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Modeling of hydrodynamic forces on a finite-sized spherical particle due to a planar shock wave SUBRAMANIAN ANNAMALAI, MANOJ PARMAR, YASH MEHTA, S. BALACHANDAR, University of Florida — Shock-particle interaction is a very important phenomenon, for example in the study of explosive dispersal of particles. When conducting simulations involving millions of particles, it is not feasible to resolve the flow around each particle. Therefore the goal here is to obtain an exact analytic solution for shock-particle interaction in the limit of weak shock, and based on which propose a model which can estimate the force on a particle as a finite-strength shock wave passes over it. For the exact solution we consider an acoustic wave passing over a finite-sized rigid spherical particle situated in a viscous compressible ambient fluid. Linearized Navier-Stokes equations are solved to evaluate the (first-order) force that acts upon the particle due to this disturbance (acoustic wave). In the inviscid limit we observe that our force expression is identical to that obtained by Parmar et al., J. Fluid Mech. 699, 352 (2012), although the latter's work was limited to only small particle diameters. However we clearly see the viscous forces to depend on particle size. The overall force thus obtained is compared against DNS results. Our model is able to correctly predict the magnitude of the peak force in addition to the time at which the maximum occurs.

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