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Development of a Gas-Solid Drag Law for Clustered Particles Using Particle-Resolved Direct Numerical Simulation

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Abstract

Particle-resolved direct numerical simulation (PR-DNS) is used to quantify the drag force on clustered particle configurations over the solid phase volume fraction range of $0.1 \leq \phi \leq 0.35$ and the mean slip Reynolds number range of $0.01 \leq Re_m \leq 50$. The particle configurations and flow parameters correspond to gas-solid suspensions of Geldart A particles in which formation of clusters have been reported. In our PR-DNS, we use clustered particle configurations that match cluster statistics observed in experimental studies. To generate the particle configurations, we perform discrete element method (DEM) simulations of homogeneous cooling gas (HCG) systems with cohesive and inelastic particles in the absence interstitial fluid. Clustered particle sub-ensembles are then extracted from HCG simulations to match the statistics of cluster size distributions observed in experiments. These sub-ensembles are used for PR-DNS. It is found that the mean drag on clustered configurations decreases when compared to the drag laws for uniform particle configura-

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