

Abstract Submitted
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Unsteady Forces on Particles in Compressible Flow¹ MANOJ PARMAR, ANDREAS HASELBACHER, S. BALACHANDAR, University of Florida — The acceleration of a body immersed in a fluid gives rise to so-called added-mass and history forces because some of the surrounding fluid is accelerated due to non-penetration condition and due to the development of the boundary layer. These forces have been studied in detail, both theoretically and numerically, for incompressible flows and spherical particles. The purpose of the present investigation is to assess the effect of compressibility on these forces. Our primary interest is in strong accelerations of particles such as by impacting shock waves. Prior work investigated analytically unsteady forces on cylinders and spheres only using acoustic approximations at vanishingly small freestream Mach numbers. We extend this prior work to finite freestream Mach numbers and acceleration rates and compute numerically the unsteady forces for imposed accelerations. We find that the freestream Mach number and the acceleration rates have a strong effect on the unsteady forces. In contrast to incompressible flow, the unsteady force is not established immediately and the quasi-steady force coefficient is dependent on the acceleration rate.

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