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Abstracts of Papers to Appear

A STABLE AND CONSERVATIVE INTERFACE TREATMENT OF ARBITRARY SPATIAL ACCURACY. Mark H. Carpenter,* Jan Nordström,† and David Gottlieb.‡ **Aerodynamic and Acoustic Methods Branch, NASA Langley Research Center, Hampton, Virginia 23681-2199; †Computational Aerodynamics Department, FFA, Aeronautical Research Institute of Sweden, Bromma, Sweden; ‡Division of Applied Mathematics, Brown University, Providence, Rhode Island 02912.* E-mail: m.h.carpenter@larc.nasa.gov, nmj@ffa.se, dig@cfm.brown.edu.

Stable and accurate interface conditions based on the SAT penalty method are derived for the linear advection-diffusion equation. The conditions are functionally independent of the spatial order of accuracy and rely only on the form of the discrete operator. We focus on high-order finite-difference operators that satisfy the summation-by-parts (SBP) property. We prove that stability is a natural consequence of the SBP operators used in conjunction with the new, penalty-type, boundary conditions. In addition, we show that the interface treatments are conservative. The issue of the order of accuracy of the interface boundary conditions is clarified. New finite-difference operators of spatial accuracy up to sixth order are constructed, which satisfy the SBP property. These finite-difference operators are shown to admit design accuracy (pth-order global accuracy) when $(p-1)$th-order stencil closures are used near the boundaries, if the physical boundary conditions and interface conditions are implemented to at least pth-order accuracy. Stability and accuracy are demonstrated on the nonlinear Burgers' equation for a 12-subdomain problem with randomly distributed interfaces.

A NUMERICAL METHOD FOR SOLVING INCOMPRESSIBLE FLOW PROBLEMS WITH A SURFACE OF DISCONTINUITY. B. T. Helenbrook,* L. Martinelli,† and C. K. Law.‡ *Department of Mechanical and Aerospace Engineering, Princeton University, Princeton, New Jersey 08544.* E-mail: *helenbrk@spark.princeton.edu, †gigi@phantom2.princeton.edu, ‡cklaw@princeton.edu.

A numerical method for solving problems in which a moving surface of discontinuity separates regions of incompressible flow is presented. The method developed in the paper is notable in that it does not introduce any artificial smoothing of the change in fluid properties across the surface of discontinuity. This results in an increase in accuracy relative to methods which introduce smoothing effects. The method was also shown to be fairly versatile; problems describing a free surface, an immiscible fluid interface, and a premixed flame discontinuity were solved. There is a limitation, however, in that the method appears to be most suitable for application to inviscid problems. The reason for this limitation and possible approaches toward resolving it are discussed.

DIFFERENCE SCHEMES FOR SOLVING THE GENERALIZED NONLINEAR SCHRÖDINGER EQUATION. Qianshun Chang,* Erhui Jia,* and W. Sun.† **Institute of Applied Mathematics, Chinese Academy of Sciences, Beijing 100080, People's Republic of China; †Department of Mathematics, City University of Hong Kong, Kowloon, Hong Kong.*

This paper studies finite difference schemes for solving the generalized nonlinear Schrödinger (GNLS) equation $iu_t - u_x x + q(|u|^2)u = f(x,t)u$. A new linearlized Crank–Nicolson-type scheme is presented by applying an extrapolation technique to the real coefficient of the nonlinear term in the GNLS equation. Several schemes, including Crank–Nicolson-type schemes, Hopscotch-type schemes, split step Fourier scheme, and pseudospectral scheme, are adopted for solving three model problems of GNLS equation which arise from many physical problems, with $q(s) = s^2$, $q(s) = \ln(1+s)$, and $q(s) = -4s/(1+s)$, respectively. The numerical results demonstrate that the linearized Crank–Nicolson scheme is efficient and robust.

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RELAXATION SCHEME FOR A LATTICE–BOLTZMANN TYPE DISCRETE VELOCITY MODEL AND NUMERICAL NAVIER–STOKES LIMIT. Axel Klar. *Fachbereich Mathematik, University of Kaiserslautern, 67663 Kaiserslautern, Germany.* E-mail: klar@mathematik.uni-kl.de.

A discrete velocity model based on a Lattice–Boltzmann approximation is considered in the low Mach number limit. A numerical scheme for this model working uniformly in the incompressible Navier–Stokes limit is constructed. The scheme is induced by the asymptotic analysis of the Navier–Stokes limit and works uniformly for all ranges of mean free paths. In the limit the scheme reduces to an explicit finite difference scheme for the incompressible Navier–Stokes equation, the Chorin projection method with MAC grid. Numerical results are presented and the uniform convergence of the scheme is established numerically.

CONSERVATIVE REMAPPING AND REGION OVERLAYS BY INTERSECTING ARBITRARY POLYHEDRA. Jeffrey Grandy. *Lawrence Livermore National Laboratory, Livermore, California 94551.* E-mail: grandy@llnl.gov.

An efficient algorithm for first-order grid intersections, by computing geometrically the intersection volume between donor and target zones, is developed for polyhedral meshes. We examine two applications of grid intersections. One application is first-order remapping, in which zone and node-centered fields defined on a given mesh are transferred to a different mesh. The second application is region overlays, in which a region with homogeneous material properties is approximated by a grid of polyhedra and mapped onto an arbitrary hexahedral mesh, creating mixed zones on the boundary of the region. We demonstrate the use of this grid intersection algorithm within the framework of hydrodynamics simulations, and using a domain decomposed mesh we study the feasibility of a parallel implementation.