study of pricing algorithms in mathematical finance, of links between PDEs and stochastic processes and their applications in physics, chemistry and biology. This research enables us to collaborate with banks and other firms such as Calyon, CAI, CDC, EDF, GDF, PSA, Société Générale, Summit, Sita, PSA, etc.
Mathematical finance. The department is also involved with INRIA (A. Sulem) and the University of Marne la Vallée (V. Bally, D. Lamberton and M.-C. Quenez) in an INRIA project-team named MathFi. In particular we are developing the software PREMIA dedicated to option pricing. This is done with the contribution of S. Blunck, M. Ciuka, E. Volchkova and A .Zanette, and trainees from ENPC and ENSTA. The version 7 of PREMIA has been released in February. The next version developed during the year 2005 includes pricing interest rate derivatives, pricing credit risk derivatives, pricing and hedging of equity in jump models, calibration in jump models as well

as pricing equity in Black-Sholes and Heston models. In 2005, N. Moreni defended is PhD in December on “Monte Carlo methods and options pricing”, he is now working at Banca IMI. The thesis of A. Alfonsi on numerical schemes in finance, of J. Guyon on Euler's scheme convergence and bifurcating Markov chains for the detection of aging in cells, J. Lelong on stochastic algorithms and calibration, R. Laviolette on energy derivatives, and S. Scotti on error calculus in finance are in progress. The team has been working on the elaboration of a 3rd year formation at ENPC in Mathematical finance. This formation started in September 2005, with links to the research Master in Applied Mathematics of UMLV.

Monte Carlo methods. B. Lapeyre has left the direction of CERMICS to take the direction of the Doctoral Formation Department. He is working on stochastic algorithms, with applications in finance. The ANR ADAP'MC, in collaboration with ENST, Ecole Polytechnique and University of Dauphine, is starting on adaptive Monte-Carlo methods.

Physics and chemistry. B. Jourdain is working in collaboration with the team “Molecular and multi-scale simulations”, C. Le Bris and T. Lelièvre on models for polymers fluid, coupling deterministic PDE at macroscopic level and stochastic differential equation at microscopic level. They prove results on existence and uniqueness for solutions in such new models. The collaboration with E. Cancès and M. El Makrini concerns also Monte Carlo methods in quantum chemistry.

Biology. J.-F. Delmas visited UBC at Vancouver in autumn, starting collaboration on branching processes. He is also developing an activity in statistics and biology in collaboration with Necker Hospital and University of Orléans. J. Foki is starting a PhD on detection of language for babies in collaboration with program PILE.

CAIMAN

(S. Barrère, M. Benjemaa, M. Bernacki, A. Bouquet, A. Catella, V. Dolean, H. Fahs, L. Fezoui, H. Fol, N. Glinsky-Olivier, S. Lanteri, L. Oukníne, R. Perrussel, S. Piperno, M. Poret, F. Rapetti, G. Scarella, S. Sorrès; external associate researchers: J. Virieux (Geosciences Azur), C. Dedeban (FT R&D))

Caiman is a joint project-team with INRIA (the French National Research Institute in Computer Science and Automatics), the CNRS (French National Centre of Scientific Research) and the Nice-Sophia Antipolis University (NSAU), through the Dieudonné Laboratory (UMR 6621).

Global objectives. The team aims at proposing new, efficient solutions for the numerical simulation of physical phenomena related to wave propagation (electro-magnetism, acoustics, aero-acoustics, seismics, etc) and complex flows in interaction (fluid-structure interactions, real gases,...). Scientific activities sweep a large range from physical modelling to design and analysis of numerical methods. A particular emphasis is put on their validation on realistic configurations and their algorithmic – possibly parallel – implementation.

Our research activities are mainly devoted to wave propagation and complex fluid dynamics. Concerning wave propagation problems, we propose numerical methods based on finite volumes or discontinuous finite elements. These kind of approaches allow great modularity and can achieve high-accuracy with many kinds of meshes (unstructured grids, non-conforming grids, locally refine grids,...). Our methods are mainly developed for problems solved in the time domain with explicit time-schemes. We are also considering extensions towards implicit time schemes with possible acceleration using domain decomposition, or towards the frequency domain. Current applications relate to heterogeneous electromagnetism, acoustics, propagation of acoustic waves in a non-uniform steady compressible flow (aero-acoustics) and geophysics. Concerning fluid dynamics, we are working on Schwartz-type domain decom-position algorithms, with optimized interface conditions for Euler or Navier-Stokes equations solved using finite volume methods on tetrahedral unstructured meshes. We also apply the non-dissipative discontinuous Galerkin methods developed for wave propagation problems for the numerical investigation of aero-acoustic instabilities in shear flows.

Discontinuous Galerkin methods. 2005 has been a year of further development of activities around Discontinuous Galerkin methods for wave propagation problems, and of confirmation of a large room for improvement in their use. Concerning development, the basic method (based on Lagrange polynomials) for which the convergence was proved, has been implemented in three space dimensions in P0, P1 and P2 versions (the first two being parallel). The solvers have been tested in the context of the propagation of an electromagnetic wave emitted from a cellular phone in head tissues (ARC INRIA HEADEXP). This software is an initial prototype, since very promising developments have been initiated after a phase of prospective testing in two-space dimensions of a generic solver of arbitrary accuracy. Concerning algorithmic potential of the methods, further developments concern a solver with locally-adapted spatial accuracy and of a version with locally adapted time step, which is one of the main accomplishments of this year. It is now possible to partially overcome the problem of the low stability limit of the energy-conserving leap-frog time-scheme (which limits the step to a value related to the smallest element in the mesh) by using a time-adaptive recursively defined Verlet method. A locally implicit time scheme was also proposed.

Applications. These numerical methods have been applied to other domains with wave propagation in a heterogeneous medium. In aero-acoustics, we have solved the linearized Euler equations around a non-uniform steady-state. In the PhD thesis of M. Bernacki, we have used a non-dissipative discontinuous Galerkin time domain method, for which the global energy variation in the solution is strongly related to the nature of the supporting flow, hence making possible the numerical simulation or numerical limitation of Kelvin-Helmholtz instabilities. In elasto-dynamics, we have studied the two-dimensional P-SV wave propagation in a heterogeneous vertical linearly elastic and isotropic medium. The numerical methods proposed allow for the simulation of complex phenomena, involving free surfaces or arbitrary non-planar faults, like the dynamic rupture of a complex geometrical fault.

Fluid dynamics

(K. Djadel, A. Ern, S. Meunier, A. Stephansen, P. Sochala, P. Tardif d'Hamonville)

Our research group investigates four topics: (i) finite element methods, (ii) a posteriori error estimates and adaptive meshing, (iii) transport in porous media, and (iv) hydrology and hydraulics. In 2005, one PhD student (P. Sochala) and one post-doctorate researcher (K. Djadel) have joined the research group, while one PhD student (L. El Alaoui) and one post-doctorate researcher (H. Beaugendre) have left. L. El Alaoui is currently post-doctorate researcher in the Department of Mathematics at Imperial College (London, UK), and H. Beaugendre is currently "Maitre de conferences" in the Department of Mathematics at the University of Bordeaux I.

Finite Element Methods. Our research in finite element methods deals with Discontinuous Galerkin (DG) methods, continuous finite element methods stabilized by penalizing the jumps of the gradient of the discrete solution, and nonconforming finite elements (e.g., Crouzeix--Raviart). A. Ern, in collaboration with J.-L. Guermond (Texas A&M), has derived a unified analysis of DG methods for Friedrichs' systems. Such systems, which have been introduced by Friedrichs in 1958, are systems of first-order Partial Differential Equations (PDE's) endowed with symmetry and positivity properties. Examples include advection-reaction equations, advection-diffusion-reaction equations in mixed form, the linear elasticity equations in the mixed stress-pressure-displacement form, and the Maxwell equations in the so-called diffusive regime, to cite a few examples. Friedrichs' systems encompass both hyperbolic-type and elliptic-type PDE's and, as such, are particularly well-suited to provide a general basis for a unified analysis of DG methods. To design a DG method merely involves two ingredients: an interface operator to control the jumps of the discrete solution at interfaces and a boundary operator to enforce boundary conditions weakly. A general error analysis has been presented for such methods. Moreover, a simple and direct link can be made between these operators and the so-called numerical fluxes which are often employed to formulate DG methods, especially in engineering practice.

The second topic concerning finite elements is the stabilization of continuous finite element methods by penalizing the jumps of the gradient of the discrete solution. A. Ern, in collaboration with E. Burman (EPFL) who has recently developed such methods, have derived a general error analysis for the approximation of Friedrichs' systems by such methods. The advantage of stabilized continuous finite element methods with respect to DG methods is that on a given mesh, the former require less memory than the latter.

The third topic concerning finite elements is the analysis of nonconforming finite element approximations of convection-diffusion equations. The goal is to derive (quasi)-optimal error estimates uniformly in the cell Peclet numbers. For this purpose, two stabilization techniques have been proposed and analyzed by A. Ern and L. El Alaoui: subgrid viscosity and face penalty. One important motivation for using nonconforming finite elements is that owing to a direct link with finite volume box schemes, they allow for a conservative reconstruction of the diffusive flux at the element scale.

