JOURNAL OF COMPUTATIONAL PHYSICS **118**, 189 (1995)

Abstracts of Papers to Appear in Future Issues

ROBUST MULTIGRID SOLUTION OF THE SHALLOW-WATER BALANCE EQUATIONS. Irad Yavneh and James C. McWilliams. *National Center for Atmospheric Research, Boulder, Colorado 80307-3000, U.S.A.*

Balance equation models describing accurate, gravity-wave-free states on the so-called "slow manifold" of the primitive equations are of wide and growing interest, both theoretical and practical, for geophysical fluid dynamics. As a particular example with only two spatial dimensions, the shallow-water balance equations are a coupled, highly nonlinear, nonsymmetric system of partial differential equations, for which only *ad hoc* solvers of limited robustness have previously been developed. Two multigrid algorithms are presented, one explicit and one implicit in time, which are shown by analysis and numerical examples to be efficient and robust solution techniques for this system. These examples include modons and shallow-water turbulence at a finite Rossby number. It is found that, in some regimes of physical parameters, quite large time steps can be taken with the implicit solver, with little loss of accuracy or efficiency. This is interpreted as due to significantly slower evolutionary rates of the dominant patterns compared to parcel trajectory rates.

ON THE NUMERICAL TREATMENT OF CORNER SINGULARITY IN THE VORTICITY FIELD. J. M. Floryan and L. Czechowski. *Department of Mechanical Engineering, The University of Western Ontario, London, Ontario, Canada N6A 5B9.*

The error in simulation of viscous flows in domains with sharp corners has been evaluated for a model problem at zero Reynolds number. Methods based on a local analytical solution give reliable results but their applicability is limited. The ad hoc numerical methods give an error that is not negligible and has a nonlocal character in some parts of the flow.

DIVERGENCE PRESERVING DISCRETE SURFACE INTEGRAL METHODS FOR MAXWELL'S CURL EQUATIONS USING NON-ORTHOGONAL UNSTRUCTURED GRIDS. Niel K. Madsen. *Engineering Research Division, Lawrence Livermore National Laboratory, Livermore, California 94550 and Research Institute for Advanced Computer Science, NASA Ames Research Center, Moffett Field, California 94035, U.S.A.*

Several new discrete surface integral methods for solving Maxwell's equations in the time-domain are presented. These methods, which allow the use of general non-orthogonal mixed-polyhedral unstructured grids, are direct generalizations of the canonical staggered-grid finite difference method. These methods are conservative in that they locally preserve "divergence" or charge. Employing mixed polyhedral cells (hexahedral, tetrahedral, etc.), these methods allow more accurate modeling of non-rectangular structures and objects because the traditional "stair-stepped" boundary approximations associated with the orthogonal grid based finite difference methods can be avoided. Numerical results demonstrating the accuracy of these new methods are presented.

AN ADAPTIVE TVD LIMITER. Yih Nen Jeng and Uon Jan Payne. *Institute of Aeronautics and Astronautics, National Cheng Kung University, 70101, Tainan, Taiwan, Republic of China.*

An adaptive TVD limiter, based on a limiter approximating the upper boundary of the TVD range and that of the third-order upwind TVD scheme, is developed in this work. The limiter switches to the compressive limiter near a discontinuity, to the third-order TVD scheme's limiter in the smooth region, and to a weighted averaged scheme in the transition region between smooth and high gradient solutions. Numerical experiments show that the proposed scheme works very well for one-dimensional scalar equation problems but becomes less effective in one- and two-dimensional Euler equation problems. Further study is required for the two-dimensional scalar equation problems.

A FAST LEVEL SET METHOD FOR PROPAGATING INTERFACES. David Adalsteinsson and James A. Sethian. *Lawrence Berkeley Laboratory and Department of Mathematics, University of California, Berkeley, California 94720, U.S.A.*

A method is introduced to decrease the computational labor of the standard level set method for propagating interfaces. The fast approach uses only points close to the curve at every time step. We describe this new algorithm and compare its efficiency and accuracy with the standard level set approach.

0021-9991/95 $6.00