absorbing Rayleigh waves, which propagate along free surfaces of elastic media. The boundary formulas developed here can be applied without modification to problems in both two and three dimensions.

A Comparative Study of Advanced Shock-Capturing Schemes Applied to Burgers' Equation. H. Q. Yang and A. J. Przekwas. *CFD Research Corporation, 3325-D Triana Boulevard, Huntsville, Alabama 35805, USA.*

In recent years, a number of new shock-capturing finite difference schemes, often called high resolution schemes, have been proposed. We have considered several variations of the TVD and FCT schemes and geometrical approaches such as MUSCL, ENO, and PPM. Included is an organized overview and classification of the schemes. Only essential features are described, and numerical implementation is discussed. Much of the mathematical theory is omitted, but a key source reference list is provided. In this paper we present a comparative study of these schemes applied to the Burgers' equation. The objective is to assess their performance for problems involving formation and propagation of shocks, shock collisions, and expansion of discontinuities.

Absorbing Boundary Conditions, Difference Operators, and Stability. R. A. Renaut. *Arizona State University, Tempe, Arizona 85287-1804, USA.*

In this paper we present a review of some of the methods currently used for solving the absorbing boundary problem for the two-dimensional scalar wave equation. We show the relationship between the methods of Lindman and Clayton and Engquist. Through this relationship we can derive discretizations of any rational approximation to the one-way wave equation. We prove that, for all the cases considered here, which can be solved in a manner similar to Lindman's approach, the bounds imposed on the Courant number for stability at the boundary are no more severe than the bound $1/\sqrt{2}$ required for stability of the interior scheme. These bounds are, however, necessary but not sufficient. We also compare the methods reviewed numerically. It is demonstrated that Lindman's scheme is no better than a sixth-order approximation of Halpern and Trefethen. For low-order approximations, Higdon's one-dimensional equations are satisfactory, but as the order increases the two-dimensional form of the equations, as derived by Halpern and Trefethen, is preferable.

A Combined Spectral-Finite Element Method for Solving Two-Dimensional Unsteady Navier–Stokes Equations. Ben-yu Guo and Wei-ming Cao. *Shanghai University of Science and Technology, Shanghai, China.*

In this paper, a combined Fourier spectral-finite element method is proposed for solving two-dimensional, semi-periodic, unsteady Navier–Stokes equations. The convergence is proved and the numerical results are presented.

A Finite Difference Procedure for a Class of Free Boundary Problems. Bengt Fornberg. *Corporate Research, Exxon Research and Engineering Company, Annandale, New Jersey 08801, USA*; and Rita Meyer-Spasche. *Max-Planck-Institute for Plasma Physics, IPP-EURATOM Association, D-W-8046 Garching, Germany.*

Finite difference schemes loose accuracy when free boundaries cross over rectangular grids. For a class of second-order equations, the leading error term at such a boundary can be eliminated by a simple correction strategy. This procedure works in any number of space dimensions and offers an alternative to (more costly and complicated) adaptive grid techniques.

Orthogonal Grid Generation in a 2D Domain via the Boundary Integral Technique. I. S. Kang. *Chemical Engineering Department, POSTECH, P.O. Box 125, Pohang, 790 Korea*; L. G. Leal. *Department of Chemical and Nuclear Engineering, University of California, Santa Barbara, Santa Barbara, California 93106, USA.*

A new numerical scheme is proposed for the generation of an orthogonal coordinate grid in an arbitrary simply connected two-dimensional domain. The scheme is robust and noniterative and is based on the conjunction of the familiar boundary integral technique with the covariant Laplace equation method for mapping. In the proposed scheme, two types of problems are considered: (1) Boundary correspondence is specified on two adjacent sides of the boundary, or (2) The distortion factor is specified in the product form $f(\xi, \eta) = \Pi(\xi)\,\Theta(\eta)$.

Global and Local Remeshing Algorithms for Compressible Flows. C. J. Hwang and S. J. Wu. *Institute of Aeronautics and Astronautics, National Cheng Kung University, Tainan, Taiwan, Republic of China.*

A new adaptive remeshing approach for unstructured meshes, which includes the error indicator, global, and local mesh regeneration techniques, has been developed in this paper. In this approach, nodes are first distributed according to the remeshing parameters, and those nodes are connected into a complete mesh. The concepts of side-based and vertex-based fronts are introduced to achieve the triangulation. According to the CPU time and the versatility, the vertex-based triangulation technique is proved to be more efficient. By using vertex-based triangulation approach, a local remeshing method, which regenerates only some regions of the flow domain, is presented. To demonstrate the reliability and availability of the proposed procedure, several compressible flow problems are investigated. The regular/stretched triangles and the mixed type of triangular and quadrilateral stretched elements are used. In this work, the Euler equations are solved by the multistep Runge–Kutta Galerkin finite element methods. From the numerical results, the approaches, which employ the directionally stretched elements, are effective and suitable for treating the flow problems with one-dimensional features. The development of the local remeshing algorithm for unsteady flows is worthwhile and important.

Spectral Methods in Time for a Class of Parabolic Partial Differential Equations. Glenn Ierley, Brian Spencer, and Rodney Worthing. *Department of Mathematical Sciences, Michigan Technological University, Houghton, Michigan 49931, USA.*

In this paper, we introduce a fully spectral solution for the partial differential equation $u_t + uu_x + vu_{xx} + \mu u_{xxx} + \lambda u_{xxxx} = 0$. For periodic boundary conditions in space, the use of a Fourier expansion in x admits of a particularly efficient algorithm with respect to expansion of the time dependence in a Chebyshev series. Boundary conditions other than periodic may still be treated with reasonable, though lesser, efficiency. For all cases, very high accuracy is attainable at moderate computational cost relative to the expense of variable order finite difference methods in time.

Time Domain Numerical Calculations of Unsteady Vortical Flows about a Flat Plate Airfoil. S. I. Hariharan and Yu Ping. *Department of Mathematical Sciences, University of Akron, Akron, Ohio 44325 USA*; J. R. Scott. *NASA Lewis Research Center, Cleveland, Ohio 44135, USA.*

A time domain numerical scheme is developed to solve for the unsteady flow about a flat plate airfoil due to imposed upstream, small amplitude, transverse velocity perturbations. The governing equation for the resulting unsteady potential is a homogeneous, constant coefficient, convective wave