# Abstracts of Papers to Appear in Future Issues

SPECTRAL METHODS FOR NONLINEAR PARABOLIC SYSTEMS. John Strain, *Department of Mathematics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720, U.S.A.*

Many physical problems are naturally formulated as nonlinear parabolic systems of partial differential equations in periodic geometry. In this paper, a simple, efficient, spectrally accurate numerical method for these problems is described and implemented. The method combines stiff extrapolation with fast solvers for elliptic systems. Theory and numerical results show that the method solves even difficult problems including phase field models and mean curvature flows.

COMPLEX MAPPED MATRIX METHODS IN HYDRODYNAMIC STABILITY PROBLEMS. Andrew W. Gill and G. E. Sneddon, *Department of Mathematics and Statistics, James Cook University, Townsville 4811, Australia.*

The ordinary differential equations governing the linear stability of inviscid flows contain singularities at real or complex points called critical latitudes, which degrade the accuracy of standard numerical schemes. However, the use of a complex mapping prior to the numerical attack offers some respite. This mapping shifts the computational domain to a contour in the complex plane to avoid the critical latitudes. Both quadratic and cubic complex maps are considered in some detail. An analytic result for choosing the optimum quadratic complex map in the case of a single critical latitude is presented. Numerical results are given for two test problems and a barotropic vortex model. A comparison is made between methods with and without these mappings. The results show that the use of complex maps can lead to remarkably accurate solutions.

SOME PRACTICAL EXPERIENCE WITH THE TIME INTEGRATION OF DISSIPATIVE EQUATIONS. Bosco García-Archilla, *Departamento de Matemática Aplicada y Computación, Universidad de Valladolid, Valladolid, Spain.*

Different methods for the numerical integration of evolution dissipative partial differential equations are tested with the Kuramoto–Sivashinsky equation. Discretizations in space include Galerkin and nonlinear Galerkin methods. For integration in time three different codes are used, including standard stiff ODE methods. Numerical tests show that standard codes for stiff ODE render a gain of computing time of several orders of magnitude with respect to problem-tailored methods.

A MULTISCALE WAVELET SOLVER WITH $O(n)$ COMPLEXITY. John R. Williams and Kevin Amaratunga, *Intelligent Engineering Systems Laboratory, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, U.S.A.*

In this paper, we use the biorthogonal wavelets recently constructed by Dahlke and Weinreich to implement a highly efficient procedure for solving a certain class of one-dimensional problems, $(\partial^l/\partial x^l)u = f$, $l \in \mathbf{Z}$, $l > 0$. For these problems, the *discrete biorthogonal wavelet transform* allows us to set up a system of wavelet–Galerkin equations in which the scales are uncoupled, so that a true multiscale solution procedure may be formulated. We prove that the resulting stiffness matrix is in fact an almost perfectly diagonal matrix (the original aim of the construction was to achieve a block diagonal structure) and we show that this leads to an algorithm whose cost is $O(n)$. We also present numerical results which demonstrate that the multiscale biorthogonal wavelet algorithm is superior to the more conventional single scale orthogonal wavelet approach both in terms of speed and in terms of convergence.

ON NONREFLECTING BOUNDARY CONDITIONS. Marcus J. Grote and Joseph B. Keller, *Stanford University, Stanford, California 94305, U.S.A.*

Improvements are made in nonreflecting boundary conditions at artificial boundaries for use with the Helmholtz equation. First, it is shown how to remove the difficulties that arise when the exact DtN (Dirichlet-to-Neumann) condition is truncated for use in computation, by modifying the truncated condition. Second, the exact DtN boundary condition is derived for elliptic and spheroidal coordinates. Third, approximate local boundary conditions are derived for these coordinates. Fourth, the truncated DtN condition in elliptic and spheroidal coordinates is modified to remove difficulties. Fifth, a sequence of new and more accurate local boundary conditions is derived for polar coordinates in two dimensions. Numerical results are presented to demonstrate the usefulness of these improvements.



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