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Abstracts of Papers to Appear in Future Issues

SOLVING TIME-DEPENDENT TWO-DIMENSIONAL EDDY CURRENT PROBLEMS Min Eig Lee, S. I. Hariharan, and Nathan Ida, *University of Akron, Akron, Ohio, USA.*

In this paper we report our results on transient eddy current calculations. Typical situation describes a two-dimensional transverse magnetic field incident on an infinitely long conductor. The conductor is assumed to be a good conductor but not a perfect one. Electromagnetic wave scattering and field penetration occur in this situation. The resulting problem is an initial boundary-value interface problem with the boundary of the conductor being the interface. A potential function is defined to model the situation in the time domain. Finite-difference time-domain (FD-TD) techniques are used to march the potential function explicitly in time. Treatment of low-frequency radiation condition is given special consideration. Results are validated with approximate analytic solutions.

ON THE PRINCIPAL AXES OF DIFFUSION IN DIFFERENCE SCHEMES FOR 2D TRANSPORT PROBLEMS William Layton, *University of Pittsburgh, Pittsburgh, Pennsylvania, USA.*

Via Taylor series, we associate with a difference stencil L^h approximating $Lu := au_x + bu_y$ its modified equation:

$$L^h u = Lu + \frac{h}{2}\{Au_{xx} + 2Bu_{xy} + Cu_{yy}\} + O(h^2)$$

By rotating axes to eliminate the $2Bu_{xy}$ term, the principle axes through which the diffusion in L^h acts is calculated. Interestingly, for many schemes proposed for 2D transport problems these axes have little to do with the "streamline" and "crosswind" directions of the continuous problem. Several examples are considered from this point of view.

THE BEHAVIOR OF FLUX DIFFERENCE SPLITTING SCHEMES NEAR SLOWLY MOVING SHOCK WAVES. Thomas W. Roberts, *NASA Langley Research Center, Hampton, Virginia, USA.*

An investigation of the behavior of shock capturing schemes which compute the numerical flux from a solution of Riemann's problem is performed. The schemes of Godunov, Roe, and Osher are examined for a one-dimensional model problem consisting of a nearly stationary shock. Both scalar and systems of equations are examined. It is found that for slow shocks there is a significant error generated when solving systems of equations, while the scalar results are well behaved. This error consists of a long wavelength noise in the downstream running wave families that is not effectively damped by the dissipation of the scheme. The source of this error is shown, and the implications for the performance of these schemes are considered. This error may contribute to the slow convergence to steady state reported by many researchers.

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THE SOLUTION OF FADDEEV INTEGRAL EQUATIONS FOR THREE-BODY SCATTERING BY MEANS OF B-SPLINES.
A. J. Huizing and B. L. G. Bakker, *Vrije Universiteit, Amsterdam, THE NETHERLANDS.*

A method for the solution of Fredholm integral equations of the second kind with singularities both in the kernel and in the solution is developed, based on the approximation of the solution by B-splines. The main problem of this method, the distribution of knots, is extensively investigated. The Faddeev equations describing the physical problem of pion deuteron elastic scattering are solved as an application of this method.

AN ADAPTIVE GRID SOLUTION PROCEDURE FOR CONVECTION-DIFFUSION PROBLEMS.
S. Acharya and F. H. Moukalled, *Louisiana State University, Baton Rouge, Louisiana, USA.*

A computationally efficient and stable adaptive grid solution procedure is developed for convection-diffusion problems. In this method, grid refinement and adaptation is based on an equidistribution law but is only performed in regions with high error estimates that are flagged from a preliminary coarse grid solution. The equidistribution law is implicit in the grid generation procedure which requires the solution of two Poisson equations with control functions that are obtained directly from the error estimates or weighting functions at the grid points. Solution on the refined, equidistributed mesh in the flagged region is obtained with boundary conditions interpolated from the coarse grid results. Accurate solutions in both the flagged region and the coarse grid regions of the domain are obtained with a multigrid approach that requires successive solutions on the refined, equidistributed mesh in the flagged region and on the coarse mesh in the entire domain. The adaptive grid method including the multigrid calculations can be extended to several levels of refinement. The acronym LAME is coined for this procedure in view of its local adaptation, multigridding, and equidistribution features. The method is shown to be stable, computationally efficient and accurate by applying it to three test problems and comparing with conventional calculations on a fixed curvilinear grid.

