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Abstracts of Papers to Appear in Future Issues

SOME OBSERVATIONS ON A STATIC SPATIAL REMESHING METHOD BASED ON EQUIDISTRIBUTION PRINCIPLES. P. Saucez. *Laboratoire de Mathématique et Recherche Opérationnelle, Faculté Polytechnique de Mons, 7000 Mons, Belgium.* A. Vande Wouwer, *Laboratoire d'Automatique, Faculté Polytechnique de Mons, 7000 Mons, Belgium.* W. E. Schiesser, *Department of Computer Science and Engineering, Lehigh University, Bethlehem, Pennsylvania 18015.*

This paper proposes a line solution procedure with time and space adaptation for one-dimensional systems of partial differential equations whose solutions display steep moving fronts. The spatial remeshing algorithm, which is a variation of the method published by Sanz-Serna and Christie and an extension suggested by Revilla, is a static remeshing method based on equidistribution principles. The selection of the several algorithm components, i.e., grid placement criterion, spatial discretization scheme, time integrator, adaptation frequency, and parameter tuning, are investigated and illustrated with several test examples, i.e., the cubic Schrödinger equation, a model of a single-step reaction with diffusion, and a model of flame propagation.

A STRONGLY COUPLED TIME-MARCHING METHOD FOR SOLVING THE NAVIER–STOKES AND k-ω TURBULENCE MODEL EQUATIONS WITH MULTIGRID. Feng Liu and Xiaoqing Zheng. *Department of Mechanical and Aerospace Engineering, University of California, Irvine, California 92717.*

Many researchers use a time-lagged or loosely coupled approach in solving the Navier–Stokes equations and two-equation turbulence model equations in a time-marching method. The Navier–Stokes equations and the turbulence model equations are solved separately and often with different methods. In this paper a strongly coupled method is presented for such calculations. The Navier–Stokes equations and two-equation turbulence model equations, in particular, the k-ω equations, are considered as one single set of strongly coupled equations and solved with the same explicit time-marching algorithm without time-lagging. A multigrid method, together with other acceleration techniques such as local time steps and implicit residual smoothing, is applied to both the Navier–Stokes and the turbulence model equations. Time step limits due to the source terms in the k-ω equations are relieved by treating the appropriate source terms implicitly. The equations are also strongly coupled in space through the use of staggered control volumes. The method is applied to the calculation of flows through cascades as well as over isolated airfoils. Convergence rate is greatly improved by the use of the multigrid method with the strongly coupled time-marching scheme.

IMPLEMENTATION OF HIERARCHICAL CLUSTERING METHODS. Arturo Serna. *LAEC, Observatoire de Paris-Meudon, F-92195 Meudon, France.*

We present an implementation of hierarchical clustering methods to distribute a set of objects into a set of groups. Our code is particularly conceived to identify and analyze substructures in galaxy clusters or in large-scale catalogues. However, its general scheme allows for very easy adaptation to any other kinds of systems and physical problems. The algorithms to draw the hierarchical tree associated to a given sample of data, as well as those for analyzing and interpreting the results obtained from this technique, are also presented here.

A SECOND-ORDER ACCURATE CAPTURING SCHEME FOR 1D INVISCID FLOWS OF GAS AND WATER WITH VACUUM ZONES. H. S. Tang and D. Huang. *Department of Mathematics, Peking University, Beijing 100871, China.*

A second-order accurate difference scheme is developed to study cavitation in unsteady, one-dimensional, inviscid, compressible flows of water with gas. The scheme can capture shock waves, interfaces separating gas and water, as well as cavitation zones that are modelled as vacuum states, and it takes into account water's capability to resist tensile stresses. As an extended version of the standard MUSCL scheme, this scheme is based on the solutions of local gas–water–vacuum initial value problems. In order to prevent the computed water density from becoming lower than its minimum bound, additional techniques are introduced. Numerical results are presented with gas–water Riemann problems to demonstrate the performance of the scheme. The scheme is also applied to simulate the cavitation process of the flow in a water shock tube.

COMPUTATIONS OF BOUNDARY OPTIMAL CONTROL PROBLEMS FOR AN ELECTRICALLY CONDUCTING FLUID. L. S. Hou* and S. S. Ravindran.† **Department of Mathematics and Statistics, York University, North York, Ontario, M3J 1P3, Canada; and †Center for Research in Scientific Computation, Department of Mathematics, North Carolina State University, Raleigh, North Carolina 27695-8205.*

We study four optimal problems for an electrically conducting fluid. The control is the (normal) electrical current on the boundary of the flow domain. The objectives are to match a desired velocity field, or to match a desired electrical potential field, or to minimize the potential gradient, or to minimize the vorticity in the flow domain. We develop a systematic way to use the Lagrange multiplier rules to derive an optimality system of equations from which an optimal solution can be computed. Mixed finite element methods are used to find approximate solutions for the optimality systems of equations that characterize the optimal controls. A direct method and an iterative method are proposed for solving the discrete, nonlinear optimality systems of equations. Numerical results for several examples are presented.

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