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Abstracts of Papers to Appear

A Wave Automaton for Wave Propagation in Inhomogeneous Anisotropic Media. Olivier Legrand, Fabrice Mortessagne, Patrick Sebbah, and Christian Vanneste. *Laboratoire de Physique de la Matière Condensée, Université de Nice–Sophia Antipolis, Parc Valrose, B.P. 71, 06108 Nice Cedex 2, France.*

This paper presents an extension built on a hexagonal grid of the wave automaton, which was introduced in the past few years to describe wave propagation in inhomogeneous media. This new method is capable of computing wave propagation in 2D anisotropic media without the need of introducing interpolating schemes. After a comparison of isotropic single scattering with analytical results using Mie theory, the method is used to compute the field scattered by one anisotropic particle for various orientations of its principal axes. Scattering by a collection of anisotropic particles is also presented.

A High-Order Discontinuous Galerkin Method for 2D Incompressible Flows. Jian-Guo Liu* and Chi-Wong Shu.† **Institute for Physical Science and Technology and Department of Mathematics, University of Maryland, College Park, Maryland 20742; †Division of Applied Mathematics, Brown University, Providence, Rhode Island 02912.*

In this paper we introduce a high order discontinuous Galerkin method for two-dimensional incompressible flow in the vorticity stream-function formulation. The momentum equation is treated explicitly, utilizing the efficiency of the discontinuous Galerkin method. The stream-function is obtained by a standard Poisson solver using continuous finite elements. There is a natural matching between these two finite element spaces, since the normal component of the velocity field is *continuous* across element boundaries. This allows a correct upwinding gluing in the discontinuous Galerkin framework, while still maintaining total energy conservation with no numerical dissipation and total enstrophy stability. The method is efficient for inviscid or high Reynolds number flows. Optimal error estimates are proven and verified by numerical experiments.

A Weak Form of the Conjugate Gradient FFT Method for Two-Dimensional Elastodynamics. George Pelekanos,* Ralph E. Kleinman,† and Peter M. van de Berg.‡ **Department of Mathematics and Statistics, Southern Illinois University, Edwardsville, Illinois 62026; †Department of Mathematical Sciences, University of Delaware, Newark, Delaware 19716; and ‡Laboratory of Electromagnetic Research, Faculty of Electrical Engineering, Delft University of Technology, Delft, The Netherlands.*

The problem of two-dimensional scattering of elastic waves by an elastic inclusion can be formulated in terms of a domain integral equation, in which the grad–div operator acts on a vector potential. The vector potential is the spatial convolution of a Green's function with the product of the density and the displacement over the domain of interest. A weak form of the integral equation of the unknown displacement is obtained by testing it with rooftop functions. This method shows excellent numerical performance.

A Fixed Grid Method for Capturing the Motion of Self-Intersecting Wavefronts and Related PDEs. Steven J. Ruuth,* Barry Merriman,† and Stanley Osher.† **Simon Fraser University, Department of Mathematics and Statistics, 8888 University Dr., Burnaby, British Columbia, Canada V5A 1S6; †University of California, Department of Mathematics, 405 Hilgard Avenue, Los Angeles, California 90095-1555.*

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Moving surfaces self-intersect arise naturally in the geometric optics model of wavefront motion. Standard ray tracing techniques can be used to compute these motions, but they lose resolution as rays diverge. In this paper we develop numerical methods that maintain uniform spatial resolution of the front at all times. Our approach is a fixed grid, wavefront capturing formulation based on the dynamic surface Extension method of Steinhoff and Fan. The new methods can treat arbitrarily complicated self-intersecting fronts, as well as refraction, reflection, and focusing. We also develop methods for curvature dependent front motions and the motion of filaments. We validate our methods with numerical experiments.

NEW HIGH-RESOLUTION SEMI-DISCRETE CENTRAL SCHEMES FOR HAMILTON–JACOBI EQUATIONS. Alexander Kurganov* and Eitan Tadmor.† *_Department of Mathematics, University of Michigan, Ann Arbor, Michigan 48109;_ †_Department of Mathematics, University of California at Los Angeles, Los Angeles, California 90095._

We introduce a new high-resolution central scheme for multidimensional Hamilton–Jacobi equations. The scheme retains the simplicity of the nonoscillatory central schemes developed by Lin and Tadmor, yet it enjoys a smaller amount of numerical viscosity, independent of $1/\Delta t$. By letting $\Delta t \downarrow 0$ we obtain a new second-order central scheme in the particularly simple semi-discrete form, along the lines of the new semi-discrete central schemes recently introduced by the authors in the context of hyperbolic conservation laws. Fully discrete versions are obtained with appropriate Runge–Kutta solvers. The smaller amount of dissipation allows efficient integration of convection–diffusion equations, where the accumulated error is independent of a small time step dictated by the CFL limitation. The scheme is nonoscillatory thanks to the use of nonlinear limiters. Here we advocate the use of such limiters on *second discrete derivatives,* which is shown to yield an improved high resolution when compared to the usual limitation of first derivatives. Numerical experiments demonstrate the remarkable resolution obtained by the proposed new central scheme.