AN IMPROVED UPWIND FINITE VOLUME RELAXATION METHOD FOR HIGH SPEED VISCOUS FLOWS. Arthur C. Taylor III, *Department of Mechanical Engineering and Mechanics, Old Dominion University, Norfolk, Virginia 23529-0247, U.S.A.*; Wing-fai Ng, *Department of Mechanical Engineering, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 240612-0238, U.S.A.*; Robert W. Walters, *Department of Aerospace and Ocean Engineering, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061-0238, U.S.A.*

An improved upwind relaxation algorithm for the Navier–Stokes equations is presented, and results are given from the application of the method to two test problems, including (1) a shock/boundary layer interaction on a flat plate ($M_\infty = 2.0$), and (2) a high-speed inlet ($M_\infty = 5.0$). The technique is restricted to high-speed (i.e., supersonic/hypersonic) viscous flows. The new algorithm depends on a partitioning of the global domain into regions or sub-domains, where a relatively thin "elliptic" region is identified near each solid wall boundary, and the remainder of the flowfield is identified to be a single larger "hyperbolic" (i.e., hyperbolic/parabolic in the streamwise direction) region. A direct solution procedure by Lower/Upper factorization is applied to the elliptic region(s), the results of which are then coupled to a standard line Gauss–Seidel relaxation sweep across the entire domain in the primary flow direction. In the first test problem, the new algorithm reduced total run times as much as 75% when compared to the standard alternating forward/backward vertical line Gauss–Seidel (VLGS) algorithm, whereas in the second test problem, a total savings as high as 20% was achieved. Essentially all of this improvement occurred only after the initial transient in the solution was overcome. However, in the second test problem, a significant improvement in the computational performance of the standard forward/backward VLGS algorithm was noted when overcoming the initial transient simply by converting from the use of conserved variables to primitive variables in the spatial discretization and linearization of all terms.

LOCATING THREE-DIMENSIONAL ROOTS BY A BISECTION METHOD. John M. Greene, *General Atomics, San Diego, California 92186-9784, U.S.A.*

The evaluation of roots of equations is a problem of perennial interest. Bisection methods have advantages since the volume in which the root is known to be located can be steadily decreased. This method depends on the existence of a criterion for determining whether a root exists within a given volume. Here topological degree theory is exploited to provide this criterion. Only three-dimensional volumes are considered here. The result is of some use in locating roots and in illustrating the theory. The classification of roots as X-points or O-points, and the generalization to three dimensions, is also discussed.

NUMERICAL COMPUTATION OF 2D SOMMERFELD INTEGRALS—DECOMPOSITION OF THE ANGULAR INTEGRAL. Steven L. Dvorak, *Electromagnetics Laboratory, Department of Electrical and Computer Engineering, University of Arizona, Tucson, Arizona 85721, U.S.A.*; Edward F. Kuester, *Electromagnetics Laboratory, Department of Electrical and Computer Engineering, Campus Box 425, University of Colorado, Boulder, Colorado 80309, U.S.A.*

Spectral domain techniques are frequently used in conjunction with Galerkin's method to obtain the current distribution on planar structures. When this technique is employed, a large percentage of the computation time is spent filling the impedance matrix. Therefore, it is important to develop accurate and efficient numerical techniques for the computation of the impedance elements, which can be written as two-dimensional (2D) Sommerfeld integrals. Once the current distribution has been found, then the near-zone electric field distribution can be obtained by computing another set of 2D Sommerfeld integrals. The computational efficiency of the 2D Sommerfeld integrals can be improved in two ways. The first method, which is discussed in this paper, involves finding a new way to compute the inner angular integral in the polar representation of these integrals. It turns out that the angular integral can be decomposed into a finite number of incomplete Lipschitz–Hankel integrals, which in turn can be