Journal of Computational Physics **183,** 332–333 (2002)
doi:10.1006/jcph.2002.7211

Abstracts of Papers to Appear

3D Hybrid Simulation Code Using Curvilinear Coordinates. T. Bagdonat and U. Motschmann. Institute for Theoretical Physics, Techn. Univ. of Braunschweig, Mendelssohnstr. 3, D-38106 Braunschweig, Germany.

A new simulation code using the hybrid approximation for modeling extraterrestrial plasma processes is described, which can be used in an arbitrary three-dimensional, ordered, hexahedral grid. Maxwell's equations are transformed using common tensor analysis and solved by a finite differencing scheme. A particle coalescing technique was adopted to account for differences in cell size. The numerical techniques and some results are presented.

A New Compact Spectral Scheme for Turbulence Simulations. Changhoon Lee and Youngchwa Seo. School of Mechanical Engineering, Yonsei University, Seoul, Korea.

We propose a new kind of compact difference scheme for the computation of the first and second derivatives in the simulation of high-Reynolds number turbulent flows. The scheme combines and truncates the pseudospectral representation of derivative for convergence acceleration. Comparison of the wave resolution property with available optimized compact schemes minimizing the prescribed wave resolution error reveals our scheme's superiority for the same size of stencils without introducing optimization parameters. An accompanying boundary scheme is also proposed with the stability analysis. The proposed scheme is tested for the evaluation of derivatives of a function that decays very slowly in the wavenumber space, and for the simulation of three-dimensional isotropic turbulence.

PROST: A Parabolic Reconstruction of Surface Tension for the Volume-of-Fluid Method. Yuriko Renardy and Michael Renardy. Department of Mathematics and ICAM, 460 McBryde Hall, Virginia Tech, Blacksburg, Virginia 24061-0123.

Volume-of-fluid (VOF) methods are popular for the direct numerical simulation of time-dependent viscous incompressible flow of multiple liquids. As in any numerical method, however, it has its weaknesses, namely, for flows in which the capillary force is the dominant physical mechanism. The lack of convergence with spatial refinement, or convergence to a solution that is slightly different from the exact solution, has been documented in the literature. A well-known limiting case for this is the existence of spurious currents for the simulation of a spherical drop with zero initial velocity. These currents are present in all previous versions of VOF algorithms. In this paper, we develop an accurate representation of the body force due to surface tension, which effectively eliminates spurious currents. We call this algorithm PROST: proper representation of surface tension. There are several components to this procedure, including the new body force algorithm, improvements in the projection method for the Navier–Stokes solver, and a higher order interface advection scheme. The curvature to the interface is calculated from an optimal fit for a quadratic approximation to the interface over groups of cells.

An Efficient Algorithm for Solving the Inverse Problem of Locating the Interfaces Using the Frequency Sounding Data. Alexandre Timonov and Michael V. Klibanov. Department of Mathematics, University of North Carolina at Charlotte, Charlotte, North Carolina 28223.

0021-9991/02 $35.00

We consider the inverse coefficient problem of locating the interface positions arising in frequency sounding of layered media. Such a problem is of particular interest in the exploration of geophysics, underwater acoustics and electromagnetics, optical sensing, and so forth. We found that a simplified algorithm can be constructed to determine the approximate positions of interfaces. Unlike the conventional nonlinear least squares, this algorithm does not require the time-consuming constrained optimisation. Instead, the predictor–corrector method is applied to solve numerically the auxiliary Cauchy problem for a Riccati equation. The feasibility of this algorithm is demonstrated in computational experiments with a model problem of electromagnetic frequency sounding of layered media.

A Time-Domain Finite Element Method for Helmholtz Equations. Tri Van* and Aihua Wood.† *Mission Research Corporation, 3975 Research Boulevard, Dayton, Ohio 45430; and †Air Force Institute of Technology, 2950 P Street, AFIT/ENC, WPAFB, Ohio 45433.

A time-domain finite element method is developed to approximate the electromagnetic fields scattered by a bounded, inhomogeneous two-dimensional cavity embedded in the infinite ground plane. The time-dependent scattering problem is first discretized in time by Newmark's time-stepping scheme. A nonlocal boundary condition on the cavity aperture is constructed to reduce the computational domain to the cavity itself. The variational problems using finite element methods are shown to have unique solutions. Numerical experiments for both TE and TM polarizations demonstrate the accuracy and stability of the method.