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Abstracts of Papers to Appear

Numerical Investigation on the Stability of Singular Driven Cavity Flow. F. Auteri, N. Parolini, and L. Quartapelle. Dipartimento di Ingegneria Aerospaziale, Politecnico di Milano, Via La Masa 34, 20158 Milano, Italy.

By applying the singularity subtraction technique to the unsteady driven cavity problem, the stability of the impulsively started flow is investigated, without smoothing the corner singularity. A second-order spectral projection method allows localization of the critical Reynolds number for the first Hopf bifurcation in the interval [8017.6, 8018.8).

Computational Aspects of the Ultra-Weak Variational Formulation. Tomi Huttunen,* Peter Monk,† and Jari P. Kaipio.* *Department of Applied Physics, University of Kuopio, P.O. Box 1627, 70211 Kuopio, Finland; and †Department of Mathematical Sciences, University of Delaware, Newark, Delaware 19711.

The ultra-weak variational formulation (UWVF) approach has been proposed as an effective method for solving Helmholtz problems with high wave numbers. However, for coarse meshes the method can suffer from instability. In this paper we consider computational aspects of the ultra-weak variational formulation for the inhomogeneous Helmholtz problem. We introduce a method to improve the UWVF scheme and we compare iterative solvers for the resulting linear system. Computations for the acoustic transmission problem in 2D show that the new approach enables Helmholtz problems to be solved on a relatively coarse mesh for a wide range of wave numbers.

Algorithm Refinement for Stochastic Partial Differential Equations: I. Linear Diffusion. Francis J. Alexander,* Alejandro L. Garcia,† and Daniel M. Tartakovsky.‡ *CCS-3, Los Alamos National Laboratory, Los Alamos, New Mexico 87545; †Center for Applied Scientific Computing, Lawrence Livermore National Laboratory, Livermore, California 94551; and ‡T-7, Los Alamos National Laboratory, Los Alamos, New Mexico 87545.

A hybrid particle/continuum algorithm is formulated for Fickian diffusion in the fluctuating hydrodynamic limit. The particles are taken as independent random walkers; the fluctuating diffusion equation is solved by finite differences with deterministic and white-noise fluxes. At the interface between the particle and continuum computations the coupling is by flux matching, giving exact mass conservation. This methodology is an extension of Adaptive Mesh and Algorithm Refinement to stochastic partial differential equations. Results from a variety of numerical experiments are presented for both steady and time-dependent scenarios. In all cases the mean and variance of density are captured correctly by the stochastic hybrid algorithm. For a nonstochastic version (i.e., using only deterministic continuum fluxes) the mean density is correct, but the variance is reduced except in particle regions away from the interface. Extensions of the methodology to fluid mechanics applications are discussed.

Remeshed Smoothed Particle Hydrodynamics for the Simulation of Viscous and Heat Conducting Flows. A. K. Chaniotis,* D. Poulikakos,* and P. Koumoutsakos.† *Institute of Energy Technology, Laboratory of Thermodynamics in Emerging Technologies, †Institute of Computational Sciences, ETH, Zürich, Switzerland; and Center for Turbulence Research, NASA Ames, Moffett Field, California 94035.

We present an extension of the classical scheme of smoothed particle hydrodynamics (SPH) for the accurate handling of diffusion terms in the momentum and energy equation of viscous and heat conducting flows. A key aspect of the present SPH approach is the periodic reinitialization (remeshing) of the particle locations, which are

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being distorted by the flow map. High-order moment conserving kernels are being implemented for this remeshing procedure leading to accurate simulations. The accuracy of the proposed SPH methodology is tested for a number of benchmark problems involving flow and energy transport. The results demonstrate that the proposed SPH methodology is capable of DNS quality simulations while maintaining its robustness and adaptivity.

FINESSE: Axisymmetric MHD Equilibria with Flow. A. J. C. Beliën,* M. A. Botchev,* J. P. Goedbloed,* B. van der Holst,† and R. Keppens.* *FOM-Institute for Plasma Physics, Association Euratom-FOM, P.O. Box 1207, 3430 BE Nieuwegein, The Netherlands; and †Centre for Plasma Astrophysics, K.U. Leuven, Celestijnenlaan 200B, B-3001 Heverlee, Belgium.

The FINESSE code (finite element solver for stationary equilibria) computes axisymmetric magnetohydrodynamic equilibria in poloidal elliptic flow regimes for a variety of astrophysical and laboratory plasma configurations. The obtained equilibria are accurate and are used to study the spectral characteristics of such flowing equilibria. The nonlinear partial differential equation for the poloidal magnetic flux is solved in a weak form via Picard iteration, resulting in a large-scale linear problem. The algebraic Bernoulli equation for the poloidal Alfvén Mach number is solved with a nonlinear root finder. Converged solutions are obtained by iterating on these two equations.