

STRUCTURE OF MAGNETOGASDYNAMIC WEAK SHOCK WAVES

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Abstract. The problem of the detailed structure of magnetogasdynamic shock waves is investigated. It is assumed that the flow takes place under normal magnetic field H_0 and the conductivity of the medium is considered infinite. An approximate analytical solution of the nonlinear differential equations describing the phenomena is obtained. The suggested analytical results in this paper are in good agreement with the previous numerical computations for the thickness and the velocity distribution inside the transition region. In addition, the enthalpy distribution inside the shock front is predicted.

1. Introduction

The structure of magnetogasdynamic shock wave problem was studied earlier by Sen (1956) using numerical treatment. The aim of this paper is to demonstrate a simpler treatment to the structure of magnetogasdynamic weak shock waves. This helps us to get an approximate analytical solution which was not achieved before and agrees with the numerical results.

In this treatment we consider the following problems in the hope to obtain:

- (1) An analytical formula for the velocity at the inflection point.
- (2) An approximate analytical solution to the basic equations governing the system.

In this paper we shall follow Liepmann *et al.* (1962); Fishman *et al.* (1960) where they have used the assumption

$$q' \simeq \tau' u', \quad (i)$$

where q' is the heat flux; τ' , the viscous stress; u' , the velocity. This assumption enables us then to obtain all the properties inside the shock front in terms of the velocity only.

De Hoffmann and Teller (1950) studied a model for the coupled motion of hydrodynamic flow and electromagnetic field using two simplifying assumptions. First, the conductivity of the medium is considered infinite and the second assumption is to describe the motion by a plane shock wave. They have extended the Rankine–Hugoniot conditions of classical hydrodynamics to this model, while Sen (1956) studied the present problem using numerical treatment.

With the aid of assumption (i), the coupled system of nonlinear differential equations are reduced to one nonlinear equation for the velocity only. To solve this equation we