

# High Resolution Solutions for the Supersonic Formation of Shocks in Transonic Flow

Analysis of Self-Similar Solutions of Multidimensional Conservation Laws

Allen Tesdall

City University of New York, College of Staten Island  
Staten Island, New York 10314

Barbara Lee Keyfitz

The Ohio State University  
Columbus, Ohio 43210

## *Abstract*

We present numerical solutions of two problems for the unsteady transonic small disturbance equations whose solutions contain shocks. The first problem is a two-dimensional Riemann problem with initial data corresponding to a slightly supersonic flow hitting the corner of an expanding duct at  $t = 0$ . The second problem is a boundary value problem that describes steady transonic flow over an airfoil. In both cases, the solutions contain regions of supersonic and subsonic flow, and an expansion wave interacts with a sonic line to produce a shock. We use high resolution methods, together with local grid refinement, to investigate the nature of the solution in the neighborhood of the point where the shock forms. We find that the shock originates in the supersonic region as originally proposed by Guderley, and very close to, but not at, the sonic line.