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Abstracts of Papers to Appear

Using an ODE Solver for a Class of Integro-Differential Systems. Alan C. Hindmarsh and Mark D. Rotter. Lawrence Livermore National Laboratory.

By a simple extension of the Method of Lines, the ordinary differential equation (ODE) solver VODPK may be used to solve a certain class of integro-differential equation systems (IDE systems). The problems are characterized by a pair of advected frequency-dependent quantities, coupled to a population variable whose rate includes a spectral integral, in one space dimension. We have found that with an appropriate choice of preconditioner to aid in the convergence of the linear iterations, an extremely efficient method is obtained for the solution of these types of IDE system problems. We discuss the semi-discretization process and the formation of the preconditioner in some detail. Finally, we present an application of the technique.

A High-Resolution Pressure-Based Algorithm for Fluid Flow at All Speeds. F. Moukalled and M. Darwish. American University of Beirut, Faculty of Engineering & Architecture, Mechanical Engineering Department, P.O. Box 11-0236, Beirut, Lebanon.

A new collocated finite volume-based solution procedure for predicting viscous compressible and incompressible flows is presented. The technique is equally applicable in the subsonic, transonic, and supersonic regimes. Pressure is selected as a dependent variable in preference to density because changes in pressure are significant at all speeds as opposed to variations in density which become very small at low Mach numbers. The newly developed algorithm has two new features: (i) the use of the normalized variable and space formulation methodology to bound the convective fluxes: and (ii) the use of a high-resolution scheme in calculating interface density values to enhance the shock capturing property of the algorithm. The virtues of the newly developed method are demonstrated by solving a wide range of flows spanning the subsonic, transonic, and supersonic spectrum. Results obtained indicate higher accuracy when calculating interface density values using a high-resolution scheme.

Self-Consistent Description of the Radial Space-Charge Confinement in dc Column Plasmas. M. Schmidt, D. Uhrlandt, and R. Winkler. Institut für Niedertemperatur-Plasmaphysik, 17489 Greifswald, Germany.

A new method for the self-consistent description of the radial space-charge confinement and the corresponding non-local kinetics of the plasma components in the cylindrical dc column plasma is presented. The method comprises the solution of the space-dependent kinetic equation of the electron component, the fluid equations of ions and excited neutral particles and Poisson's equation. The non-linearly coupled equations are solved self-consistently applying a nonlinear optimization technique which is used to optimize a polynomial representation of the radial space-charge potential. The applicability of several optimization methods and their suitability concerning the convergence and accuracy are discussed. A few examples of the self-consistent description are presented.

On the Numerical Solution of One-Dimensional PDEs Using Adaptive Methods Based on Equidistribution. G. Beckett, J. A. Mackenzie, A. Ramage, and D. M. Sloan. Department of Mathematics, University of Strathclyde, Livingstone Tower, 26 Richmond Street, Glasgow G1 1XH, Scotland.

Numerical experiments are described that illustrate some important features concerning the performance of moving mesh methods for solving one-dimensional partial differential equations (PDEs). The particular method

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considered here is an adaptive finite difference method based on the equidistribution of a monitor function, and it is one of the moving mesh methods proposed by Huang, Ren, and Russell [SIAM J. Numer. Anal. **31** (1994) 709–730]. We show how the accuracy of the computations is strongly dependent on the choice of monitor function, and we present a monitor function that yields an optimal rate of convergence. Motivated by efficiency considerations for problems in two or more space dimensions, we demonstrate a robust and efficient algorithm in which the mesh equations are uncoupled from the physical PDE. The accuracy and efficiency of the various formulations of the algorithm are considered and a novel automatic time-step control mechanism is integrated into the scheme.

A Multilevel Algorithm for Large Eddy Simulation of Turbulent Compressible Flows. Marc Terracol,* Pierre Sagaut,* and Claude Basdevant.† *ONERA, 29 av. de la Division Leclerc, 92322 Châtillon cedex, France; and †Université Paris-Nord, LAGA UMR 7539, 99 Avenue J.B. Clément, 93430 Villetaneuse, France.

A multilevel method for large-eddy simulation of turbulent compressible flows is proposed. The method relies on the splitting of the turbulent flowfield into several frequency bands in space and time, each band being associated with a specific computational grid in physical space. This allows us to take into account in a deterministic way the information contained on finer grids. A subgrid model adapted to such a decomposition—based on a generalization of Germano's identity to multilevel decomposition—is also introduced. The approach is validated by several multilevel simulations in a subsonic plane channel flow configuration for both a low and a high value of the Reynolds number, while reductions of the CPU times of up to 80% are obtained.