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A Level-set based framework for viscous simulation of particle-laden supersonic flows PRATIK DAS, Univ of Iowa, OISHIK SEN, The University of Iowa, GUSTAAF JACOBS, San Diego State University, H.S. UDAYKUMAR, The University of Iowa — Particle-laden supersonic flows are important in natural and industrial processes, such as, volcanic eruptions, explosions, pneumatic conveyance of particle in material processing etc. Numerical study of such high-speed particle laden flows at the mesoscale calls for a numerical framework which allows simulation of supersonic flow around multiple moving solid objects. Only a few efforts have been made toward development of numerical frameworks for viscous simulation of particle-fluid interaction in supersonic flow regime. The current work presents a Cartesian grid based sharp-interface method for viscous simulations of interaction between supersonic flow with moving rigid particles. The no-slip boundary condition is imposed at the solid-fluid interfaces using a modified ghost fluid method(GFM). The current method is validated against the similarity solution of compressible boundary layer over flat-plate and benchmark numerical solution for steady supersonic flow over cylinder. Further validation is carried out against benchmark numerical results for shock induced lift-off of a cylinder in a shock tube. 3D simulation of steady supersonic flow over sphere is performed to compare the numerically obtained drag co-efficient with experimental results. A particle-resolved viscous simulation of shock interaction with a cloud of particles is performed to demonstrate that the current method is suitable for large-scale particle resolved simulations of particle-laden supersonic flows.

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