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# Abstracts of Papers to Appear in Future Issues

NUMERICAL SIMULATION OF STRATIFIED COATING FLOW BY A VARIATIONAL METHOD. D. Berghezan and F. Dupret. *Unité de Mécanique Appliquée, Université Catholique de Louvain, 2 place du Levant, 1348 Louvain-la-Neuve, Belgium.*

We present a method for calculating the two-dimensional steady state flow of stratified Newtonian liquids. Lagrange multipliers are used to impose the free surface conditions. When surface tension is not vanishing, contact angles are easily introduced. Inlet and outlet free sections are treated by means of a technique which allows us to calculate layer thicknesses as part of the result. Parametric studies are thereby facilitated. The solution procedure is derived from a variational approach. At each iteration, a linear system is obtained by linearizing the weak form of the problem. A finite element discretization is carried out on this continuous system. The mesh is adapted to the successive configurations of the free boundaries. Ill-shaped elements are corrected by exerting artificial forces on the mesh vertices. The global iterative scheme exhibits a quasi-quadratic convergence. The outflow from a slot and the curtain coating flow are analysed and illustrate the power of the method.

THE ALTERNATING DIRECTION MULTI-ZONE IMPLICIT METHOD. Moshe Rosenfeld. *Faculty of Engineering, Tel Aviv University, Tel Aviv, Israel*; Yuval Yassour. *Faculty of Aerospace Engineering, Technion, Haifa, Israel.*

Within the structured grid approach, numerical solution of partial differential equations (PDE) in complex regions requires the decomposition of the domain into several zones. Implicit solution methods of the discrete equations are preferred because of their superior numerical properties. Indeed, many existing multi-zone solution methods use implicit techniques, but the zonal boundaries are updated explicitly. The zonal boundaries are created between the zones in the process of domain decomposition, but otherwise they are regular interior field points. If only steady state solutions are sought, the explicit calculation of the zonal boundaries usually affects only the convergence rate but not the accuracy of the solution. However, in time-dependent cases this may degrade the time accuracy of the solution. In the present work, we propose a novel fully implicit method for solving sets of PDE using multi-zones and structured grids. The method combines the zonal approach with the alternating direction implicit (ADI) method, and hence the method is referred to as the alternating direction multi-zone implicit (ADMZI) method. The key idea is the generation of different sets of zones for each stage (factor) of the ADI method, rather than using the same set of zones for all the stages. Consequently, the ADI sweeps are performed between physical boundaries, so that zonal boundaries are avoided and the solution is fully implicit. The ADMZI method can be applied to any set of PDE that employs an ADI (or approximate factorization) method. Typical examples include the time-dependent compressible or incompressible Navier–Stokes equations. Several conceptual examples and actual numerical test cases (that solve the heat conduction equation) confirm the versatility, efficiency, and accuracy of the ADMZI method.

DUAL PRINCIPLES IN MAXIMUM ENTROPY RECONSTRUCTION OF THE WAVE DISTRIBUTION FUNCTION. Tord Oscarsson. *Swedish Institute of Space Physics, University of Umeå, Umeå, Sweden.*

Maximum entropy methods are used for reconstructing the distribution of energy in wave vector space from frequency spectra observed on board satellites. The reconstruction scheme is based on a modified entropy function, and dual principles are used to solve the resulting optimization problem. Our scheme is not limited to reconstructions of wave distribution functions, but it should be useful also for solving other types of underdetermined inverse problems.

INSTABILITIES OF THE SKYRME MODEL. William Y. Crutchfield and John B. Bell. *Applied Mathematics Group, Lawrence Livermore National Laboratory, Livermore, California 94550, U.S.A.*

Previous efforts to apply finite difference methods to the Skyrme model to simulate time evolution have discovered apparent numerical instabilities. As a result, previous authors have been forced to take unusually small time-steps and introduce artificial viscosity to maintain stability. This paper analyzes finite difference schemes for the Skyrme model, demonstrates two mechanisms for the instability, and derives a corrective measure. A stable finite difference scheme in three dimensions which uses a factor of eight less memory than previous schemes is described.

ON A CLASS OF NON-SEPARABLE QUANTUM-MECHANICAL EIGENVALUE PROBLEMS: ANALYTICAL AND TECHNICAL CONSIDERATIONS WITHIN THE FRAME OF A BORN EXPANSION METHOD. S. Barcza. *Konkoly Observatory, 1525 Budapest Pf 67, Hungary.*

An idea of Born is reviewed and elaborated to non-separable quantum-mechanical eigenvalue problems in which the Schrödinger equation can be solved exactly for a subconfiguration. (By subconfiguration we mean a subsystem in which one dynamic variable of the whole system is considered as parameter; derivations with respect to this variable are omitted.) The eigenfunctions in the subconfiguration (e.g., the eigenfunctions of a Born–Oppenheimer approximation) are used as a basis to expand the eigenfunction of the complete problem. By analytical methods it is shown how to construct the complete ensemble of solutions which can be systematically mapped and classified by their analytical behaviour in one of the singularities (in a regular singularity). A modification of the Numerov procedure is given to the numerical solution of the coupled second-order ordinary differential equations which arise from our treatment. The analytical asymptotic solutions are used to bridge over the asymptotic regions in which the error of the Numerov procedure is large. As a concrete example the comprehensive asymptotic analysis of the Schrödinger equation of a hydrogen-like ion in strong homogeneous magnetic field is presented, practical methods and computational aspects are discussed, and finally a few actual numerical results are reported: some energy levels are given as a function of field strength.

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