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The *Acta Numerica* series presents invited review articles, by leading researchers, in the field of numerical computing. This, the sixth, volume contains eight articles illustrating development in different areas of the field.

The first article by R. Cools, "Constructing cubature formulae: the science behind the art," deals with cubature formulae of algebraic and trigonometric degree for multivariate integrals, starting from a general-theoretical background. The second article is W. Dahmen's, "Wavelet and multiscale methods for operator equations". Here the author reviews wavelet schemes by selecting the ideas and concepts that can help in future developments in the field. The third paper is L. Greengard and V. Rokhlin's, "A new version of the Fast Multipole Method for the Laplace equation in three dimensions." It deals with the development of a new, fast multipole method for the Laplace equation in 3D based on the authors' by improving on earlier methodologies, developed by the authors, for particle simulations as presented in various articles cited herein. Simulation results are also presented.

The fourth article is "Lanczos-type solvers for nonsymmetric linear systems of equations" by M. H. Gutknecht. The smoothing process and speed of convergence are also discussed. Some efficient solvers, including the Lanczos Biorthogonalization algorithm for nonsymmetric systems, are derived. Convergence, breakdown, and termination are discussed in detail and ways to cure breakdowns are presented. The fifth article, "Numerical solution of multivariate polynomial systems by homotopy continuation methods," is by T. Y. Li.

The next article, "Numerical solution of highly oscillatory ordinary differential equations" by L. R. Petzold et al., deals with highly oscillatory ODEs that may arise in various practical situations. Linear problems and underlying concepts to understand numerical methods for highly oscillatory problems are outlined. Then highly oscillatory rigid and flexible mechanical systems, methods for molecular dynamics, circuit analysis and orbit mechanics are discussed.

The seventh article, "Computational methods for semiclassical and quantum transport in semiconductor devices" by C. Ringhofer, presents an overview of recently developed numerical methods. Most of the discussion is of the Galerkin method for semiclassical and quantum kinetic systems and difference methods on classical and quantum hydrodynamic systems. The stability and convergence of the methods are also discussed. The last paper, S. Smale's "Complexity theory and numerical analysis," deals with the estimation of arithmetic operations during the numerical solution of a problem.

This volume provides comprehensive and well organized facts about various steps in the development of methodologies within the subjects addressed. New directions for development and research are given at the end of some of the articles. It should be very helpful for researchers in the field of numerical mathematics and scientific computing.

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