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Abstracts of Papers to Appear in Future Issues

DISCRETIZATION ON NON-ORTHOGONAL, QUADRILATERAL GRIDS FOR INHOMOGENEOUS, ANISOTROPIC MEDIA. I. Aavatsmark, T. Barkve, Ø. Bøe, and T. Mannseth. *Norsk Hydro A/S, Forskningssenteret, N-5020 Bergen, Norway*.

Two classes of discretization methods are proposed for control-volume formulations on quadrilateral grids in two space dimensions. Curvilinear grids are considered as a special case. The methods are applicable for any system of conservation laws where the flux is defined by a gradient law, like Darcy's law for porous-media flow. A strong feature of the methods is the ability to handle media inhomogeneities in combination with full-tensor anisotropy and/or non-orthogonality of the grid. Further properties of the methods will be discussed and examples of their use will be presented.

AN EULERIAN APPROACH FOR VORTEX MOTION USING A LEVEL SET REGULARIZATION PROCEDURE. Eduard Harabetian,* Stanley Osher,† and Chi-Wang Shu.‡ **Department of Mathematics, University of Michigan, Ann Arbor, Michigan 48109, U.S.A.; †Department of Mathematics, University of California, Los Angeles, California, 90024, U.S.A.; and ‡Division of Applied Mathematics, Brown University, Providence, Rhode Island 02912, U.S.A.*

We present an Eulerian, fixed grid, approach to solve the motion of an incompressible fluid, in two and three dimensions, in which the vorticity is concentrated on a lower dimensional set. Our approach uses a decomposition of the vorticity of the form $\xi = P(\varphi)\eta$, in which both φ (the level set function) and η (the vorticity strength vector) are smooth. We derive coupled equations for φ and η which give a regularization of the problem. The regularization is topological and is automatically accomplished through the use of numerical schemes whose viscosity shrinks to zero with grid size. There is no need for explicit filtering, even when singularities appear in the front. The method also has the advantage of automatically allowing topological changes such as merging of sufaces. Numerical examples, including two- and three-dimensional vortex sheets, two-dimensional vortex dipole sheets, and point vortices, are given. To our knowledge, this is the first three-dimensional vortex sheet calculation in which the sheet evolution feeds back to the calculation of the fluid velocity. Vortex in cell calculations for three-dimensional vortex sheets were done earlier by Trygvasson *et al.*

THREE-DIMENSIONAL PLASMA PARTICLE-IN-CELL CALCULATIONS OF ION THRUSTER BACKFLOW CONTAMINATION. Robie I. Samanta Roy,* Daniel E. Hastings,* and Steven Taylor.† **Space Power and Propulsion Laboratory, Department of Aeronautics and Astronautics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, U.S.A.; and †Scalable Concurrent Programming Laboratory, Department of Computer Science, California Institute of Technology, Pasadena, California 91125, U.S.A.*

A fully three-dimensional hybrid plasma particle-in-cell model for multi-computer environments was developed to assess the spacecraft backflow contamination of an ion thruster. Results of plume backflow are presented for a 13-cm xenon ion thruster operating with a current level of 0.4 A on a model spacecraft similar to the U.S. Air Force Advanced Research and Global Observation Satellite. The computational domain was over 40 m^3 in volume and used over 35 million particles representing charge-exchange (CEX) xenon ions produced in the plume. Results obtained on a massively parallel 256-node Cray T3D clearly show the plasma density enhancement around the spacecraft due to the CEX ions. Three-dimensional results are compared with the results of a two-dimensional axisymmetric model to explore the three-dimensionality of the backstreaming flow field.

COUPLING BOLTZMAN AND NAVIER–STOKES EQUATIONS BY FRICTION. Jean-François Bourgat,* Patrick Le Tallec,† and Moulay D. Tidriri.‡ *INRIA, Domaine de Voluceau- Rocquencourt- B.P. 105- Le Chesnay Cedex, France; †Université Paris-Dauphine and INRIA, Domaine de Voluceau- Rocquencourt- B.P. 105- Le Chesnay Cedex, France; and ‡ICASE, Mail Stop 132C, Hampton, Virginia 23681-0001, U.S.A.*

The aim of this paper is to introduce and validate a coupled Navier–Stokes Boltzman approach for the calculation of hypersonic rarefied flows around manoeuvering vehicles. The proposed strategy uses locally a kinetic model in the boundary layer coupled through wall friction forces to a global Navier–Stokes solver. Different numerical experiments illustrate the potentialities of the method.

ON THE CONSTRUCTION AND USE OF REDUCED CHEMICAL KINETIC MECHANISMS PRODUCED ON THE BASIS OF GIVEN ALGEBRAIC RELATIONS. D. A. Goussis. *Department of Mechanical Engineering, University of Patras, 26110 Rio-Patras, Greece.*

An algorithm proposed by Chen (*Combust. Sci. Technol.* **57,** 89 (1988)) for the construction of reduced chemical kinetic mechanisms is reviewed. It is shown that the algorithm can be formally used only with the steady state approximation. A new algorithm is presented which can accept more general assumptions. However, for the new algorithm to be successful these assumptions must meet a certain condition which is presented. The reduced mechanisms generated by both algorithms do not provide optimum accuracy and stability in numerical simulations. This can be achieved by a specific refinement of these reduced mechanisms according to the CSP method.

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