FOREWORD

The MAMCDP'09 workshop took place in Paris in January 2009. It was intended to promote multiresolution and other adaptive techniques for complex applications where convection is the prevailing phenomenon. This event and the present proceedings were funded within the scope of the Équipe de Recherche Technologique (ERT) *Simulation Avancée du Transport des Hydrocarbures*, approved by the French Ministère de la Recherche and the IFP.

The organizing committee was composed by Frédéric Coquel, Yvon Maday, Marie Postel (LJLL, UPMC-Paris 6), Siegfried Müller (IGPM, Aachen) and Quang Huy Tran (IFP, Rueil-Malmaison). Presentations were given by both senior and young researchers from various institutions over two days, in the following order:

DAY 1 (January 22, 2009)

- Fully adaptive multiresolution methods for evolutionary PDEs, by Kai Schneider (Université de Provence, Marseille, France)
- Multiresolution acceleration methods in three dimensions, by Barna L. Bihari (ICON Consulting, Inc/IBM, Livermore, USA)
- Parallelization of multiscale-based grid adaptation using space filling curves, by Silvia Sorana Melian[1] (Institut für Geometrie und Praktische Mathematik, Aachen, Germany)
- Utilisation of Harten multiresolution in scientific computing: two examples, by Guillaume Chiavassa (École Centrale de Marseille, France)
- Combining multiresolution and anisotropy: theory, algorithms and open problems, by Albert Cohen (Laboratoire Jacques-Louis Lions, Paris, France)
- Guaranteed and robust discontinuous Galerkin a posteriori error estimates for convection-diffusion reaction problems, by Martin Vohralik (Laboratoire Jacques-Louis Lions, Paris, France)
- A new strategy for adapting time-step in the Local Time Stepping method applied to hyperbolic PDEs, by Quang Long Nguyen (IFP, Rueil-Malmaison, France)

DAY 2 (January 23, 2009)

- Adaptive methods for the Vlasov equation, by Éric Sonnendrücker (Institut de Recherche Mathématique Avancée, Strasbourg, France)
- Wavelet-based CVS method to solve a convection-dominated problem: the numerical simulation of turbulence, by Marie Farge (École Normale Supérieure, Paris, France)
- How to predict accurate grids in adaptive semi-Lagrangian schemes, by Martin Campos Pinto (Institut de Recherche Mathématique Avancée, Strasbourg, France)
- Local time steps for a finite volume scheme, by Isabelle Faille (IFP, Rueil-Malmaison, France)
- Using Harten's multiresolution framework on existing codes for hyperbolic PDEs, by Rosa Donat (Universitat de València, Burjassot, Spain)

The slides of the oral presentations are available at: http://www.ann.jussieu.fr/mamcdp09/.

We were very pleased that following this event, several speakers and their collaborators have agreed to contribute to the present proceedings volume, which is made up of eight articles organized as follows:

(1) Frédéric Coquel, Yvon Maday, Siegfried Müller, Marie Postel and Quang Huy Tran, *New trends in multiresolution and adaptive methods for convection-dominated problems*, is an introductory review written by the editors and organizers of the workshop in order to make the topic easier to tackle by non-expert readers.

[1] Formerly Silvia Sorana Mogosan

Article published by EDP Sciences and available at http://www.edpsciences.org/proc or http://dx.doi.org/10.1051/proc/2009050

(2) Guillaume Chiavassa, Rosa Donat and Anna Martinez-Gavara, in *Cost-effective multiresolution schemes for shock computations*, present two different applications of the cost-effective multilevel technique initially introduced by Ami Harten. The reduction in the computational time required for 2-D numerical simulations is drastic.

(3) Ralf Deiterding, Margarete O. Domingues, Sônia M. Gomes, Olivier Roussel and Kai Schneider, in *Adaptive multiresolution or adaptive mesh refinement? a case study for 2-D Euler equations*, present adaptive multiresolution (MR) computations of the two-dimensional compressible Euler equations for a classical Riemann problem. The results are then compared with respect to accuracy and computational efficiency, in terms of CPU time and memory requirements, with the corresponding finite volume scheme on a regular grid and with computations using adaptive mesh refinement (AMR).

(4) Martin Campos Pinto, in *How to predict accurate wavelet grids in adaptive semi-Lagrangian schemes?* presents a new adaptive semi-Lagrangian scheme based on wavelet approximations for solving transport equations with underlying smooth flow. Error estimates are established.

(5) Isabelle Faille, Frédéric Nataf, Françoise Willien and Sylvie Wolf, in *Two local time stepping schemes for parabolic problems*, present two strategies for solving time-dependent problems on grids with local refinements in time using different time steps in different regions of space and illustrate the accuracy with numerical results on parabolic and a two-phase flow problems.

(6) Frédéric Coquel, Quang Long Nguyen, Marie Postel, and Quang Huy Tran, in *Local time stepping with adaptive time step control for a two-phase fluid system*, propose a local time stepping strategy in order to alleviate the constraints due to the CFL stability condition, in the context of conservation laws modelling two-phase flows in pipelines. A special focus is given to the optimal choice of micro time steps within a macro time step.

(7) Romain Nguyen van yen, Marie Farge and Kai Schneider, in *Wavelet regularization of a Fourier-Galerkin method for solving the 2-D incompressible Euler equations*, study several ways to regularize the solution by wavelet filtering at each timestep and compare them with the classical viscous and hyperviscous regularization methods. They obtained a compression rate of order 3.

(8) Kolja Brix, Silvia Sorana Melian, Siegfried Müller and Gero Schieffer, in *Parallelisation of multiscale-based grid adaptation using space-filling curves* propose a strategy to parallelise multiscale-based grid adaptation via MPI in order to perform 3-D computations for complex geometries on distributed memory architectures and therefore in reasonable CPU times.

Finally, we express our warmest thanks to the editorial board, and especially to Jean-Frédéric Gerbeau for accepting this volume for publication in ESAIM: Proceedings.

The Editors
Frédéric Coquel, Yvon Maday, Siegfried Müller, Marie Postel and Quang Huy Tran