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Abstracts of Papers to Appear

A Numerical Method for the Accurate Solution of the Fokker–Planck–Landau Equation in the Nonhomogeneous Case. Francis Filbet* and Lorenzo Pareschi.† *IECN-INRIA project Numath—Université de Nancy I, BP 239, 54506 Vandœuvre-lès-Nancy cedex, France; and †Department of Mathematics, University of Ferrara, Via Machiavelli 35, I-44100, Ferrara, Italy and Department of Mathematics, University of Wisconsin—Madison, Van Vleck Hall, 480 Lincoln Drive, Madison Wisconsin 53706.

A new approach for the accurate numerical solution of the Fokker–Planck–Landau (FPL) equation in the nonhomogeneous case is presented. The method couples, through a time-splitting algorithm, a finite-volume scheme for the transport with a fast spectral solver for the efficient solution of the collision operator recently introduced. The scheme allows the use of different grids in the velocity space for the transport and the collision phases. The use of a suitable explicit Runge–Kutta solver for the time integration of the collision phase permits avoid once of excessive small time steps induced by the stiffness of the diffusive collision operator. Numerical results for both space homogeneous and space nonhomogeneous situations show the efficiency and the accuracy of the present method.

Optimization of the Crystal Surface Temperature Distribution in the Single-Crystal Growth Process by the Czochralski Method. Ja Hoon Jeong and In Seok Kang. Department of Chemical Engineering and Division of Mechanical Engineering, Pohang University of Science and Technology, San 31, Hyoja Dong, Pohang, 790-784, South Korea.

The optimization of the crystal surface temperature distribution is performed for single-crystal growth in the Czochralski process. In the optimization problem, we seek an optimal solution in the sense that the index of crystalline defects is minimized while the single-crystal growth rate is maximized. In the objective function, the von Mises stress is considered a driving force that induces crystalline defects. In order to solve the optimization problem with the equality constraints given by the governing partial differential equations, the variational method is used. Based on the calculus of variations and the method of Lagrange multiplier, the Euler–Lagrange equations are derived in the form of coupled partial differential equations. They are solved by using the finite-difference method and the iterative numerical scheme proposed in this work. In order to handle inequality constraints, the penalty function method is applied. The optimal distributions of the crystal surface temperature obtained in this work may provide an insight into the optimal design of thermal surroundings, such as thermal shield configurations and heater/cooler positions.

Analysis of a Fractional-Step Method on Overset Grids. Tristan M. Burton and John K. Eaton. Mechanical Engineering Department, Stanford University, Stanford, California 94305-3030.

A fractional-step method for solving the incompressible Navier–Stokes equations on overset grids is derived as a matrix factorization of the spatially and temporally discretized system of equations. The algorithm is applied to several test problems using second-order-accurate finite-volume flux differencing on staggered grid systems and a hybrid implicit/explicit time advancement scheme. Spatial order of accuracy is shown to depend on the behavior of the overset grid overlap during grid refinement. The temporal order of accuracy of the time advancement algorithm on a single grid is maintained on the overset grid.

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The Time-Line Interpolation Method for Large-Time-Step Godunov-Type Schemes. Vincent Guinot. International Institute for Infrastructural, Hydraulics, and Environmental Engineering—IHE, Westvest 7, P.O. Box 3015, 2601 DA Delft, The Netherlands.

This paper describes the use of the time-line interpolation procedure for the design of large-time-step, Godunov-type schemes for systems of hyperbolic conservation laws in one dimension. These schemes are based on a specific procedure to characterize the left and right states of the Riemann problems at the cell interfaces when the Courant number associated with the waves exceeds unity. To do so, the time-line interpolation technique is used. Constant and linear reconstruction techniques are presented. Sonic or critical points are seen to be a source of difficulty in the algorithm and an appropriate treatment is proposed. The algorithms are applied to the linear advection equation, to the inviscid Burgers equation, and to the set of hyperbolic conservation laws that describe shallow water flow in one dimension. These simulations show the superiority of the linear time reconstruction over the use of a constant time reconstruction. When the linear reconstruction technique is used, the modulus of the amplification factor of the scheme is equal to unity for all wave numbers, inducing oscillations in the computed profile owing to the phase error. The introduction of a slope limiter allows these oscillations to be eliminated, but yields numerical diffusion, thus restricting the range of applications of the scheme.

High-Order Time-Stable Numerical Boundary Scheme for the Temporally Dependent Maxwell Equations in Two Dimensions. J. F. Nystrom. MRC Institute, Moscow, Idaho 83844-1024.

High-order time-stable boundary operators for perfectly electrically conducting (PEC) surfaces are presented for a 3×3 hyperbolic system representing electromagnetic fields TE to z. First a set of operators satisfying the summation-by-parts property are presented for a 2×2 hyperbolic system representing one-dimensional electromagnetic propagation in a PEC cavity. Boundary operators are then developed for two-dimensional electromagnetic propagation in the xy-plane. This procedure leads to a time-stable scheme for a 3×3 hyperbolic system and concurrently shows how to eliminate the ambiguity associated with tangential and normal electromagnetic field components at corners and edges of PEC scatterers when using colocated computational electromagnetic schemes. A numerical comparison to the popular Yee scheme is included, and this comparison suggests that the fourth-order (in space and time) scheme derived herein does effectively compute the Maxwell equations in two dimensions.