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# Abstracts of Papers to Appear

GRID OVERLAPPING FOR IMPLICIT PARALLEL COMPUTATION OF COMPRESSIBLE FLOWS. Zi-Niu Wu and Hui Zou. *National Laboratory for CFD/Institute of Fluid Dynamics, Beijing University of Aeronautics and Astronautics, Beijing, People's Republic of China.*

The suitability of applying the overlapping grid method to parallel computation of steady and unsteady compressible inviscid flows with three-point block-tridiagonal implicit schemes is addressed in this paper. An easily usable interface treatment is constructed and analyzed for both steady and unsteady problems. The performance of the method, such as convergence rate and time accuracy, can be controlled through the overlapping width. The method needs no iteration at each time step or modification of the Thomas algorithm for the solution of the implicit parts. In both steady and unsteady cases a very good absolute parallel efficiency is demonstrated for bidimensional subsonic and transonic flow computations.

WELL-POSED PERFECTLY MATCHED LAYERS FOR ADVECTIVE ACOUSTICS. S. Abarbanel,* D. Gottlieb,† and J. S. Hesthaven.† **Department of Applied Mathematics, Tel Aviv University, Tel Aviv, Israel; and* †*Division of Applied Mathematics, Brown University, Box F, Providence, Rhode Island 02912*. E-mail: saul@math.tau.ac.il, dig@cfm.brown.edu, and jansh@cfm.brown.edu.

Using a mathematical framework originally developed for the development of PML schemes in computational electromagnetics, we develop a set of strongly well-posed PML equations for the absorption of acoustic and vorticity waves in two-dimensional convective acoustics under the assumption of a spatially constant mean flow. A central piece in this development is the development of a variable transformation that conserves the dispersion relation of the physical space equations. The PML equations are given for layers being perpendicular to the direction of the mean flow as well as for layers being parallel to the mean flow. The efficacy of the PML scheme is illustrated by solving the equations of acoustics using a fourth-order scheme, confirming the accuracy as well as stability of the proposed schemes.

A CONSISTENT HYBRID FINITE-VOLUME/PARTICLE METHOD FOR THE PDF EQUATIONS OF TURBULENT REACTIVE FLOWS. Metin Muradoglu, Patrick Jenny, Stephen B. Pope, and David A. Caughey. *Sibley School of Mechanical and Aerospace Engineering, Cornell University, Ithaca, New York 14853.* E-mail: metinm@mae.cornell.edu, jenny@mae.cornell.edu, pope@mae.cornell.edu, and caughey@mae.cornell.edu.

The paper describes a new hybrid finite-volume (FV)/particle method developed for the solution of the PDF equations for statistically stationary turbulent reactive flows. In this approach, the conservation equations for mean mass, momentum, and energy conservation are solved by a FV method while a particle algorithm is employed to solve the fluctuating velocity–turbulence frequency-compositions joint PDF transport equation. The mean velocity and pressure are supplied to the particle code by the FV code which in turn obtains all the Reynolds stresses, the scalar fluxes, and the reaction terms needed in the FV code. An important feature of the method is the complete consistency between the set of equations solved by the FV and particle methods. The algorithmic and numerical issues arising in the development of the hybrid method are studied in the simple setting of the stochastic ideal flow equations. Numerical results are obtained for 1D reactive stochastic ideal flow to demonstrate numerical properties of the method. The total numerical error is identified as statistical error, bias, spatial truncation error, and temporal truncation error. In contrast to the self-contained particle method, the bias is found to be negligibly small. It is shown that all the numerical errors converge at the expected rates. Finally, the global convergence of the hybrid



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method is demonstrated, and the optimal strategy for time-averaging that gives the best global convergence rate is investigated.

COMPUTER-AIDED ANALYSIS OF VISCOUS FILM FLOW ALONG AN INCLINED WAVY WALL. N. A. Malamataris and V. Bontozoglou. *Department of Mechanical and Industrial Engineering, University of Thessaly, GR-38334 Volos, Greece.*

The steady, laminar flow of a Newtonian liquid along an inclined wavy wall is studied in a two-dimensional numerical experiment using the Galerkin finite element method. The dimensionless Navier–Stokes equations are solved in the whole range of the laminar flow regime. Numerical predictions are compared with available experimental data for very low Reynolds numbers. The emphasis in the discussion of results is given in the presentation of free surface profiles, streamlines, and velocity and pressure distributions along the free surface and the wall. The interaction of the dimensionless numbers of the flow is studied, criteria for flow reversal are established, and a resonance phenomenon at high Reynolds numbers is investigated.

SPECTRAL COLLOCATION TIME-DOMAIN MODELING OF DIFFRACTIVE OPTICAL ELEMENTS. J. S. Hesthaven,* P. G. Dinesen,† and J. P. Lynov.† **Division of Applied Mathematics, Brown University, Box F, Providence, Rhode Island 02912; and* †*Optics and Fluid Dynamics Department, Risø National Laboratory, P.O. Box 49, DK-4000 Roskilde, Denmark.* E-mail: jansh@cfm.brown.edu, palle.dinesen@risoe.dk, and jens-peter.lynov@risoe.dk.

A spectral collocation multidomain scheme is developed for the accurate and efficient time-domain solution of Maxwell's equations within multilayered diffractive optical elements. Special attention is being paid to the modeling of out-of-plane waveguide couplers. Emphasis is given to the proper construction of high-order schemes with the ability to handle very general problems of considerable geometric and material complexity. Central questions regarding efficient absorbing boundary conditions and time-stepping issues are also addressed. The efficacy of the overall scheme for the time-domain modeling of electrically large, and computationally challenging, problems is illustrated by solving a number of plane as well as nonplane waveguide problems.