A posteriori error estimates and adaptive mesh generation. A first important issue analyzed by A. Ern, L. El Alaoui and E. Burman is the robustness of the a posteriori error estimates for nonconforming approximations of convection-diffusion equations. More precisely, the first semi-robust error estimator in a nonconforming setting has been proposed, that is, the ratio of the constants in the lower and upper bounds for the ratio of the error indicator to the actual error scales only as the square root of the Peclet number and not as the Peclet number. This represents a sizeable improvement for the sharpness of the estimates for convection-dominated flows. Furthermore, A. Ern, in collaboration with M. Braack (Heidelberg University) and S. Perotto (Politecnico di Milano), has investigated adaptive modelling techniques (coupled to adaptive meshing techniques) driven by a posteriori error analysis. Given (say) two models, an inaccurate one and an accurate one, the goal is to equilibrate modelling and discretization errors by solely using information retrieved from the discrete solution and that of a suitable discrete dual problem. Two applications are explored: cross-diffusion effects in multi-component combustive flows (with M. Braack) and changing the space dimension to improve or coarsen the model (with S. Perotto).

Transport in porous media. The main application in view is the transport of radionucleides leaking from radioactive waste storage in deep geological layers. This is currently an important issue in France since the National Agency ANDRA is due to report on the feasability of radioactive waste underground storage by the end of 2005. In our research group, two research topics are investigated. The goal of A. Stephansen's PhD thesis (supported by ANDRA) is to develop and analyze DG methods to approximate transport equations in media with strong heterogeneities and anisotropies and then to design robust error indicators to adapt the mesh in transient problems. Part of her work is carried in collaboration with P. Zunino (Politecnico di Milano) Second, the goal of S. Meunier's PhD thesis (supported by EDF) is to derive space-time a posteriori error indicators for coupled thermo-hydro-mechanics problems and to implement them in EdF's software (Code_Aster). Such couplings are important in near-field calculations near waste repositories and may affect the amount of pollutants released into the environment. Finally, P. Tardif d'Hamonville has now started the final year of his PhD thesis, which is carried in collaboration with L. Dormieux (LMSGC Laboratory at ENPC). P. Tardif d'Hamonville has achieved finite element simulations to evaluate diffusion and dispersion tensors in 3D sphere networks and, thus, to assess quantitatively the impact of pore morphology and advection velocity on these tensors.

Hydraulics and hydrology. A new collaboration has been started with the CETMEF. The goal of K. Djadel's post-doctorate research is to design and analyze DG methods to approximate the shallow-water equations. Targeted applications include waves propagating on dry beds to simulate floods or dam breaks. Furthermore, a new PhD thesis has been started in 2005. The goal of P. Sochala's thesis (funded by ENPC) is to develop numerical algorithms to simulate the coupling between subsurface and surface flows. One application in view is the simulation of overland flow caused by heavy rainfall along the surface of hill slopes. Finally, the collaboration with the CEREVE laboratory at ENPC and the QHAN Research Unit at CEMAGREF on hill slope hydrology has been pursued. A post-doctorate research project on dynamics and hysteresis effects in the movement of shallow watertables has been launched and is scheduled to start in early 2006.

Molecular and multi-scale simulations

(E. Cancès, G. Bencteux, A. Deleurence, M. El Makrini, H. Galicher, A. Gloria, C. Le Bris, T. Lelièvre, M. Lewin, F. Lodier, A. Orriols, C. Patz, A. Scemama, G. Stoltz)

The scientific activity of the molecular and multi-scale simulation team covers several fields: electronic structure calculations, numerical statistical physics, laser control of molecular processes, multi-scale simulation of materials, and magneto-hydrodynamics.

Electronic structure calculations. We have continued our studies of the existing algorithms used for electronic structure calculations, and our enterprise consisting in designing new, efficient and rigorously founded algorithms. The questions that we have investigated include: the design of domain decomposition methods as an alternative to diagonalization for Kohn-Sham calculations (E. Cancès, C. Le Bris, in collaboration with W. Hager, University of Florida, M. Barrault, EDF, and Guy Bencteux, EDF), the improvement of numerical strategies for the Diffusion Monte Carlo method (E. Cancès, B. Jourdain, T. Lelièvre and A. Scemama, in collaboration with M. Caffarel, CNRS Toulouse, and M. Rousset, University of Nice), and the computation of the first excited state in the framework of multi-configuration methods (E. Cancès, H. Galicher and M. Lewin). This work is supported by *Electricité de France* (EDF) and the *Commissariat à l'Energie Atomique* (CEA). In parallel with the above numerical works, we have pursued in our enterprise to put the models and the techniques on a sound mathematical basis. We have also devoted a huge effort to a pedagogic endeavour that we consider crucial. The twofold purpose is to both attract to the field of computational chemistry more mathematicians, and introduce the chemists to a growing and important mathematical literature devoted to the models and techniques they use. Two state of the art review articles have been published in order to provide the community with a reliable account of all recent developments in the field both from a mathematical and a numerical viewpoint. In addition, lecture notes from a course on the mathematical and numerical analysis of the models from computational chemistry, at the DEA (M2) level, have been published.

Numerical statistical physics. Molecular dynamics is often used in statistical physics for computing ensemble averages. The bottom line for this is the assumed ergodicity of the Hamiltonian dynamics in the micro-canonical ensemble. Ensemble averages are thus expressed as averaged long time limits of integrals calculated along the actual trajectory. Based on a theoretical result concerning the convergence of the numerical averages toward the exact result, we were able to propose a new method to accelerate this convergence. This scientific program is a collaboration with François Castella, Philippe Chartier and Erwan Faou from INRIA Rennes. It is supported by the ACI *simulation moléculaire* (scientific leader: C. Le Bris). A systematic comparison of some sampling techniques in the canonical ensemble has also been performed (E. Cancès and G. Stoltz, in collaboration with F. Legoll, Lami). The comparison comprises both deterministic algorithms, such as thermostatted molecular dynamics simulations, and stochastic algorithms, such as discretizations of the Langevin dynamics. The techniques are compared in terms of accuracy, efficiency, computational cost. The results obtained could contribute to change the landscape of sampling techniques in the years to come. Finally, the calculation of free energy differences has been examined from both mathematical and numerical viewpoints by C. Le Bris, T. Lelièvre and G. Stoltz, in collaboration with M. Rousset (University of Nice) and E. Vanden-Eijnden (Courant Institute). Another related work on the various discretization schemes used for simulating constrained stochastic differential equations should follow.

Laser control of molecular processes. Our interest focuses on the very practical issues of the laboratory implementations of closed loop optimal control. This is done in collaboration with the group of H. Rabitz (Princeton University) and made possible by a PICS CNRS-NSF grant. Of particular interest is for instance the description of the most important parameters to be used in the optimization of the laser field. This is in particular important to shed some light on the intimate physical mechanism underlying the control process. A numerical strategy for identifying these parameters has been tested. A publication of the promising results obtained should come shortly. Different from the experimental algorithms, the so-called monotonically convergent search procedures were also studied in collaboration with Y. Maday and J. Salomon (Paris 6), H. Rabitz (Princeton) and Y.Ohtsuki (Tohoku Univ. Japan). An important step ahead was the illustration of a special relationship between the monotonic algorithms and the Lyapounov schemes.

Multi-scale simulation of solids. As was the case for many years now, our research program in the multi-scale simulation of solids divides into a theoretical part and a more numerical one. On the theoretical side, in collaboration with Xavier Blanc (of Laboratory Jacques-Louis Lions, Paris) and Pierre-Louis Lions (Collège de France), C. Le Bris has continued to address the question of how to define ground state energies for some microscopic systems composed of an infinite number of particles.

On the numerical front, C. Le Bris, in collaboration with X. Blanc and F. Legoll, have published the mathematical and numerical analysis of a prototypical model for simulations in materials science. The model under study couples an atomistic description of the sample with a macroscopic continuum description. The PhD work of Antoine Gloria deals with the homogenization theory. Starting from the modelling of foams, he has focused on some theoretical questions related to the homogenization of elliptic operators.

Multi-scale simulation of fluids. The subject of this activity covers two different applications and settings. The first one is the modelling of polymeric fluid flows, the second is that of suspensions. In both contexts, our focus in 2005 has been the understanding of the long-time behaviour of the flows. This is in particular in order to understand questions related to return to equilibrium, and dissipation of energy in such problems. For polymeric fluids, the study has been conducted by C. Le Bris and T. Lelièvre, in collaboration with Benjamin Jourdain (CERMICS) and Felix Otto (University of Bonn). On the other hand, for suspensions, as a follow up to the study of well-posedness of the problem, the long time limit has been investigated by C. Le Bris and E. Cancès. It should also be noticed that C. Le Bris gave in the summer 2005 a series of lectures on the modelling of complex fluids at the Peking University in Beijing, China. This could be the first step in a long term collaboration with this institution.

Magneto-hydrodynamics. In collaboration with J.-F. Gerbeau (Inria, REO), and in association with Alcan (formerly Aluminium Péchiney), C. Le Bris, T. Lelièvre and A. Orriols have pursued their efforts for the numerical simulation of electrolytic cells for the industrial production of Aluminium. A comprehensive series of tests have been performed to validate the approach on test cases closer to the actual industrial situation. The purpose of these test cases was twofold. First, we identified pertinent cost functions and commands for a control problem aiming at optimizing the motion and position of a moving interface between two liquids. Second, we were able to compare some well known results in the literature obtained by linear stability analysis performed on simplified systems and those obtained by a fully nonlinear approach. In addition to this, J.-F. Gerbeau, C. Le Bris and T. Lelièvre have completed the writing of a book presenting a complete account of the past decade of efforts, and comparing the approach and the simulation strategy with those of competitors.

