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Abstracts of Papers to Appear

A NEW PARALLEL SOLVER FOR THE NONPERIODIC INCOMPRESSIBLE NAVIER–STOKES EQUATIONS WITH A FOURIER METHOD: APPLICATION TO FRONTAL POLYMERIZATION. M. Garbey and D. Tromeur-Dervout. *Center for the Development of Parallel Scientific Computing CDCSP, University Lyon 1, Bât 101, 43 bd du 11 Novembre 1918, 69622 Villeurbanne, Lyon 69622, France.* E-mail: mgarbey@cdcsp.univ-lyon1.fr and dtromeur@cdcsp.lyon1.fr.

We present a specific use of domain decomposition and decomposition in function space combined with asymptotic analytical qualitative results to obtain, on parallel computers, efficient and accurate solvers [3] for rapidly varying quasi-planar unsteady combustion fronts in liquids. In particular, we give a *new parallel direct solver* of the unsteady incompressible Navier–Stokes equations in the stream function formulation. This solver is based on an embedding technique that allows us to generalize our previous results from the case with periodic boundary conditions to the *nonperiodic* case with wall boundary conditions in a direction perpendicular to front propagation. The solution is decomposed into a particular solution, suitable for a Fourier method, and the general homogeneous solution, calculated from an analytic solution with high precision, to satisfy the boundary conditions. The algorithm is implemented for parallel computers and results in a very effective code. Results on the effect of the convection onto the front propagation are provided.

REDUCTION OF THE NUMBER OF PARTICLES IN THE STOCHASTIC WEIGHTED PARTICLE METHOD FOR THE BOLTZMANN EQUATION. Sergej Rjasanow,* Thomas Schreiber,† and Wolfgang Wagner‡. **University of Saarland, Department of Mathematics, Postfach 15 11 50, D-66041 Saarbrücken, Germany; †University of Kaiserslautern, Department of Informatics, D-67653 Kaiserslautern, Germany; and ‡Weierstrass Institute for Applied Analysis and Stochastics, Mohrenstrasse 39, D-10117 Berlin, Germany.* E-mail: rjasanow@num.uni-sb.de, tschreib@informatik.uni-kl.de, and wagner@wias-berlin.de.

Different ideas for reducing the number of particles in the stochastic weighted particle method for the Boltzmann equation are described and discussed. The corresponding error bounds are obtained and numerical tests for the spatially homogeneous Boltzmann equation presented. It is shown that if an appropriate reduction procedure is used then any effect on the accuracy of the numerical scheme is negligible.

SPECTRAL ANALYSIS OF SYMMETRIC OPERATORS: APPLICATION TO THE LAPLACE TIDAL MODEL. A. I. Yaremchuk* and J. Schröter†. **Andreyev Acoustics Institute, Shvernika 4, 117034 Moscow, Russia; †Alfred-Wegener Institute, Bremerhaven, Germany.* E-mail: jgs@awi-bremerhaven.de.

A finite-storage iterative algorithm is proposed for performing spectral analysis and synthesis with respect to an arbitrary symmetric operator. This operator can be of any nature, and it is only necessary to define its action. The whole analysis may be performed by a repeated application of the operator. Compared with traditional methods, our approach allows us to treat discrete systems of very high dimension. As an example, we consider in the framework of an ocean governed by the Laplace tidal equations the problem of separation of large-scale geostrophic modes and surface-waves contributing to a given flow. As a second example we apply the algorithm to a problem in satellite remote sensing. We reconstruct the mean large-scale oceanic circulation from observed sea surface height data. In the case of a synthetic data set the agreement of analytical and numerical results is satisfactory.

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FAST SHALLOW-WATER EQUATION SOLVERS IN LATITUDE-LONGITUDE COORDINATES. William F. Spotz, Mark A. Taylor, and Paul N. Swarztrauber. *National Center for Atmospheric Research, P.O. Box 3000, Boulder, Colorado 80307.* E-mail: spotz@ucar.edu, taylorm@ucar.edu, and pauls@ucar.edu.

Here we redirect attention to a fast pseudospectral method on the sphere developed by Merilees in 1973, recently revived by Fornberg. In these works, the required spatial derivatives are computed by the formal differentiation of one-dimensional Fourier series approximations to both scalar and vector functions on the surface of the sphere. Filters must be used to alleviate prohibitive time-stepping restrictions and maintain stability on the non-isotropic latitude-longitude grids. Merilees' original filter was eventually found to be unusable, as it was unstable for longer runs. In this paper we examine alternatives to Merilees' filter. In particular, we first use a harmonic filter that consists of a harmonic analysis followed directly by a synthesis. The resulting stability and accuracy are identical to the traditional spectral transform method. Fewer Legendre transforms are required since they are limited to the filter and not used to compute spatial derivatives. In theory, this approach can also be viewed as a fast spectral method since fast harmonic filters exist in the literature. Next we examine alternative fast Fourier filters with intent to reproduce the accuracy and stability provided by the harmonic filter. Computational examples are provided with both high order difference and Fourier derivative calculations. In addition, results are presented for both harmonic and Fourier filters.

A DIFFUSION-GENERATED APPROACH TO MULTIPHASE MOTION. Steven J. Ruuth. *Department of Mathematics, University of California, 405 Hilgard Avenue, Los Angeles, California 90095-1555.* E-mail: ruuth@math.ucla.edu.

In this article, we present a diffusion-generated approach for evolving multiple junctions. This work generalizes an earlier method by Merriman, Bence, and Osher which alternately diffuses and sharpens characteristic functions for each phase region to produce pure mean curvature flow. Specifically, our new method produces a normal velocity which depends on a positive multiple of the curvature of the interface plus the difference in bulk energy densities for prescribed junction angles. This simple method naturally treats topological mergings and breakings, produces no overlapping regions or vacuums, and can be made very fast. Numerical studies are provided which show that our method agrees with front tracking and a recent variational approach for a variety of examples. Asymptotic expansions are also carried out near junctions to justify our algorithms.