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Abstracts of Papers to Appear in Future Issues

REVIEW OF SOME ADAPTIVE NODE-MOVEMENT TECHNIQUES IN FINITE-ELEMENT AND FINITE-DIFFERENCE SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS. D. F. Hawken, J. J. Gottlieb, and J. S. Hansen, *Institute for Aerospace Studies, University of Toronto, Ontario, CANADA.*

This article summarizes the results of a literature search for adaptive numerical methods of solving partial differential equations; the methods discussed involve the adaptive movement of nodes, so as to obtain a low level of solution truncation error while minimizing the number of nodes used in the calculation. Such methods are applicable to the solution of nonstationary flow problems that contain moving regions of rapid change in the flow variables, surrounded by regions of relatively smooth variation. Flows with shock waves, contact surfaces, slip streams, phase-change interfaces, and boundary layers can be modelled with great precision by these methods. It will be shown that significant economies of execution can be attained if nodes are moved so that they remain concentrated in regions of rapid variation of the flow variables.

PRECONDITIONED DESCENT ALGORITHM FOR RAPID CALCULATIONS OF MAGNETOHYDRODYNAMIC EQUILIBRIA. S. P. Hirshman, *Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA*; O. Betancourt, *City College, CUNY, New York, New York, USA.*

Conjugate gradient descent algorithms have been used in several magnetohydrodynamic (MHD) equilibrium codes to find numerical minima of the MHD energy and thus to locate local stable equilibria. Numerical convergence studies with the spectral equilibrium code VMEC (variational moments equilibrium code) have shown that the number of descent iterations required to obtain a fixed level of convergence grows linearly with the number of radial mesh points. This undesirable mesh dependence is due to the quadratic dependence on the radial mesh spacing of the condition number for the linearized discrete MHD equations. By use of a preconditioning matrix to coalesce the eigenvalues of the linearized MHD forces around unity, it is possible to reduce the condition number substantially and thereby nearly eliminate the mesh size dependence of the convergence rate of the descent algorithm. An invertible, positive-definite tridiagonal preconditioning matrix is derived for the force equations used in VMEC, and the improvement in temporal convergence is demonstrated for several three-dimensional equilibria.

THE DISCRETE CONTINUITY EQUATION IN PRIMITIVE VARIABLE SOLUTIONS OF INCOMPRESSIBLE FLOW. F. Sotiropoulos and S. Abdallah, *University of Cincinnati, Cincinnati, Ohio, USA.*

The use of a non-staggered computational grid for the numerical solutions of the incompressible flow equations has many advantages over the use of a staggered grid. A penalty, however, is inherent in the finite-difference approximations of the governing equations on non-staggered grids. In the primitive-variable solutions, the penalty is that the discrete continuity equation does not converge to machine accuracy. It rather converges to a source term which is proportional to the fourth-order derivative of the pressure, the time increment, and the square of the grid spacing. An approach which minimizes the error in the discrete continuity equation is developed. Numerical results obtained for the driven cavity problem confirm the analytical developments.

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