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Abstracts of Papers to Appear in Future Issues

A P-STABLE EIGHTH-ORDER METHOD FOR THE NUMERICAL INTEGRATION OF PERIODIC INITIAL-VALUE PROBLEMS. T. E. Simos* and Ch. Tsitouras.† **Laboratory of Applied Mathematics and Computers, Department of Sciences, Technical University of Crete, Kounoupidiana, GR-73100 Chania, Crete, Greece; and †Department of Mathematics, General Sciences Department, National Technical University of Athens, Zografou Campus, GR-15780, Athens, Greece.*

An eighth-order P-stable two-step method for the numerical integration of second-order periodic initial-value problems is developed in this paper. This method has seven stages per iteration and an interval of periodicity equal to $(0, \infty)$; i.e., it is P-stable. Numerical and theoretical results obtained for several well-known problems show the efficiency of the new method.

FINITE DIFFERENCE SCHEMES FOR THREE-DIMENSIONAL TIME-DEPENDENT CONVECTION-DIFFUSION EQUATION USING FULL GLOBAL DISCRETIZATION. H. Y. Xu, M. D. Matovic, and A. Pollard. *Centre for Advanced Gas Combustion Technology, Department of Mechanical Engineering, Queen's University of Kingston, Ontario, Canada K7L-3N6.*

The three-dimensional, time-dependent convection-diffusion equation (CDE) is considered. An exponential transformation is used to collectively transform the CDE. The idea of global discretization is used, where attention is paid to the whole transformed CDE, but not to the individual spatial and temporal derivatives in the equation. Four finite difference schemes for both CDE and transformed CDE are established. The modified partial differential equations of these schemes are obtained, which indicate that the truncation errors of the schemes can be of second and fourth order, depending on the prescription of the time step length. Some characteristic physical parameters, i.e., local Reynolds number, local Strouhal number, and viscous diffusive length, are introduced into the schemes and the viscous diffusive length is found to be a significant parameter in relating temporal discretisation with spatial discretisation. A series of benchmark analytical solutions of Navier–Stokes and Burgers equations, as well as the numerical solutions using the well-known discretisation schemes, are used to investigate the properties of the derived schemes. The high-order schemes achieves higher resolutions over the conventional schemes without decreasing much sparsity of the matrix structures. The grid refinement studies reveal that the inverse exponential transformation of the finite difference schemes tends to destroy some resolution of the schemes, especially for large local Reynolds number.

THE SPECTRAL ELEMENT METHOD FOR THE SHALLOW WATER EQUATIONS ON THE SPHERE. Mark Taylor,* Joseph Tribbia,* and Mohamed Iskandarani.† **National Center for Atmospheric Research, Boulder, Colorado 80303; and †Institute of Marine and Coastal Sciences, Rutgers University, P.O. Box 231, New Brunswick, New Jersey 08903-0231.*

The spectral element method is implemented for the shallow water equations in spherical geometry and its performance is compared with other models. This is the first step in evaluating the suitability of spectral elements of climate modeling. The potential advantages and disadvantages of spectral elements over more conventional models used for climate studies are discussed. The method requires that the sphere be tiled with rectangles, for which we make use of the gnomonic projection to map the sphere onto the cube. To measure the performance of the method relative to other models, results are presented from a standard suite of shallow water test cases for the sphere. These results confirm the spectral accuracy of the method.

A GMRES-BASED PLANE SMOOTHER IN MULTIGRID TO SOLVE 3D ANISOTROPIC FLUID FLOW PPROBLEMS. C. W. Oosterlee. *German National Research Center for Information Technology GMD Institute for Algorithms and Scientific Computing SCAI Schloss Birlinghoven, 53754 Sankt Augustin, Germany.*

For a discretization of the 3D steady incompressible Navier–Stokes equations a solution method is presented for solving flow problems on stretched grids. The discretization is a vertex-centered finite volume discretization with a flux splitting approach for the convective terms. Second-order accuracy is obtained with the well-known defect correction technique (B. Koren, *J. Comput. Phys.* **87,** 25, 1990). The solution method used is multigrid, for which a plane smoother is presented for obtaining good convergence in flow domains with severely stretched grids. A matrix is set up in a plane, which is solved iteratively with a preconditioned GMRES method. Here, a stop criterion for GMRES is tested, which reduces the number of inner iterations compared to an ''exact'' plane solver without affecting the multigrid convergence rates. The performance of the solution method is shown for a Poisson model problem and for 3D incompressible channel flow examples.

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