Optimization and systems

(J.P. Chancelier, G. Cohen, M. de Lara, A. Dallagi, J.F. Pommaret, B. Seck, C. Strugarek; external associate researchers: L. Andrieu (EDF), P. Carpentier (ENSTA))

This team is involved in research about optimization (mostly in a stochastic setting), system simulation and control.

Stochastic optimization. Our main concern is with devising numerical methods for solving such problems. Numerical resolution most of the time implies "discretization". In this context, discretization means two distinct processes: in addition to the classical Monte Carlo sampling (or any other quadrature methodology) to approximate expectations, one needs to properly translate the "information" constraints into a finite scheme. Those information constraints are a fundamental ingredient of stochastic decision problems: they correspond to the rule of the game which specifies "what do you know about random inputs or outputs prior to making decisions", and this question arises at every stage in a dynamic setting. At least, "causality" is required (that is, the future is known only statistically whereas past realizations may possibly be observed). Most of the time, such informational constraints amount to saying that decisions are feedbacks over "observations" or that they are random variables which are "measurable" with respect to sigma-algebras generated by those observations. Finally, apart from the problem of expectation approximation, and sometimes prior to it, a careful numerical treatment of those "measurability" constraints is required.

Serious difficulties arise when information constraints can be affected by past decisions, for, in this case, decision making must not only care about the direct influence of decisions on the cost function, but also on the indirect (or "dual") effect which consists in trying to reveal as much information as possible to next decision makers, possibly at the price of sacrificing some immediate performance in terms of the cost function. These problems involving dual effect are known to be very tricky for a long time (Witsenhausen's counterexample in 1968) and one past contribution of the team (about to be published in the open literature) has been to study the largest possible class of problems for which dual effect is absent. In the past (K. Barty's thesis), the information issue was handled through the technique of "scenario trees", but unlike what is generally found in the literature, those scenario trees were not postulated a priori as a fuzzy translation of information constraints. We have tried to propose techniques starting from the initial continuous problem formulation and ending with the construction of such discretizations using quantization ideas. A first asymptotic convergence theorem was given in which, again, attention is paid to the convergence of the information structures (also known as sigma-algebras) in addition to that of Monte Carlo approximations. In the last two years, others paths have been followed because it has been realized that, not only scenario trees do not seem at all to be a necessary road towards an appropriate discrete representation of informational constraints, but they may also carry some serious drawbacks (which can only be revealed by the study of asymptotic rates of convergence, a topic we have only started to touch recently). Those new ways of tackling the issue of discretization can be arranged in the following categories: one is inspired by the so-called Nadaraya-Watson or "kernel" technique for conditional expectation estimation, for which a new discretized (computer friendly) approximation can be devised. A second one is derived from the observation that this kernel technique can be considered as a particular instance of a more general technique that we call a "particle finite element" method (the idea is to search for solutions in a finitely generated linear subspace of functions (feedbacks) of (on) observations; this idea of looking for solutions as a finite linear combinations of "elements" can as well be applied to all other "variables" involved in the problem, e.g. state, as well as control, variables in stochastic optimal control problems, and dual variables, or more generally, Lagrange multipliers of any other constraints involved). This very general point of view (presently investigated in the team, in particular in A. Dallagi's thesis work) raises several issues: How to choose the primal and dual bases in a way which exploits any priori knowledge one might have of the solution? How to coordinate convergence of finite to infinite dimensional primal and dual bases so that finite dimensional problems are well-defined and behaved at each iteration stage, and so that asymptotic properties are also adequately ensured? From a more practical point of view, given the size of an available collection of Monte Carlo samples, what is a reasonable size for the collection of finite elements? Indeed, it may seem a priori that the largest this collection is, the best the "fitting power" of the true solution is (or else, the least the bias of approximation is). But, on the other hand, if the number of coefficients to tune is too large with respect to the size of the Monte Carlo sample collection (which is used in the approximation of expectations), then one may expect that the variance of best coefficient value estimation will be poor: that is, as in the more classical problem of conditional expectation estimation, there is an optimal trade-off between variance and bias for a given (but asymptotically large) sample collection. These are some of the issues presently investigated.

In parallel, in a joint work by C. Strugarek, K. Barty and J.S. Roy (EDF), other ideas around kernel approximation are investigated. Here, kernels (whose window widths asymptotically go to zero at a certain rate as iteration stage goes to infinity) are kinds of Dirac approximations centred around successively generated Monte Carlo samples in a scheme which is closer to "stochastic gradient" techniques, so as to asymptotically construct an approximation of the solution which is not dependent on a particular finite element basis choice. In C. Strugarek's thesis work, other topics pertaining to stochastic optimization are also investigated (as a non exhaustive list, let us mention issues about decomposition and coordination of stochastic optimization problems, problems with constraints in probability --- joint work with R. Henrion and W. Roemisch (Berlin) --- a topic initiated in our group by L. Andrieu's thesis, etc.).

Risk aspects are also considered by Michel De Lara with two collaborations: participation to ANR RiskAttitude (economy and risk); contract with EDF and thesis supervision of Babacar Seck on the relationships between risk handling in engineering problems and their translation in economics (utility functions, risk aversion).

Simulation and optimal control. J.-P.

Chancelier and G. Cohen have successfully completed their work on simulation and optimal control of tunnel ventilation. After it has been identified that a key parameter for this problem is the atmospheric pressure difference at the two ends of a tunnel, a quantity that can hardly be measured with sufficient accuracy by direct means, a dynamic estimation algorithm has been devised to provide an on-line monitoring of this critical quantity using other measurements (in particular air speed in the tunnel which is easier to measure). This algorithm has been successfully tested through simulations using various scenarios of variations of the actual pressure difference. Then, through another intensive campaign of simulations, it has been proved that 80% of the energy consumption by the "accelerators" (electric fans) can be saved by using this on-line pressure difference estimation within the control loop (obviously, the pressure difference can contribute for free to cleaning the tunnel from pollution generated by cars and lorries provided one does not try to fight against the airflow generated by this pressure difference in trying to blow the air in the wrong direction at any time). Unfortunately, this "lab success" is not likely to be translated in a real operational success as long as our partner, the CETU (Centre d'Etudes des Tunnels, Lyon) is not ready to pursue those developments through real implementations.

Max-plus algebra. Jointly with J.P. Quadrat (INRIA, Metalau team) and S. Gaubert (INRIA, Maxplus team), G. Cohen pursued his investigation of max-plus algebra and geometry. In the max-plus algebra, truly invertible matrices are a very small class; matrices admitting a pseudo-inverse are called regular and are a wider class with many other characterizations and geometric properties. A paper around this topic is in preparation. Another topic, in continuity with the work and publications of previous years around max-plus convex functions and separation theorems, is an attempt to extend duality theory of constrained optimization to max-plus convex optimization.

Scilab Scientific Computing Software. J.P. Chancelier, one of the main Scilab authors, is now involved in a new software project called NSP. NSP means "New Scilab Project". It aims at implementing a new interpreter and running environment for the Scilab language. This project goes back to 1998 but substantial efforts for development started in 2003 when the Scilab Consortium was created. It is a GPL project, distinct from Scilab, based on the C language with Unix (Linux) and Gtk2 as its main targets. Internal objects are written in C using a C based system of classes. Gtk2 (2.4) is almost fully interfaced. All of the internal Scilab data types are implemented, i.e. they can be internally created and manipulated through libraries. Some Matlab data types such as cells are natively implemented, and extra data types, such as hash tables or linked lists, are also present in NSP. The whole Scilab syntax is covered by the NSP interpreter with some extensions. Note however, that a large effort remains to be done to provide all the functions and functionality already present in Scilab.

Algebraic analysis of PDE systems. J.F. Pommaret is involved in research in control theory and its generalizations, foundations of mechanics and thermo-dynamics, computer algebra for partial differential equations. These works deal with the formal/local study of systems of partial differential equations and groups of transformations, both with their applications to engineering sciences. During the last months, the emphasis has been put on the difficult concept of "identifiability", namely the possibility to recover the coefficients-parameters of a control system through the knowledge of a certain minimum number of trajectories to be determined by an effective algorithm.

Mathematical methods for sustainable management of renewable ressource and biodiversity. M. De Lara is developing many collaborations on this general theme: mathematical epidemiology of infectious diseases (with the laboratory GEMI – "Génétique et évolution des maladies infectieuses", UMR CNRS-IRD-Montpellier); economic interpretation of sustainable development, invariance and environmental preferences (ACI MEDD); sustainable management of biodiversity under uncertainty and global dynamics (French Institute for Biodiversity). He is also the coordinator of the project MOOREA (Methods and Optimization Tools in Applied Ecology) and organized two meetings in 2005.

