Sub–shock formation in gas mixtures

Fiammetta Conforto

Abstract. The problem of sub–shock formation within a shock structure (travelling wave) solution for hyperbolic systems of balance laws has been widely studied (see [1] and related bibliography). Important results have been obtained on the non–existence of smooth solutions when the speed of propagation of the wave front exceeds the maximum eigenvalue evaluated in the unperturbed equilibrium state into which the front propagates [1]. More recently, Bisi et al. [2] showed that, in a multi–temperature gas mixture of two components, described by a closure at Euler level of the Boltzmann equations, the shock structure solution may exhibit, in different ranges of Mach numbers, one or more sub–shocks, each one relevant to the field variables characterizing one of the species.

The leading idea of this research is the generalization of the results presented by Currò and Fusco [3] on discontinuous travelling waves solutions admitted in the framework of 13 moment Extended Thermodynamics. Our investigation deals with the whole hierarchy of principal sub–systems of the 13 moment equations deduced by a Grad closure of the Boltzmann equations for a gas mixture, both in the inert and in the reactive case. Our aim consists in determining the different ranges of Mach numbers characterizing the different shock–structure solutions, continuous or not, and to show the existence of ranges into which each constituent of the mixture may generate a sub–shock. A preliminary analysis of the possible sub–shocks arising in the case of the 13 moment description of a gas mixture undergoing a reversible bimolecular reaction can be found in [4].

References

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