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Abstracts of Papers to Appear in Future Issues

DEVELOPMENT OF AN IMPROVED GAS-KINETIC BGK SCHEME FOR INVISCID AND VISCOUS FLOWS. Dongsuk Chae, Chongam Kim, and Oh-Hyun Rho. *Department of Aerospace Engineering, Seoul National University, Seoul 151-742, Korea.*

This paper deals with the development of an improved gas-kinetic BGK scheme for inviscid and viscous flow fields. As the first step toward its efficient calculations, particle distribution functions in the general solution of the BGK model are simplified to the extent that the essential features of the standard gas-kinetic BGK scheme are not lost. Then, improved schemes are suggested, which overcome difficulties that may arise in the applications of BGK-type schemes to compressible viscous flow calculations. A Prandtl number correction method is also developed to allow the present schemes to work for arbitrary Pr number. For steady-state problems, convergence acceleration techniques suitable for the present schemes are developed in the framework of an implicit time integration. Various numerical experiments ranging from one-dimensional shock tubes to viscous turbulent flows are performed to demonstrate accuracy, robustness, and other essential features of the present method.

A REPRESENTATION OF BOUNDED VISCOUS FLOW BASED ON HODGE DECOMPOSITION OF WALL IMPULSE. D. M. Summers. *School of Mathematical and Physical Sciences, Napier University, 219 Colinton Road, Edinburgh EH14 1DJ, Scotland*. E-mail: davids@maths.napier.ac.uk.

A Lagrangian representation of bounded incompressible flow is introduced in which viscous boundary conditions are given kinematic expression by the generation of impulse at the wall. The relationship between such a process and the boundary conditions is deduced from two complementary Hodge decompositions. The orientation of the created impulse vector may be chosen to be parallel at the wall (this being equivalent to a thin vortex doublet sheet) or normal at the wall (this being a thin monopole vortex sheet). Although the representation is developed here for two dimensions, it can be generalized in a natural way to three dimensions. The case of tangentially oriented wall impulse is applied to flow over a semi-infinite plate; the case of normally oriented wall impulse is applied to flow past a circular cylinder.

A NOVEL LATTICE BGK APPROACH FOR LOW MACH NUMBER COMBINATION. Olga Filippova and Dieter Hänel. *Institute of Combustion and Gasdynamics, University of Duisburg, D-47048 Duisburg, Germany.* E-mail: haenel@vug.uni-duisburg.de.

An extended lattice Boltzmann (BGK) model is presented for the simulation of low Mach number flows with significant density changes. For applications to reactive flows this new model is coupled with a finite-difference scheme for solving the transport equations of energy and species. With a boundary fitting formulation and local grid refinement the scheme enables accurate and efficient computations of low Mach number reactive flows in complex geometry on the simplest Cartesian grids. Examples of reactive flows around porous burners are presented.

COMPACT IMPLICIT MACCORMACK-TYPE SCHEMES WITH HIGH ACCURACY. R. Hixon* and E. Turkel.*,† **Institute for Computational Mechanics in Propulsion (ICOMP) NASA Glenn Research Center, Cleveland, Ohio 44135; and †Tel Aviv University, Tel Aviv, Israel.*

In this work, the MacCormack methodology is extended to implicit compact differencing schemes. A prefactorization method which splits the implicit matrix into two independent upper and lower matrices which are easier

to invert is developed. Using this method, a new class of high-order accurate compact MacCormack-type schemes is derived. Two fourth-order schemes are described, and results are shown for three linear and nonlinear CAA Benchmark Problems.

FAST EVALUATION OF TWO-DIMENSIONAL TRANSIENT WAVE FIELDS. Mingyu Lu, Jianguo Wang, A. Arif Ergin, and Eric Michielssen. *Center for Computational Electromagnetics, Department of Electrical and Computer Engineering, University of Illinois at Urbana–Champaign, Urbana, Illinois 61801.* E-mail: mingyulu@students.uiuc.edu, jwang@extreme.ece.uiuc.edu, aergin@decwa.ece.uiuc.edu, michiels@decwa.ece.uiuc.edu.

This paper presents a novel scheme to efficiently evaluate transient linear wave fields that are generated by two-dimensional (2D) source configurations. The scheme, termed the plane wave time domain algorithm (PWTD), realizes a diagonal translation operator for 2D transient wave fields through their representation in terms of Hilbert transformed plane wave expansions. Numerical results are presented that validate the algorithm and demonstrate its convergence properties. The proposed PWTD algorithm can be coupled to classical 2D time domain integral equation solvers in a two-level and multilevel setting. It is shown that analysis of a 2D surface scattering phenomenon, in which sources are represented in terms of N_s spatial and N_t temporal samples, based on two-level and multilevel PWTD augmented integral equation solvers, requires $O(N_s^{1.5} N_t \log N_t)$ and $O(N_s N_t \log N_s \log N_t)$ computational resources, respectively (as opposed to $O(N_s^2 N_t^2)$ for a classical solver). Therefore, these PWTD schemes render feasible the rapid integral equation based analysis of 2D transient scattering phenomena involving large surfaces.