PDE and materials

(A. Blanchet, A. El Hajj, M. El Rhabi, N. Forcadel, H. Ibrahim, C. Imbert, A. Ghorbel, R. Monneau)

The PDE and Materials team is interested in the modelling of the physics of materials, and in the theoretical and numerical analysis of these models and their simulations. At the present time, our group concentrates its efforts on the study of the dynamics of line defects in crystals, called dislocations (typical length of a micron).These dislocations are responsible of the macroscopic plastic behaviour of metals, and the understanding of plasticity at a microscopic level is one of our main motivations in this direction of research. Our activity is included in an ACI "Young scientists" contract of the French Ministry of Research (2003-2006), called "Modelling and mathematical analysis of dislocation dynamics". We work in particular in collaboration with the laboratory of the study of microstructure LEM at the ONERA. This part of our activity mainly focuses on the complicated dynamics of interacting dislocations lines. Let us cite in particular the works in progress of N. Forcadel (PhD student, 2nd year) on the link between dislocation dynamics and mean curvature motion, and A. Ghorbel (PhD student, 3rd year) on a 1D model of interacting dislocations.

Dislocation dynamics. In 2005, we have extended our research to the study of dislocations density models in connection with elasto-visco-plasticity of metals. This project is a part of the "Pluriformations Program" with the University of Marne-la-Vallée. In this framework, let us cite the PhD thesis of A. El Hajj (2nd year), co-directed with M. Cannone. Recently H. Ibrahim started a PhD thesis on the study of dislocations density models with scale effects. He is co-directed by M. Jazar (Beyrouth University). We also welcomed recently M. El Rhabi on a post-doc position working on the link between these models and the mechanics, in connection with S. Forest of the Center of Materials (ENSMP). Part of our objectives is to establish the connection between the dynamics of a finite number of dislocations lines and the dynamics of dislocation densities, based on non-linear homogenization tools. We are at the very beginning of this project working with C. Imbert (at partial time in CERMICS) and E. Rouy (Lyon University).

Free boundary problems. A. Blanchet and R. Monneau are also members of an ACI NIM contract on "PDE and finance". A. Blanchet defended his PhD, entitled "Monotonicity formula applied to free boundary problems and modelling in biology", and was co-directed by J. Dolbeault from Paris IX - Dauphine University. His thesis presents regularity properties for partial differential equations of parabolic type. In the main part of his thesis, he studies the free boundary for parabolic obstacle problems with variable coefficients. This problem was naturally motivated by the modelling of American options in finance. He proves fine regularity results for the solution and for the free boundary. In the second part of his thesis he studies the Keller-Segel system modelling aggregation of cells in biology, proving in particular the existence of solutions without blow-up when the initial mass of cells is less than an optimal threshold. Let us more generally mention that our team continues its international collaborations, in particular with Chile, Sweden, Japan and Italy.

CERMICS members

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IMBERT Cyril (Univ. Montpellier)
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GALICHER Hervé
GHORBEL Amin
GLORIA Antoine
GUYON Julien
IBRAHIM Hassan
LAVIOLETTE Ralf
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LODIER François
MEUNIER Sébastien

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FALCONE Maurizio (Univ. Roma la Sapienza)
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Administrative Assistants

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TEACHING

Organization

A. Ern chairs the First Year Department at ENPC. This department supervises the whole course program for the first year studies at ENPC.

S. Piperno organized the "Mathematics and Computer Science Department opening week" at INRIA Sophia Antipolis for the students of Ecole Nationale des Ponts et Chaussées.

Lectures

Probability and statistics
ENPC
A. ALFONSI, J. GUYON, B.JOURDAIN, T. LELIEVRE

Mathematical finance
ENPC
A. ALFONSI J. GUYON, B.JOURDAIN

Preliminary lessons for the course of Statistics
ENPC
A. ALFONSI

Sensitivity and error calculations, application to finance
Master 2, university Paris I and university Paris VI
N. BOULEAU

Epistemology
ENPC
N. BOULEAU, B. WALLISER ET K. CHATZIS

Analysis
ENPC
E. CANCÈS, A. ERN, R. MONNEAU

Fourier analysis and spectral theory
ENPC
E. CANCÈS

Molecular simulation : theoretical and numerical aspects
Master Mathématiques de la Modélisation, University Paris 6
E. CANCÈS, G. TURINICI

Numerical analysis and optimization
Course on lecture of G. Allaire and P.-L. Lions, Ecole Polytechnique
E. CANCÈS

Scientific Computing
ENPC
E. CANCÈS, A. ERN, G. TURINICI

Differentiable optimization
ENSTA
P. CARPENTIER

Optimization of large systems
ENSTA
P. CARPENTIER

Numerical methods for stochastic optimization,
Master Mathématiques, Informatique et Applications, PARIS 1

P. CARPENTIER

Numerical methods for financial models
Research Master Applied Mathematics, UMLV
J.-P CHANCELIER, B.JOURDAIN

Stochastic control: continuous time, discretization schemes and control of Markov chains
Master Mathématiques, Informatique et Applications (spécialité Mod. et Méth. Math. en Economie et Finance), Paris I
J.P. CHANCELIER.

Acoustics, computer science and music
ENSMP
J.P. CHANCELIER, B. D'ANDREA

Automatic control
ENSMP
J.P. CHANCELIER, B. D'ANDREA

On stochastic models for engineers
ENPC
J.P. CHANCELIER, M. DE LARA, J.F. DELMAS

Scilab course
ENPC
J.P. CHANCELIER, M. DE LARA.

Probabilistic Tools for Finance
ENPC
M. DE LARA

Mathematics for Environmental Decision,
Master EDDEE (Economics of Sustainable Development, Environment and Energy)
M. DE LARA

Statistics
ENPC
J.F. DELMAS, B. JOURDAIN, J. GUYON

Introduction to probability and statistics
ENSTA
J.F. DELMAS, J. LELONG, J. GUYON

Computational Mechanics Master
ENPC
A. ERN, 12h

Probabilities and Applications
ENPC
B. JOURDAIN, T. LELIÈVRE

Monte-Carlo methods in finance,
Research Master Probability and Applications, University Paris VI
B. JOURDAIN

Parallel scientific computing,
Mastère de Mécanique Numérique, ENS des Mines de Paris.
S. LANTERI

Introduction to probabilities,
Propédeutique, Ecole Polytechnique.
B. LAPEYRE

Numerical methods for option pricing and hedging,
Postgraduate study course in mathematical engineering, EPFL.
B. LAPEYRE

Monte-Carlo methods in finance,
Formation Cycle of College de l'Ecole Polytechnique,
B. LAPEYRE

Projects and courses in Finance Applied mathematics specialization
Ecole Polytechnique,
B. LAPEYRE, B.JOURDAIN

Monte-Carlo methods in finance
ENPC and Research Master Applied Mathematics, UMLV
B. LAPEYRE and B. JOURDAIN

Modelling, Implementation, Simulation
ENPC
B. LAPEYRE, C. LE BRIS

Multiscale systems
Master Mathématiques de la Modélisation, Université Paris 6
C. LE BRIS

Multi-scale systems
Cours de la majeure SEISM, Ecole Polytechnique
C. LE BRIS

Non-probabilistic methods in mathematical finance
ENPC
T. LELIEVRE, O. BOKANOWSKI

Non Linear Analysis and Applications
ENPC
R. MONNEAU

Mathematical Methods for Free Boundary Problems
Master Paris IX Dauphine University
R. MONNEAU

Integral equations, Fluid-structure interaction
Mastére de Mécanique Numérique, ENSMP
S. PIPERNO

Algebraic analysis of control systems defined by partial differential equations
European intensive course FAP/CTS, ENPC,
J.F. POMMARET

Numerical analysis
ESIEE
G. STOLTZ

PUBLICATIONS

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R. MONNEAU, H. SHAHGHOLIAN,
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G. STOLTZ,
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C. LE BRIS,
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Lecture Notes

E. CANCÈS, A. ERN
Analysis, 1st year, ENPC

X. CHATEAU, L. DORMIEUX, A. ERN
Computational mechanics, 2nd year, ENPC

J.F.DELMAS, B.JOURDAIN
Stochastic models, (accepted for publication in the SMAI collection applied mathematics), 2nd year ENPC,

J.F. DELMAS
Statistics, 1st year ENPC,

J.F. DELMAS
Introduction to probability and statistics, Course and Exercises, 1st year ENSTA

A. ERN
Scientific computing, 1st year, ENPC

B.JOURDAIN
Probability and statistics, 1st year ENPC,

Scientific program organization

C. LE BRIS
IMA, Minneapolis, Thematic year Mathematics of Materials and Macromolecules: Multiple Scales, Disorder, and Singularities, Aug. 2004-Jul. 2005

C. LE BRIS
CRM - Montreal, Thematic year les mathématiques de la modélisation multiéchelle et stochastique, Sept. 2004-Aug. 2005

Conference/seminar organization

A. ERN
Minisymposium on Mixed and Discontinuous Finite Elements for Flows in Porous Media, SIAM Geoscience Conference, June 07-10 2005, Avignon, France

A. ERN
Numerical methods for shallow-water equations, ENPC, 21 November 2005, France

A. ERN, J.-P. CROISILLE, F. DUBOIS, R. LUCE, J.-F. MAITRE
Numerical methods for fluids, 19 December 2005, CNAM, Paris

B. LAPEYRE
Participation to the organizing committee of the workshop “Optimisation Frameworks and their Application to Industry” "Confront & Share Methods: Efficiencies and Limits" EDF, 19-21 October 2005, Paris.

