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Particle-resolved direct numerical simulations of compressible flows past particles at finite Mach number and volume fraction.[1] MEHDI KHALLOUFI, GREGORY SHALLCROSS, JESSE CAPECELATRO, University of Michigan — In this study, particle-resolved direct numerical simulations of homogeneous particle suspensions are used to quantify the statistics associated with drag force and associated pseudo-turbulent kinetic energy (PTKE) over a range of volume fractions and Mach numbers. A new immersed boundary method implemented within a low-dissipative, high-order finite difference flow solver is employed to assess the budget of PTKE (drag production, viscous dissipation, and pressure strain), at the sub-particle scale to inform model closure. Particular attention is paid on the role of gas-phase compressibility and neighbor-induced velocity fluctuations on the distribution of drag forces. In addition, the budget of PTKE will be used to inform new subgrid-scale models that can be employed in Euler-Euler and Euler-Lagrange methods.

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