Supersonic Flow Past a Symmetrically Curved Cone

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ABSTRACT. We study the conic shock waves for 3-dimensional steady irrotational isentropic supersonic flow against a sharp symmetrically curved conic projectile. An approximate solution was constructed and the existence of a conic shock wave solution is established by linear iteration.

1. INTRODUCTION

The shock wave formation is one of the most fascinating phenomena in hydrodynamics and has been the focus of many research efforts. The mathematical model for shock waves in hydrodynamics is a quasi-linear hyperbolic system of Euler equations:

\[
\begin{align*}
\rho_t + \nabla \cdot \rho \mathbf{v} &= 0, \\
\mathbf{v}_t + \mathbf{v} \cdot \nabla \mathbf{v} + \frac{\nabla p}{\rho} &= 0, \\
S_t + \mathbf{v} \cdot \nabla S &= 0,
\end{align*}
\]

where \((\rho, \mathbf{v}, S)\) are the density, velocity and entropy of the gas particles and the pressure \(p = p(\rho, S)\) is a given function.

The shock front is described by a certain jump discontinuity in the solution to the nonlinear system (1.1), see [10] and [28]. It is a typical free boundary problem because the position of the shock front is unknown beforehand and should be determined along with the solution. Because of the inherent difficulty in the problem, many of the works in shock wave study are concentrated to the simplified model of one space dimension.

The rigorous mathematical study of multi-dimensional shock waves for system (1.1) of Euler equations began with the work of A. Majda in [18, 19] where