R. MONNEAU
Co-organization of a fall school and of Workshop «Moving boundaries», December 2005, Lyon.

Conference communications

M. BERNACKI, S. LANTERI, S. PIPERNO,
Stabilization of Kelvin-Helmholtz instabilities in three-dimensional linearized Euler equations using a non-dissipative time-domain Discontinuous Galerkin method, Seventh International Conference on Mathematical and Numerical Aspects of Wave Propagation, Brown University, Rhode Island, USA, June 20-24, 2005.

M. BERNACKI, L. FEZOUI, S. LANTERI, S. PIPERNO,
Parallel Discontinuous Galerkin unstructured mesh solvers for the calculation of 3D heterogeneous wave propagation problems, DCABES and ICPACE Joint Conference on Distributed Algorithms for Science and Engineering, University of Greenwich (UK), CMS Press, pp. 65-68, August 25th-27th 2005.

N. BOULEAU
Dirichlet forms methods in finance. International Symposium on Stochastic Analysis, Random Fields and Applications, Ascona, June 2005.

E. CANCÈS
International conference on High-dimensional partial differential equations, CRM Montréal, August 2005

A. DALLAGI
Finite element method in information constraint approximation, International Conference on Optimization frameworks for Industrial applications (ICOPI), EDF Clamart, October 19-21, 2005.

A. DALLAGI
Méthodes pour l'approximation de contraintes de mesurabilité dans les problèmes de commande optimale stochastique, Congrès National d'Analyse Numérique, SMAI, Evian, may 2005.

M. DE LARA
Opening Session: On New Caledonia Abore reef ecosystem modelling for sustainable management First South Pacific Conference on Mathematics, Nouméa, New Caledonia, august 29th– September 2nd (2005)

M. DE LARA
First DIVERSITAS Open Science Conference: "Integrating biodiversity science for human well-being", 9-12 November 2005, Oaxaca, Mexico Biodiversity and productivity in stochastic environments: a mathematical look at the insurance hypothesis.

M. DE LARA
Mathematics for the Management and Preservation of Renewable Natural Resources in the Fishery and Forestry Industry Universidad de Concepción, Chile, April 4th-8th, 2005

J.F. DELMAS
Fragmentation associated to Lévy processes, 30th Conference on Stoch. Proc. and their Appl., Santa Barbara (USA), June 2005

A. ERN
A non-conforming subgrid stabilisation for convection-diffusion equations, SIAM Geoscience Conference, June 07-10 2005, Avignon, France

A. ERN
Discontinuous Galerkin methods for Friedrichs' systems ,SIAM Geoscience Conference, Avignon, France, June 07-10 2005,

A. ERN (invited plenary speaker),
Discontinuous Galerkin methods for Friedrichs' systems, ENUMATH Conference, Santiago, Spain July 18-22 2005,

A. GHORBEL
Poster communication in the 2nd conference on TAM-TAM'05 (Trends in Applied Mathematics in Tunisia, Algeria, Morocco) in Tunis (TUNISIA), April 26tth-28th 2005.

J. GUYON
University of Technology, Quantitative Methods in Finance 2005 Conference, Sydney, December 2005.

C. LE BRIS, A. GLORIA
IMA Workshop Effective Theories for Materials and Macromolecules, Minneapolis, June 2005

C. LE BRIS,
Foundations of computational mathematics international conference, Santander (Spain), July 2005

C. LE BRIS
ICMS `Dynamical Problems in Mathematical Materials Science' conference, keynote speaker, Edinburgh (UK), July 2005

C. LE BRIS
Workshop on Atomic Motion to macroscopic models, IMA, Minneapolis, April 2005

C. LE BRIS (cancelled due to airlines strike)
International Conference Broad-Minded Modelling in Continuum Physics, in honour of Gianfranco Capriz on his 80th birthday, Rome, October 2005

C. LE BRIS
Workshop on Multiscale Analysis and Computation, IPAM-UCLA, Los Angeles, November 2005

T. LELIÈVRE
The Montreal scientific computing days, February 2005

T. LELIÈVRE
SIAM Dynamical System 2005 conference, Snowbird, May 2005

T. LELIÈVRE
Computational stochastic differential equations, Bedlewo, September 2005

T. LELIÈVRE
SCPDE 2005 Conference, Hong Kong, December 2005

R. MONNEAU, A. GHORBEL
Equation d'Hamilton-Jacobi non-locale modélisant la dynamique des dislocations, acte du congrès Tendances des Applications Mathématiques en Tunisie, Algérie, Maroc 2005, Ed. ENIT-LAMSIN, 322-328 (2005).

R. MONNEAU, O. ALVAREZ, E. CARLINI, P. HOCH, Y. LE BOUAR
Dislocation dynamics described by non-local Hamilton-Jacobi equations, Materials Science & Engineering: A , Volumes 400-401, 25 pages 162-165, July 2005.

R. MONNEAU, A. BLANCHET, J. DOLBEAULT
On the one-dimensional parabolic obstacle problem with variable coefficients, Elliptic and Parabolic Problems: A Special Tribute to the Work of Haim Brezis Series: Progress in Nonlinear Differential Equations and Their Applications, Vol. 63, pages 59-66, C. Bandle et al. (Eds.), Birkhäuser (2005).

S. PIPERNO,
Fully explicit DGTD methods for wave propagation on time-and-space locally refined grids, Seventh International Conference on Mathematical and Numerical Aspects of Wave Propagation, Brown University, RI, USA, June 20-24, 2005.

G. SCARELLA, O. CLATZ, S. LANTERI, G. BEAUME, S. OUDOT, J.-P. PONS, S. PIPERNO, P. JOLY, J. WIART, Realistic numerical modelling of human head tissues exposure to electromagnetic waves from mobiles phones, Seventh International Conference on Mathematical and Numerical Aspects of Wave Propagation, Brown University, RI, USA, June 20-24, 2005.

A. STEPHANSEN
A posteriori error analysis of discontinuous Galerkin schemes for linear first-order PDEs, Admos'05, Barcelona, Spain, September 8-10

G. STOLTZ
"Multiscale Modelling in Soft Matter and Bio-Physics", seminar IPAM-UCLA, September

G. STOLTZ
"Time acceleration methods in molecular dynamics", seminar IPAM-UCLA, October

C. STRUGAREK
Conférence sur l'optimisation en finance, Coimbra, Portugal, July 5th -8th 2005

S. STRUGAREK
Stochastic gradient learning for closed loop control problems, COUCH (Conférence sur l'optimisation dans l'incertain), Heidelberg, Germany, September 28th-30th 2005

S. STRUGAREK, J.-S. ROY, K. BARTY
Poster on "Functional Stochastic Gradient Algorithm with kernels", Congrès national d'analyse numérique, SMAI, Evian may 2005

G. TURINICI
Conference ``Optimal Control of Coupled Systems of PDE'', Oberwolfach, Germany, April 2005

G. TURINICI
MIC 2005 Conference, Innsbruck, February 2005

Research reports

R. ABRAHAM and J.F. DELMAS
Feller property and infinitesimal generator of the exploration process.
CERMICS Research Report n° 2005-295

R. ABRAHAM and J.F. DELMAS
Fragmentation associated to Lévy processes using snake.
CERMICS Research Report n° 2005-291

E. BURMAN, A. ERN
Continuous interior penalty hp-finite element methods for transport operators,
CERMICS Research Report n°2005-275

A. ERN, J.L. GUERMOND
Discontinuous Galerkin methods for Friedrichs' symmetric systems. I. general theory,
CERMICS Research Report n°2005-276

L. EL ALAOUI, A. ERN
Nonconforming finite element methods with subgrid viscosity applied to advection-diffusion-reaction equations,
CERMICS Research Report n°2005-278

A. ERN, J-L. GUERMOND, G. CAPLAIN
An intrinsic criterion for the bijectivity of Hilbert operators related to Friedrichs' systems,
CERMICS Research Report n°2005-281

L. EL ALAOUI, A. ERN, E. BURMAN
A priori and a posteriori analysis of nonconforming finite elements with face penalty for advection-diffusion equations
CERMICS Research Report n°2005-289

A. ERN, J.L. GUERMOND
Discontinuous Galerkin methods for Friedrichs' systems. Part II. Second-Order elliptic PDE'S,
CERMICS Research Report n°2005-290

A. GLORIA,
An analytical framework for the numerical homogenization of monotone elliptic operators and quasiconvex energies, INRIA Research Report RR-5791

B. JOURDAIN, A. ZANETTE
A Moments and Strike Matching Binomial Algorithm for Pricing American Put Options,
INRIA Research Report 5569

T. LELIEVRE, M. EL MAKRINI, B. JOURDAIN
Diffusion Monte Carlo method: numerical analysis in a simple case.
CERMICS Research Report n° 2005-293

S. PIPERNO,
Symplectic local time-stepping in non-dissipative DGTD methods applied to wave propagation problems,
CERMICS Research Report n°2005-282 (published also as INRIA Research Report RR n°5643).

S. PIPERNO,
DGTD methods using modal basis functions and symplectic local time stepping: application to wave propagation problems,
CERMICS Research Report n°2005-292 (published also as INRIA Research Report RR n°5749),

G. TURINICI,
Equivalence between local tracking procedures and monotonic algorithms in quantum control,
INRIA Research Report RR-5564.

