Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

An explicit characteristic based immersed boundary method for compressible flows[1] GREGORY SHALLCROSS, JESSE CAPECELATRO, University of Michigan — In recent years, there has been increasing interest to develop improved models for particle-laden flows and simulate complex geometries in high-speed (compressible) flow regimes. Immersed boundary (IB) methods offer the benefits of simplicity and scalability inherent to structured grids with the flexibility to handle non-conforming geometries. While IB methods are now well established for incompressible flows, additional challenges exist for compressible flows, in particular in representing boundary conditions for scalar quantities and resolving strong discontinuities due to shocks. In this talk, the characteristic based volume penalization (CBVP) method is extended and combined with a direct forcing technique within a high-order energy stable finite difference framework for both the Navier–Stokes and Euler equations. CBVP techniques typically rely on tuning parameters that result in stiff equations that require implicit solvers. Here we propose a purely explicit CBVP approach, where the parameters are chosen based on the limits of the numerical discretization. Validation and verification are performed for one-, two-, and three-dimensional steady and unsteady flow configurations. Other complex geometries are considered to demonstrate the robust nature of the method.

[1]This work was supported by a NASA Space Technology Research Fellowship. A portion of this work was supported by an Early Stage Innovations (ESI) Grant Award number: 80NSSC20K0295 under a contract with the National Aeronautics and Space Administration.

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Date submitted: 03 Aug 2020 Electronic form version 1.4