PREFACE

Modern theory of partial differential equations is very important for applications in physics, control theory and optimum design, among others. Advanced numerical techniques are employed to compute solutions of multidimensional models on powerful computers. Scientific computations constitute a new branch of applied mathematics and informatics which combines the knowledge of modelling with the capability of implementation, resulting in commercial codes currently used in industrial applications in high-tech projects. The possible applications of numerical methods presented here include plasma physics and structural mechanics. The mathematical analysis performed for models governed by partial differential equations includes well-posedness of such models as well as convergence analysis of proposed solution methods and test examples solved by computer codes.

This issue is particularly devoted to recent advances in numerical methods for hyperbolic and kinetic equations, Hamilton-Jacobi problems as well as shape optimization. It has come together starting from a workshop on numerical methods for kinetic, hyperbolic and Hamilton-Jacobi equations. Many of the contributors gave an invited talk at this workshop, held in the framework of the French CNRS research network *CHANT* (http://chant.univ-rennes1.fr/).

Several important topics in scientific computing are covered by the articles in this special issue. In particular, very high order methods in the context of traditional finite elements as well as discontinuous Galerkin methods are addressed. Such methods, which are more efficient when very accurate solutions are needed, have benefited from the joint use of symbolic and numerical computation. There are also two articles on finite volumes, one of them introducing a genuinely multidimensional reconstruction method to overcome the limits of traditionally used 1D reconstruction. The other is devoted to the solution of Saint-Venant equations, for which important improvements have been obtained recently. Another very topical issue is the solution of Vlasov equations on a phase-space grid, which is generally at least four dimensional for realistic problems. Four articles are devoted to the semi- Lagrangian method for the Vlasov equation. The first one addresses the coupling of the Vlasov equation with the Darwin model, which is intermediate between Maxwell and Poisson equations, for the description of the electromagnetic field, the second one is devoted to a new interpolation technique based on local splines that is far more efficient for parallelisation, the third one is concerned with another efficient Hermite interpolation method, and the last one – with an adaptive scheme based on wavelets. In addition to those there are review papers on numerical methods for the Hamilton-Jacobi equation as well as numerical shape optimization, and a paper on domain decomposition.

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