CONTRACTS

Expertise in the parallelization of structured grid schemes on clusters (FT R&D)
S. PIPERNO, S. LANTERI, A. BOUQUET (INRIA contract).

Evaluation of MAXDGk for a coupled Vlasov/Maxwell software (CEA/CESTA)
S. LANTERI, S. PIPERNO, L. FEZOUI (INRIA contract).

Numerical methods for the frequency domain solution of Maxwell equations (EADS)
S. LANTERI, S. PIPERNO, H. FOL (INRIA contract).

Coupled DGEM/BEM solution of the frequency domain Maxwell equations (FT R&D)
S. LANTERI, S. PIPERNO, H. FOL (INRIA contract).

Quantitative Seismic Hazard Assessment (QSHA, ANR project of program "Catastrophes telluriques et Tsunamis")
N. GLINSKY-OLIVIER, S. LANTERI, S. PIPERNO, M. BENJEMAA

PhD fellowship of A. Stephansen (ANDRA)
A. STEPHANSEN, A. ERN

PhD fellowship of S. Meunier (EDF)
S. MEUNIER, A. ERN.

Discontinuous Galerkin methods for Saint-Venant equations (CETMEF)
A. ERN, S. PIPERNO, K. DJADEL.

Box schemes and Discontinuous Galerkin methods for flows in porous media (GDR MOMAS)
A. ERN.

PAI Procope : Adaptive modelling in flow simulations, collaboration with the University of Heidelberg
A. ERN.

Modelisation and numerical analysis of dislocation dynamics (ACI JC 1025 Jeunes chercheurs, MENRT)
R. MONNEAU.

EDP method in market finance (ACI Nouvelles Interfaces des Mathematiques)
A. BLANCHET, R. MONNEAU.

Collaboration contract France-Chile ECOS-CONYCIT C02E06, ENPC
R. MONNEAU.

Contract with Centre des Matériaux d'Evry (ENSMP)
M. EL RHABI, R. MONNEAU.

Numerical simulation of aluminum electrolysis (Alcan-Pechiney)
C. LE BRIS, T. LELIEVRE, A. ORRIOLS.

Mesoscopic models for rubbers (Michelin)
T. LELIEVRE, E. CANCES, C. LE BRIS

PREMIA software : pricing and hedging procedures library (financed by a consortium of banks),
A. ALFONSI, J.F. DELMAS, J. GUYON, B. JOURDAIN, B. LAPEYRE

Modelling of the dependence between the electricity price and the demand in electricity (EDF)
A. ALFONSI

Atom-to-continuum multiscale numerical simulation of materials (EDF),
E. CANCÈS, C. LE BRIS

Study on scale transfer in materials simulations (CEA),
E. CANCÈS, G. STOLTZ

From Risk Constraints in Stochastic Optimization Problems to Utility Functions, responsible (EDF)
M. DE LARA

Environment and re-Emergence of Infectious Diseases in the Amazonian Basin (ANR),
M. DE LARA

Risk Attitude : economy and risk, participation (ANR),
M. DE LARA

Economic Interpretation of Sustainable Development, Invariance and Environmental Preferences, (ACI Modélisation économique du développement durable),
M. DE LARA

Development of Deterministic and Stochastic Methods for Theoretical Ecology and Fisheries Management, (ACI Écologie quantitative).
M. DE LARA

Optimal control of a ventilated tunnel (CETU)
G. COHEN, J.P. CHANCELIER.

Data classification (Sita),
J.F. DELMAS

Statistics using Scilab (PSA),
J.F. DELMAS, J.P. CHANCELIER

Modelling and statistical study for the program PILE (EADS foundation)
J. FOKI, D. CHAUVEAU, J.F. DELMAS

From Risk Constraints in Stochastic Optimization Problems to Utility Functions (EDF)
B. SECK, M. DE LARA

DISSEMINATION

International seminars given

A. BLANCHET
Conference CIMPA on mathematical finance, Jordan, September 12th-22nd, 2005.

A. BLANCHET
International conference on free boundary problem, Coimbra, Portugal, June 7th-12th, 2005.

N. BOULEAU
Propagation through financial models of the error due to the Euler scheme, ZIF, Bielefeld, Germany (June)

N. BOULEAU
Chaire Galilée (Cattedra Galileiana) Course on Dirichlet forms methods (12 hours lecture), Scuola Normale, Pisa, Italy (September)

N. BOULEAU
Examples of approximations yielding Dirichlet forms, German-Japanese Symposium on Dirichlet forms, Bielefeld and Bonn, Germany (November)

E. CANCÈS, C. LE BRIS
School in Bangalore, India (February)

E. CANCÈS
Seminar of the Mathematics department IMA (Minneapolis), IPAM-UCLA (Los Angeles) Tuebingen University.

E. CANCÈS, C. LE BRIS
Interdisciplinary seminar of Sandia National Labs, Albuquerque, USA

M. DE LARA
Strategies and trajectories of coral reef fish larvae optimising self-recruitment, Universidad de Concepción, Chile (April)

J.F. DELMAS
Fragmentation of continuous random trees, University of Vancouver, Canada (November)

J.F. DELMAS
More on the fragmentation of continuous random trees, CMS Winter meeting'', Victoria, Canada (December)

A. ERN
Discontinuous Galerkin methods for Friedrichs' systems, Journées d'analyse numérique et optimisation, Rabat, Morocco (December)

A. ERN
Adaptive multi-modelling and local mesh refinement controlled by a posteriori error estimates, McGill University, Montreal, Canada (February 4th)

A. ERN
Discontinuous Galerkin methods for Friedrichs' systems, Politecnico di Milano, Italy (February 24th)

A. ERN
Discontinuous Galerkin methods for Friedrichs' systems, Heidelberg University, Heidelberg, Germany (march 3rd)

A. ERN
Discontinuous Galerkin methods for Friedrichs' systems, EPFL, Lausanne, Switzerland (May 16th)

A. ERN
Discontinuous Galerkin methods for Friedrichs' systems, University of Bergamo, Bergamo, Italy (November 18th)

B. LAPEYRE
Workshop on High-dimensional Partial Differential Equations in Sciences and Engineering,
"Linear and semi-linear high dimensional problems in finance", august 7th-12th, 2005,

B. LAPEYRE
"Developments in Quantitative Finance", Invitation to the week "Monte-Carlo methods in finance", May 16-20, 2005, Isaac Newton Institute for Mathematical Sciences.

C. LE BRIS, G. STOLTZ
Lake Arrowhead retreat, IPAM-UCLA (December)

C. LE BRIS
Seminar of the Mathematics department Universita di Pavia, Peking University, University of California San Diego, Ecole Polytechnique Fédérale de Lausanne

T. LELIEVRE
Les journées montréalaises de calcul scientifique (February)

T. LELIEVRE
Applied Math Seminar, Courant Institute of Mathematical Sciences (March)

T. LELIEVRE
Computational and Applied Mathematics Colloquium Series, Penn State University (March)

T. LELIEVRE
Applied Analysis & Computation Seminar, University of Massachusetts (April)

T. LELIEVRE
Séminaire dynamique moléculaire, Freie Universität, Berlin (November)

R. MONNEAU

Free Boundary Problems, Coimbra, Portugal (June)

R. MONNEAU
Ecole CIMPA, Irbid, Jordan (September)

J.F. POMMARET
Serbian Academy of Sciences, Belgrade, Invited series of conferences "An introduction to the Galois theory for partial differential equations" (may)

A. STEPHANSEN
Analisi a posteriori dell'errore degli schemi DG per la diffusione anisotropa, Politecnico di Milano, Italy (October 14th)

G. STOLTZ
Seminar ``Materials and Simulation Process Centre'', Caltech (November)

G. TURINICI
Seminar IMATI-CNR Pavia (may)

G. TURINICI
Seminar of the Mathematics department): IMA, University of Minnesota (Minneapolis).

National seminars given

A. ALFONSI,
Schémas de discrétisation pour les processus de Cox-Ingersoll-Ross (et carrés de Bessel), Journées de Probabilités, Nancy

N. BOULEAU
Calculs d'erreur et information de Fisher, University of Marne-la-Vallée (January)

N. BOULEAU
Propagation de l'erreur due au schéma d'Euler à travers les modèles financiers, Université de Marne-la-Vallée (April)

N. BOULEAU
Formes de Dirichlet, principe d'invariance et schéma d'Euler, Université d'Orléans, journée Probabilités du Val de Loire (June)

E. CANCÈS
Séminaire de Mathématiques Appliquées du Collège de France (March)

E. CANCÈS
Vortices in Bose-Einstein condensates, Les Treilles, France (July)

E CANCÈS
Seminar of the Chemistry department: IRSAMC (Toulouse)

G. COHEN
Systems and Optimization Working Group, Réflexions autour de la résolution numérique des problèmes d'optimisation stochastique sous contrainte d'information. Séminaire Parisien d'Optimisation, IHP, Paris (December 5th)

M. DE LARA
Séminaire Théorie des jeux, IHP On Three Relationships between Agents in the Intrinsic Witsenhausen Model for Discrete Stochastic Control and the Sequential Character of Systems with Perfect Memory (June)

