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Abstracts of Papers to Appear in Future Issues

A PERFECTLY MATCHED LAYER FOR THE ABSORPTION OF ELECTROMAGNETIC WAVES. Jean-Pierre Berenger. *Centre d'Analyse de Défense, 16 bis, Avenue Prieur de la Côte d'Or, 94114 Arcueil, France.*

A new technique of free-space simulation has been developed for solving unbounded electromagnetic problems with the finite-difference time-domain method. Referred to as PML, the new technique is based on the use of an absorbing layer especially designed to absorb without reflection the electromagnetic waves. The first part of the paper presents the theory of the PML technique. The second part is devoted to numerical experiments and to numerical comparisons with the previously used techniques of free-space simulation. These comparisons show that the PML technique works better than the others in all cases; using it allows us to obtain a higher accuracy in some problems and a release of computational requirements in some others.

UPWIND ITERATION METHODS FOR THE CELL VERTEX SCHEME IN ONE DIMENSION. K. W. Morton, M. A. Rudgyard, and G. J. Shaw. *Oxford University Computing Laboratory, Numerical Analysis Group, 11 Keble Road, Oxford, England OX1 3QD.*

This paper describes and analyses a series of methods for solving the algebraic equations obtained from the cell vertex finite volume discretisation in one dimension. The objective is to explore the possibilities for improved iteration methods that may be applied to cell vertex discretisations of the Navier-Stokes equations in higher dimensions. In general there is no natural one-to-one correspondence between cell-based residuals and nodal unknowns for this system. In order to devise iteration schemes it is therefore necessary to provide a mapping between cells and nodes. The family of methods introduced here is based on the application of standard iterative techniques to a nodal residual formed of a combination of neighbouring cell-based residuals. It includes the familiar Lax-Wendroff iteration, upwind iteration schemes, and marching schemes capable of attaining convergence rates independent of the number of algebraic equations. The aim in each case is to set to zero the residual for each cell, apart from exceptional cells such as those containing shocks. The final results show that matrix-based upwind iteration methods, using cell residuals modified to take account of critical points and applying several local iterations, converge in around 15 iterations.

AN EFFICIENT GAUSS-NEWTON-LIKE METHOD FOR THE NUMERICAL SOLUTION OF THE ORNSTEIN-ZERNIKE INTEGRAL EQUATION FOR A CLASS OF FLUID MODELS. Stanislav Labík, Roman Pospíšil, and Anatol Malijevský. *Department of Physical Chemistry, Institute of Chemical Technology, Prague 166 28, Czech Republic*; William Robert Smith. *Department of Mathematics and Statistics, University of Guelph, Guelph, Ontario N1G 2W1, Canada.*

A numerical algorithm for solving the Ornstein-Zernike (OZ) integral equation of statistical mechanics is described for the class of fluids composed of molecules with axially symmetric interactions. Since the OZ equation is a nonlinear second-kind Fredholm equation whose key feature for the class of problems of interest is the highly computationally intensive nature of the kernel, the general approach employed in this paper is thus potentially useful for similar problems with this characteristic. The algorithm achieves a high degree of computational efficiency by combining iterative linearization of the most complex portion of the kernel with a combination of Newton-Raphson and Picard iteration methods for the resulting approximate equation. This approach makes the algorithm analogous to the approach of the classical Gauss-Newton method for nonlinear regression, and we call our method the GN algorithm. An example calculation is given illustrating the use of the algorithm for the hard prolate ellipsoid fluid and its results are compared directly with those of the Picard iteration method. The GN algorithm is four to ten times as fast as the Picard method, and we present evidence that it is the most efficient general method currently available.

HYPERBOLIC SYSTEMS OF CONSERVATION LAWS, THE WEYL EQUATION, AND MULTIDIMENSIONAL UPWINDING. Sebastian Noelle. *Institute of Applied Mathematics, Bonn University, Germany.*

All linear hyperbolic systems of two conservation laws can be transformed to essentially one prototype system. This system can be identified with the Weyl equation of relativistic quantum mechanics. We derive a wave model for this equation and compare the resulting fluctuation splitting scheme with standard dimensional splitting schemes.

OPTIMISATION METHODS FOR BATHYMETRY AND OPEN BOUNDARY CONDITIONS IN A FINITE ELEMENT MODEL OF OCEAN TIDES. F. Lyard and M. L. Genco. *Equipe de Modélisation des Ecoulements Océaniques et des Marées Laboratoire des Ecoulements Géophysiques et Industriels-Institut de Mécanique de Grenoble, BP 53X, 38 041 Grenoble, France.*

A bidimensional, spectral in time, quasi-linearised hydrodynamic ocean tide model has been developed at the Institut de Mécanique de Grenoble. This model is derived from the classical shallow water equations by removing velocity unknowns in the continuity equation, that leads to an elliptic, second-order differential equation where tide denivellation remains the only unknown quantity. The problem is solved in its variational formulation and the finite elements method is used to discretise the equations in the spatial domain with a Lagrange-P2 approximation. Bottom topography has to be known at the integration points of the elements. In the case of the large oceanic basins, a specific method, called the bathymetry optimisation method, is needed to correctly take into account the bottom topography inside the model. The accuracy of the model's solutions is also strongly dependent on the quality of the open boundary conditions because of the elliptic characteristics of the problem. The optimisation method for open boundary conditions relies on the use of the *in situ* data available in the modelled domain. The aim of this paper is to present the basis of these optimisations of bathymetry and open boundary conditions. An illustration of the related improvements is presented on the North Atlantic Basin.

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