Abstract Submitted
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Normal Shocks with High Upstream Pressure[1] WILLIAM SIRIGNANO, University of California, Irvine — A normal compressive shockwave with supercritical upstream thermodynamic conditions is analyzed using Soave-Redlich-Kwong equation of state for real-gas density, enthalpy, and entropy relations for argon, nitrogen, oxygen, and carbon dioxide. Upstream pressure and temperature varying from 10 to 500 bar and 160 to 800 K. At high pressures, the flow does not follow the calorically-perfect-gas behavior. For the perfect gas, the enthalpy and ratio of pressure-to-density are directly proportional to the square of the sound speed, allowing its direct substitution in the conservation equations. A new thermodynamic function is identified for the sound speed which is shown to remain as the proper characteristic speed. Although the sound speed does not emerge directly from the conservation equations as it does for a perfect gas, the shock speed goes to this limiting value as shock strength goes to zero. For the real-gas, modifications are obtained for Prandtl's relation and the Rankine-Hugoniot relation. The modified real-gas Riemann invariants are constructed and discussed for application to weak shocks. A foundation is presented for use with other cubic equations of state, multicomponent flows, and / or for more complex flow configurations.

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