M. DE LARA
Seminaire parisien d'optimisation. On Information Problems in Stochastic Control (October)

K. DJADEL
Méthode de Galerkin Discontinu appliquée au système de Saint-Venant, ENPC (November)

K. DJADEL
Méthode de Galerkin Discontinu appliquée au systéme de Saint-Venant, LACA, University Paris 13 (December)

K. DJADEL
Methodes de Galerkin Discontinu, MACS, Université de Valenciennes et du Hainaut-Cambrésis (December)

A. ERN
A course on the theory and practice of finite elements, CFD School (Ecole de printemps MFN), Roscoff, France (June)

A. ERN
The obstacle problem in watertable-ground interaction, CEA-EDF-INRIA Summer School (September 12-15)

A. ERN
Analyse d'une méthode d'éléments finis non-conformes pour les problèmes d'advection-diffusion, Journées du GDR MOMAS, CIRM, France (November 28-30)

A. ERN
Approximations par éléments finis non-conformes des équations de convection-diffusion, Université de Bordeaux 1, Bordeaux, France (March 17th

A. ERN
Les incertitudes en modélisation et en simulation numérique, INERIS Seminar, Verneuil, France (September 30th)

N. FORCADEL
Seminars at Montpellier University and Tours University.

J. GUYON
Institut Elie Cartan, Journes de probabilités, Nancy (September)

J. GUYON
MATHFI seminar, Université de Marne-la-Vallée (February)

J. GUYON
Seminar of numerical probability, statistics of processes and finance, Univ. Paris VI (April)

J. GUYON
Bachelier seminar, Institut Henri Poincaré (June)

J. GUYON
OMEGA seminar, INRIA Sophia Antipolis (September)

J. GUYON
Seminar of probability, statistics and biology, Université Paris V (October)

J. GUYON
HSBC Capital Markets Research, Paris (November)

B.JOURDAIN
Introduction aux méthodes particulaires probabilistes, ISITV, Toulon (February 17th)

B.JOURDAIN,
Introduction aux méthodes particulaires probabilistes, theoretical physics center, Marseille (June 15th)

T. LELIEVRE
Seminar ENS, Rennes (December)

T. LELIÈVRE
Workshop on moving interfaces, CEA (May)

R. MONNEAU
Lyon University (April)

R. MONNEAU
Exposé au Collège de France (April)

R. MONNEAU
Laboratoire Modélisation et Calcul, Grenoble (June)

R. MONNEAU
CMAP, Ecole Polytechnique, Palaiseau (November)

S. PIPERNO
INRIA-Industry Meeting at INRIA Rocquencourt (February)

S. PIPERNO
France Telecom R&D in Issy-les-Moulineaux (December)

S. PIPERNO
«Interactions fluide-structure: couplages et algorithmiques de résolution» at Forum IPSI - Formation et Information en Analyse des Structures (June)

S. PIPERNO, S. LANTERI, L. FEZOUI,
Méthodes de Galerkine Discontinu pour l'électromagnétisme temporel, Séminaire CEA, CESTA (April)

J.F. POMMARET
INRIA, Sophia Antipolis, seminar on "Introduction à la théorie de Galois différentielle" (October)

G. SCARELLA, O. CLATZ, S. LANTERI, G. BEAUME, S. OUDOT, J.-P. PONS, S. PIPERNO, P. JOLY, J. WIART,
Modélisation numérique réaliste des effets (thermiques) sur les tissus de la tête des ondes électromagnétiques émises par les téléphones mobiles, Journée Scientifique sur la Modélisation Electromagnétique, ONERA CERT, Toulouse (March)

G. STOLTZ
Seminar CEA/DAM/DPTA/PMC (june)

C. STRUGAREK
Talk at "Groupe de Travail en Probabilités Appliquées" of university Paris 6, (December)

S. STRUGAREK, J.-S. ROY, K. BARTY
Gradient perturbé dans un espace de Hilbert, Théorie et Applications, Exposé à EDF Clamart (April)

S. STRUGAREK, J.-S. ROY, K. BARTY
Seminar Sydoco (INRIA), on Functional Stochastic Gradient for Optimal Control Problems (June 8th)

G. TURINICI
Seminar SUPELEC (April)

Missions and visits

E. CANCÈS, A. GLORIA, C. LE BRIS, G. STOLTZ
IPAM-UCLA, Los Angeles, Program "Bridging timescales and lengthscales in biophysics and material sciences", Invitation and working groups, Sept.-Dec. 2005

A. DALLAGI
Visit to Prof. T. Pennanen (HKKK, Helsinki, Finland) for cooperation on finite element approximation methods in stochastic optimization, December 2005.

J.-F. DELMAS
Visit to UBC at Vancouver in autumn, starting collaboration on branching processes, October to December 2005.

B. LAPEYRE
Visit to EPFL, Lausanne, Switzerland, February 2005

C. LE BRIS
Scientific collaboration in University of Montreal and New-York, March 2005

C. LE BRIS
Visit at University of Minneapolis, invitation at IMA, April 2005

C. LE BRIS
Working groups in University of Minneapolis, April/May 2005

C. LE BRIS
Courses and working groups in University of Minneapolis, June 2005

C. LE BRIS
Scientific collaboration at University of Montréal, August 2005

R. MONNEAU
Max Planck Institute, Leipzig, Germany, one week, June 2005

R. MONNEAU
Univ. Libanaise, Hadath, Lebanon, one week, July 2005

C. PATZ
Working group with Professor MIELKE and participation to a «Dynamics of phase transitions» Workshop, WIAS Institute (Berlin, Germany), September/December 2005

C. STRUGAREK
Invited by Dr. René Henrion and Pr. Werner Römisch, Humboldt University and Weierstrass Institute of Berlin, Germany, November 20th to December 5th, 2005

SUPERVISION ACTIVITY

Ongoing PHD Theses

A. ALFONSI
Credit risk, calibration and discretization of financial models, ENPC.

G. BENCTEUX
Méthode de decomposition de domaine pour les calculs ab initio en sciences des matériaux, ENPC.

M. BENJEMAA,
Numerical simulation of dynamical rupture in seisms using finite volumes methods on unstructured meshes, UNSA.

A. BOUQUET,
Adaptation of fictitious domain methods to discontinuous Galerkin methods with subgridding, UNSA.

A. CATELLA,
High order DG method on tetrahedral meshes for the solution of time domain Maxwell equations: implicit time-schemes and iterative solution algorithms, UNSA

A. DALLAGI
Méthodes particulaires en commande optimale stochastique, Univ. Paris 1.

A. DELEURENCE,
Analyse mathématique et numérique de quelques modèles de simulation multi-échelle en sciences des matériaux, ENPC.

A. EL HAJJ
Analysis and numerical analysis of elasto-visco-plastic models with dislocations ENPC (co-direction: R. Monneau of CERMICS and M. Cannone of UMLV).

M. EL MAKRINI,
Simulation de défaut dans les cristaux, ENPC.

H. FAHS,
DG methods on non-conformal tetrahedral meshes for the time-domain solution of Maxwell equations, UNSA.

J. FOKI
Fidelity test, Analysis of correlation between different signals, ENPC.

H. FOL,
DG methods on tetrahedral meshes for the solution of Maxwell equations in the frequency domain, UNSA.

N. FORCADEL
Mathematical analysis of dislocations models with mean curvatures terms, ENPC

H. GALICHER
Couplage de modèles classiques et quantiques pour la simulation des matériaux à l'échelle moléculaire, Univ. Paris 6.

A. GHORBEL
Numerical analysis of dislocations dynamics, ENPC.

A. GLORIA,
Méthodes numériques multiéchelles en élasticité non linéaire, ENPC.

J. GUYON
Euler scheme for SDE, Bifurcating auto-regressive models, ENPC.

H. IBRAHIM
Mathematical analysis of dislocations density dynamics with scale effects, ENPC (co-direction: R. Monneau and Mustapha Jazar of Univ.

libanaise).

R. LAVIOLETTE
Options pricing for energy derivatives in models with jumps (ENS Cachan)

J. LELONG
Stochastic Algorithms and calibration problems in Finance (UMLV)

S. MEUNIER
Space-time error indicators for thermo-hydro-mechanics in Code_Aster, ENPC (Cifre fellowship granted by EdF)

A. ORRIOLS
Algorithmes d'optimisation et de contrôle d'interface libre. Application à la production industrielle d'aluminium, ENPC.

S. SCOTTI
Dirichlet forms methods in finance, ENPC and Univ. of Pisa (Prof. M. Pratelli)

B. SECK
From Risk Constraints in Stochastic Optimization Problems to Utility Functions, ENPC.

A. SIRI-JEGOUSSE
Whright Fisher models and non-homogeneous coalescing process, ENPC

P. SOCHALA
Numerical methods for coupling subsurface and surface flows, ENPC.

A. STEPHANSEN
A posteriori error analysis applied to reactive transport in porous media, ENPC.

G. STOLTZ
Problèmes de transfert d'échelle en simulation des matériaux, ENPC.

C. STRUGAREK
Bornes pour la valorisation d'options exotiques couvertes par un porte-feuille mixte d'actifs de production et d'actifs financiers d'électricité, ENPC.

