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Computation of Shock Waves in Binary Inert Gas Mixtures of Diatomic Gases Using the Generalized Boltzmann Equation RAMESH AGARWAL, GENG QIAN, Washington University in St. Louis — This paper describes the methodology for computing non-equilibrium shock waves in a binary inert mixture of monoatomic and diatomic gases using the Generalized Boltzmann Equation (GBE). For solving the classical Boltzmann equation for a mixture of monoatomic gases or the Generalized Boltzmann equation for a mixture of diatomic gases, these equations are formulated in impulse space, instead of velocity space. A binary mixture of two inert gases results in four coupled GBEs. The computational framework available for the classical Boltzmann equation is extended by including the rotational and vibrational degrees of freedom in the GBE for a mixture of diatomic gases in impulse space. The problem including both rotational - translational (RT) and vibrational – translational (VT) energy transfers is solved by applying a two-stage splitting procedure to the four coupled GBEs. The two stages consist of free molecular transport and RT -VT relaxations. Computations are presented for the shock structure in a binary mixture of N_2 and Ar, and N_2 and O_2 with 1:1 density ratio at Mach 5. This is the first time, such complex computations are being reported in the literature. The methodology can be easily applied to an inert mixture containing an arbitrary number of species.

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