ADAPTIVE MESH GENERATION FOR VISCOUS FLOWS USING DELAUNAY TRIANGULATION.
Dimitri J. Mavriplis, *NASA Langley Research Center, Hampton, Virginia, USA.*

A method for generating an unstructured triangular mesh in two dimensions, suitable for computing high Reynolds number flows over arbitrary configurations is presented. The method is based on a Delaunay triangulation, which is performed in a locally stretched space, in order to obtain very high-aspect-ratio triangles in the boundary layer and wake regions. It is shown how the method can be coupled with an unstructured Navier–Stokes solver to produce a solution-adaptive mesh generation procedure for viscous flows.

COMPOSITE OVERLAPPING MESHES FOR THE SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS.
G. Chesshire, *Intel Scientific Computers, Beaverton, Oregon, USA*; W. D. Henshaw, *IBM—Thomas J. Watson Research Center, Yorktown Heights, New York, USA.*

We discuss the generation of curvilinear composite overlapping grids and the numerical solution of partial differential equations on them. A composite overlapping grid consists of a set of curvilinear component grids that cover a region and overlap where they meet. Continuity conditions (interpolation) are imposed at the overlapping boundaries. The principal advantage of composite grids is in the generation of grids for regions with complicated geometries. The grid construction program CMPGRD is used to create composite grids with any number of component grids. We describe some techniques for the solution of elliptic and time-dependent PDEs on composite meshes. Applications to the solution of the compressible Navier–Stokes equations are presented.

PARTICLE SIMULATIONS OF THE SEMICONDUCTOR BOLTZMANN EQUATION FOR ONE-DIMENSIONAL INHOMOGENEOUS STRUCTURES. P. Degond and F. Guyot-Delaurens, *Ecole Polytechnique, Palaiseau, FRANCE.*

This paper deals with the first application of the weighted particle method to the inhomogeneous semiconductor Boltzmann equation. In this method, the collision term is treated in a deterministic way. In a previous paper, we reported the application of this method to a homogeneous case. This paper gives a detailed analysis of the inhomogeneous case. In particular, we investigate three different methods to perform the coupling of the particles trajectories with the Poisson equation. Two test problems are considered. The first one is "slightly inhomogeneous" and concerns damped plasma oscillations. The second one is "strongly" inhomogeneous and consists in the modelling of a one-dimensional N^{+}-N-N^{+} structure, with a sharp doping discontinuity.

THRESHOLD ACCEPTING. A GENERAL PURPOSE OPTIMIZATION ALGORITHM APPEARING SUPERIOR TO SIMULATED ANNEALING. Gunter Dueck and Tobias Scheuer. *IBM Scientific Center, Heidelberg, WEST GERMANY (FRG).*

A new general purpose algorithm for the solution of combinatorial optimization problems is presented. The new threshold accepting method is even simpler structured than the well-known simulated annealing approach. The power of the new algorithm is demonstrated by computational results concerning the traveling salesman problem and the problem of the construction of error-correcting codes. Moreover, deterministic (!) versions of the new heuristic turn out to perform nearly equally well, consuming only a fraction of the computing time of the stochastic versions. As an example, the deterministic threshold accepting yields very-near-to-optimum tours for the famous 442-cities traveling salesman problem of Grötschel within 1 to 2 s of CPU-time.

A SECOND-ORDER IMPLICIT PARTICLE MOVER WITH ADJUSTABLE DAMPING. Alex Friedman, *Lawrence Livermore National Laboratory, Livermore, California, USA.*

A new algorithm for the calculation of particle trajectories is introduced. The algorithm combines second-order accuracy in the real frequency with third-order user-adjustable attenuation. It requires little storage of data from previous time levels. The method was designed for use in implicit particle-in-cell plasma simulation codes, and this application is treated in detail. It may also prove useful in other applications where one seeks to preserve the accuracy of low-frequency oscillations while rapidly damping under-resolved high frequency motions, e.g., solution of the field equations in electromagnetic particle codes. An explicit variation, wherein future quantities are obtained by extrapolation, can provide attenuation but not large-timestep stability.

NOTE TO APPEAR

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