P. TARDIF D'HAMONVILLE
Numerical evaluation of advective and diffusive transport in multi-phase porous media, ENPC.

Defended PHD Theses

M. BARRAULT,
Development of efficient methods for the computation of electronic structures, ENPC.

M. BERNACKI,
Finite volume schemes with centered numerical fluxes: application to aeroacoustics, ENPC.

A. BLANCHET
Monotonicity formula applied to free boundary problems and modelling in biology, Univ. Paris Dauphine (co-direction R. Monneau of CERMICS and Jean Dolbeault of Univ. Paris Dauphine).

L. EL ALAOUI
A priori and a posteriori error analysis for nonconforming mixed finite element methods, ENPC.

N. MORENI
Path integrals and Monte-Carlo methods in finance, University Paris 6.

M. PORET,
Auto-adaptive moving meshes methods for hyperbolic systems in one and two space dimensions, ENPC.

HOSTED SEMINARS

Working group of Mathfi team

M. JEANBLANC (Evry university). Couverture de produits soumis au risque de défaut.

L. DENIS (Le Mans university). Estimation du risque VaR associé à un processus de volatilité inconnue et comportant des sauts.

C. TUDOR (Paris 1 university). Martingale structure for anticipating integrals.

O. ZEITOUNY (Rouen university). La probabilité de ruine en présence d'investissements risqués.

L. NGUYEN NGOC (Créteil university). Quelques martingales liées aux processus de Levy et leurs applications.

J. GUYON (CERMICS). La densité du schéma d'Euler : vitesse de convergence dans l'espace de Schwarz.

A. CISSE (INRIA). Présentation des produits dérivés de crédit.

A. ALFONSI (CERMICS). Etude de schémas de discrétisation pour le processus de Cox-Ingersoll-Ross.

M. BEN ALAYA (Paris 13 university). Sur une extension des lois max-semistables.

A. SCHIED (Technishe Université Berlin). Some recent results on optimal portfolios.

H. PHAM (Paris 7 university). Discrétisation et simulation de l'équation de Zakai.

K. YOSHIDA (Tokyo university). Asymptotic methods in statistics and their applications to finance.

B. JOTTREAU (UMLV). Optimisation de portefeuille dans un marché soumis au risque de défaut.

C. HILLAIRET (university Paul Sabatier Toulouse). Equilibres sur un marché financier avec asymétrie d'information.

E. VOLTCHKOVA (Evry university and CERMICS). Un schéma aux différences finies pour l'évaluation d'options dans les modèles à sauts.

N. BOULEAU (ENPC). Propagation dans les modèles financiers de l'erreur dûe au schéma d'Euler.

F. CHAABANE (Sciences faculty of Bizerte, Tunisia). Théorèmes limites avec poids pour les martingales vectorielles à temps continu.

A. SELLAMI (Paris VI University). Quantization based filtering methods using first order approximation.

B. JOURDAIN (CERMICS). Arbre binomial centré sur le Strike pour le Put américain.

V. LEMAIRE (UMLV). Schéma adapté pour l'estimation du régime stationnaire d'un système dissipatif.

D. BELOMESTNY (WIAAS Berlin), Efficient calibration of jump-diffusion LIBOR market model.

E. CLEMENT (UMLV). Approximation faible d'EDS

A. GLOTER (UMLV). Propriété LAMN pour l'observation d'une diffusion intégrée.

M. ZERVOS (King's College London). Optimal timing of investment decisions.

J. LELONG (CERMICS). Théorème central limite pour Robbins Monro avec projection.

M. ROSENBAUM (UMLV). Estimation de la persistence de la volatilité dans un modèle de diffusion.

J.P. CHANCELIER (CERMICS), MAXPLUS "CONTROLE STOCHASTIQUE" A policy iteration algorithm for fixed point problems with nonexpansive operators.

J.P. CHANCELIER, A. SULEM, H. MESSAOUD, Application to impulse control problems, INRIA-Rocquencourt.

Working group on dislocations

M. CANNONE (LAMA, université Marne-la-Vallée). Perte de régularité pour données grandes dans quelques EDP non linéaires

Ph. HOCH (CEA). Équations de Hamilton-Jacobi sur maillages structurés et non-structurés

S. JAFFARD (LAMA, université Paris XII). Analyse multifractale des signaux

G. CARLIER (CEREMADE, université Paris-Dauphine). Introduction au transport de masse.

L. CORRIAS (Université d'Evry). Analyse d'un système de type Keller-Segel : existence globale et unicité des solutions, profil asymptotique en temps.

S. DEL PINO (LAN, université Paris VI). Schémas d'ordre arbitrairement élevé pour les systèmes hyperboliques à coefficients constants.

H. ZAAG (ENS Ulm). Régularité L^p pour deux modèles de chémotaxie et d'angiogénèse

F. FILBET (Université Paul Sabatier) Discrétisation de modèles d'edp pour le chimiotactisme

S. MISCHLER (Université Paris-Dauphine). Modèles de sélection-mutation

M. FALCONE (Università di Roma la Sapienza). Numerical approximation of growing sandpiles

Seminar of the team Caiman

Ph. DELORME, Ch. PEYRET - ONERA/DSNA/PARA, Calcul hp-optimal en aéroacoustique

V.-M. CRUZ-ATIENZA - UMR Géosciences Azur (CNRS-UNSA-IRD-UPMC) Simulation de la rupture dynamique en 3D de failles non-planaires Application au séisme de Landers (1993, Mw = 7.3)

L. NICOLAS (CEGELY, Ecole Centrale de Lyon, UMR CNRS 5005), Modélisation de l'interaction des champs électromagnétiques et des systèmes vivants

J. BLUM (Université de Nice-Sophia Antipolis, Laboratoire de Mathématiques J.A. Dieudonné), Sur quelques méthodes d'assimilation de données pour l'environnement

V. DOLEAN (Université de Nice-Sophia Antipolis, Laboratoire de Mathématiques J.A. Dieudonné), Optimized Schwarz methods for the Maxwell

system
R. PERRUSSEL Institut Camille Jordan, Ecole Centrale de Lyon, Méthode multiniveau algébrique pour les éléments finis d'arête

Scientific computing seminar

F. MURAT (Laboratoire JLL, université Paris VI). Introduction aux solutions renormalisées

F. MURAT (Laboratoire JLL, université Paris VI). Approximation par éléments finis d'équations linéaires elliptiques du deuxième ordre sous forme divergence avec second membre dans L1
Francois Murat - Laboratoire JLL,

D. HILHORST (Laboratoire de Mathématiques, université Paris XI). Sur un modèle mathématique pour l'invasion de bactéries dans des blessures

M. VOHRALIK (Laboratoire de Mathématiques, université Paris XI). Couplages volumes finis-éléments finis pour des équations de transport.

A. ORRIOLS (CERMICS). Parallélisation du code Mistral, solveur par éléments finis d'un problème de MHD bifluide tridimensionnel.

M. LEWIN (INRIA). Une nouvelle méthode pour le calcul d'états excités électroniques.

F. PASCAL (CMLA, ENS Cachan). Supraconvergence de la méthode des volumes finis.

R. BRIZZI (CMAP, Ecole Polytechnique). Une méthode d'éléments finis multi-échelles pour l'homogénéisation numérique.

Y. CAPDEBOSCQ (Université de Versailles Saint-Quentin). Tomographie d'impédance et d'élasticité d'objets de petit volume.

M. FERNANDEZ (INRIA), Interaction fluide-structure dans les écoulements sanguins: vers un couplage semi-implicite.

M. MOUBACHIR (INRIA).
Contrôle et identification de surfaces mobiles.

F. BOUCHUT (ENS Ulm). Volumes finis équilibrés pour les équations de type Saint-Venant : autour du schéma de reconstruction hydrostatique.

K. DJADEL (CERMICS) Méthodes de Galerkin discontinu appliquées aux équations de Saint-Venant

J.M. HERVOUET (LNHE, EDF) Equations de Saint-Venant : simulation numérique avec la méthode des éléments finis. Applications à EDF.

A. OUAHSINE (UTC Compiègne) Traitement Numérique des équations de Saint-Venant et de Boussinesq en présence de forts gradients. Présentation du modèle H-S en éléments finis.

SOFTWARE

J. P. CHANCELIER
Development of Nsp, experimental re-implementation of Scilab (Presentation to the Steering Committee of Scilab, 18 january 2006).

Applied probability team and team Mathfi
PREMIA (version 7), option pricing software.

LIST OF ACRONYMS

ACI Action Concertée Incitative
ANDRA : Agence nationale pour la gestion des déchets radioactifs
ANR : Agence nationale de la Recherche
CEMAGREF : Centre national du machinisme agricole, du génie rural, des eaux et des forêts
CEREVE : Centre d'Enseignement et de Recherche Eau, Ville, Environnement
CETMEF : Centre d'Etudes Techniques Maritimes et Fluviales
EPFL : Ecole Polytechnique Fédérale de Lausanne
GDR : Groupement de Recherche
INERIS : Institut National de l'Environnement Industriel et des Risques
LMSGC : Laboratoire des matériaux et des structures du génie civil
MOMAS : Modélisations mathématiques et simulations numériques liées aux problèmes de gestion des déchets nucléaires
PAI : Programme d'Actions Intégrées du Ministère des Affaires Extérieures
QHAN : Qualité et fonctionnement hydrologique des systèmes aquatiques
du groupement d'Antony
UMLV : Marne-la-Vallée University
UNSA : Nice - Sophia Antipolis University