ABSTRACT

The Integral Equation of Oswatitsch is a two-dimensional non-linear singular integral equation, the kernel having a dipole singularity. This equation, which occurs in transonic aerodynamic problems, governs the steady plane inviscid flow past a thin symmetric airfoil at zero incidence. It was put forward by K. Oswatitsch (1950), who solved an approximate one-dimensional version of this equation. This led to the development of integral equation method for transonic flow computations. A large number of research workers attempted to solve this equation approximately. Although reasonably good solutions have been obtained for continuous supercritical flows, no satisfactory method has been developed so far for the case of flow with a shock discontinuity.

The present work is devoted to the study in integral equation of Oswatitsch and to the development of a numerical method for the associated transonic integro-differential equation for small perturbation shock-free flow at zero incidence, as well as for flows with shock.

Two new iteration schemes have been proposed and used to solve the simplified integral equation of Oswatitsch. Shock-free supercritical solutions have been computed. To obtain solution with shock artificial viscosity term has been added explicitly.

A hybrid of finite difference method and integral equation method, called integro-differential equation method, has been developed and used to solve transonic aerodynamic problem for one-dimensional model. Artificial viscosity has been explicitly added.

The method has been extended to solve the full two-dimensional transonic non-linear singular integro-differential equation. Numerical examples have been computed and compared with other existing results.

KEY WORDS :

TRANSONIC AERODYNAMICS, HIGH SUBSONIC FLOW, SHOCK JUMP, MULTI-DIMENSIONAL INTEGRAL EQUATION, NONLINEAR INTEGRAL EQUATION, SINGULAR INTEGRAL EQUATION, INTEGRO-DIFFERENTIAL EQUATION, ARTIFICIAL VISCOSITY, OSWATITSCH EQUATION etc.