Journal of Computational Physics **149,** 423–424 (1999)
Article ID jcph.1999.6208, available online at http://www.idealibrary.com on IDEAL®

Abstracts of Papers to Appear

LOW SPEED FLOW SIMULATION BY THE GAS-KINETIC SCHEME. Mingde Su,* Kun Xu,† and M. S. Ghidaoui.‡ **Department of Engineering Mechanics, Tsinghua University, Beijing, 100084, People's Republic of China; and †Mathematics Department, and ‡Department of Civil Engineering, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong.*

This paper extends the gas-kinetic BGK-type scheme to low Mach number flows, the so-called incompressible limit. The influence of boundary conditions, internal molecular degrees of freedom K, and the flow Mach number M on the accuracy of the solutions of incompressible or nearly incompressible flow problems are quantitatively evaluated. The gas-kinetic scheme is tested carefully in two numerical examples, namely, the cavity flow problem and the flow passing a backward-facing step problem. For the cavity flow problem, the numerical results from the gas-kinetic scheme under different Reynolds numbers are compared with Ghia's data. For the backward step problem, the numerical results are compared with previously published experimental data. Both numerical examples confirm the accuracy and robustness of the gas-kinetic approach for low speed flow simulations.

A CONSERVATIVE FINITE-VOLUME SECOND-ORDER ACCURATE PROJECTION METHOD ON HYBRID UNSTRUCTURED GRIDS. Marcelo H. Kobayashi, José M. C. Pereira, and José C. F. Pereira. *Instituto Superior Técnico/Technical University of Lisbon, Department of Mechanical Engineering/SMA, Av. Rovisco Pais, 1049-001 Lisbon, Portugal.* E-mail: marcelo@navier.ist.utl.pt.

This paper describes a finite volume discretization method to compute steady, two-dimensional incompressible viscous recirculating flows using hybrid unstructured meshes, composed of triangles and quadrilaterals. However, the proposed formulation is not restricted to these topologies. The new method includes a second-order least-squares scheme for convection discretization, and a fractional step projection method based on a staggered grid arrangement for pressure velocity coupling. Numerical results are reported to demonstrate the robustness, second-order accuracy and flexibility of the proposed method. To the authors' knowledge, this manuscript represents the first general unstructured grid finite volume method to achieve full second-order accuracy for the steady incompressible 2D version of Navier–Stokes equations.

AN UNCONDITIONALLY STABLE METHOD FOR THE EULER EQUATIONS. Helge Holden, Knut-Andreas Lie, and Nils Henrik Risebro. *Department of Mathematical Sciences, Norwegian University of Science and Technology, Alfred Getz vei 1, Trondheim N-7034, Norway.*

We discuss how to combine a front tracking method with dimensional splitting to solve systems of conservation laws numerically in two space dimensions. In addition we present an adaptive grid refinement strategy. The method is unconditionally stable and allows for moderately high CFL numbers (typically 1–4), and thus it is highly efficient. The method is applied to the Euler equations of gas dynamics. In particular, it is tested on an expanding circular gas front, a wind tunnel with a step, a double Mach reflection and a shock-bubble interaction. The method shows very sharp resolution of shocks.

0021-9991/99 $30.00

WEIGHTED ESSENTIALLY NONOSCILLATORY SCHEMES ON TRIANGULAR MESHES. Changqing Hu and Chi-Wang Shu. *Division of Applied Mathematics, Brown University, Providence, Rhode Island 02912*. E-mail: hu@cfm.brown.edu, shu@cfm.brown.edu.

In this paper we construct high-order weighted essentially nonoscillatory (WENO) schemes on two dimensional unstructured meshes (triangles) in the finite volume formulation. We present third-order schemes using a combination of linear polynomials, and fourth-order schemes using a combination of quadratic polynomials. Numerical examples are shown to demonstrate the accuracies and robustness of the methods for shock calculations.

ON SIMULATION OF TURBULENT NONLINEAR FREE-SURFACE FLOWS. Ben R. Hodges and Robert L. Street. *Environmental Fluid Mechanics Laboratory, Stanford University, Stanford, California*. E-mail: hodges@cwr.uwa.edu.au, street@cive.stanford.edu.

A method for numerical simulation of the unsteady, three-dimensional, viscous Navier–Stokes equations for turbulent nonlinear free-surface flows is presented and applied to simulations of a laminar standing wave and turbulent open-channel flow with a finite-amplitude surface wave. The solution domain is discretized with a boundary-orthogonal curvilinear grid that moves with the free surface, allowing surface deformations to be smoothly resolved down to the numerical grid scale. The nonlinear kinematic and dynamic boundary conditions for boundary-orthogonal curvilinear coordinates are developed and discussed with a novel approach for advancing the free surface in curvilinear space. Dynamic large-eddy-simulation (LES) techniques are used to model subgrid scale turbulence effects. The method is shown to correctly produce the shape of a nonlinear free-surface wave and its decay due to viscosity. Application to finite-amplitude waves moving over a turbulent channel flow allows demonstration of the clear differences between a channel flow with and without waves, particularly the instantaneous turbulence structure. An interesting sidelight is the appearance of short-crested cross-channel surface waves caused by natural resonance.