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New generalized Noh solutions for HEDP hydrocode verification[1]

A. L. VELIKOVICH, J. L. GIULIANI, Plasma Physics Division, Naval Research Laboratory, S. T. ZALESAK, V. TANGRI, Berkeley Research Associates — The classic Noh solution describing stagnation of a cold ideal gas in a strong accretion shock wave has been the workhorse of compressible hydrocode verification for over three decades. We describe a number of its generalizations available for HEDP code verification. First, for an ideal gas, we have obtained self-similar solutions that describe adiabatic convergence either of a finite-pressure gas into an empty cavity or of a finite-amplitude sound wave into a uniform resting gas surrounding the center or axis of symmetry. At the moment of collapse such a flow produces a uniform gas whose velocity at each point is constant and directed towards the axis or the center, i. e. the initial condition similar to the classic solution but with a finite pressure of the converging gas. After that, a constant-velocity accretion shock propagates into the incident gas whose pressure and velocity profiles are not flat, in contrast with the classic solution. Second, for an arbitrary equation of state, we demonstrate the existence of self-similar solutions of the Noh problem in cylindrical and spherical geometry. Examples of such solutions with a three-term equation of state that includes cold, thermal ion/lattice, and thermal electron contributions are presented for aluminum and copper. These analytic solutions are compared to our numerical simulation results as an example of their use for code verification.

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