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Development of a multiscale Eulerian-Lagrangian method for high-speed multi-material flows UDAY KUMAR, University of Iowa — Explosions and combustion processes generate environments where fluid turbulence and shocks have an intimate and mutual interaction with solid materials. While there has been considerable effort to determine suitable models for low speed (i.e. incompressible and low subsonic) flows and in solid mechanics, there is sparse work of this nature in the context of compressible (particularly shocked) multi-material flows. We seek to automate the development of particle transport models and closure by employing a multi-scale approach. In order to develop multi-scale modeling capabilities for high-speed particle-laden flows, we will discuss a joint effort that brings together a macro-scale, hig–order resolution Eulerian-Lagrangian method, and a micro-scale, full-resolution, high-fidelity first principle model for direct numerical simulations of shocked flows through heterogeneous media and micro-macro coupling. The multi-scale approach is constructed in a hierarchical framework where high-fidelity DNS of particle interactions with shocked flows are employed at the micro-scale with full description of flow around resolved particles. At the macroscale the particles are modeled using Lagrangian point cloud methods. The linkage between scales is established through artificial neural networks (ANNs) trained to assimilate micro-scale physics and serve as closure models for the macro-scale simulations.

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