Abstract Submitted
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Residual Terms in the Spatially Filtered Fluid Momentum Equation for a Particle–laden Suspension[1] MENGLIN NI, Department of Mechanical Engineering, Center for Multiphase Flow Research and Education (CoMFRE), Iowa State University, MOHAMMAD MEHRABADI, Illinois Rocstar, JESSE CAPECELATRO, Mechanical Engineering, University of Michigan, SHANKAR SUBRAMANIAM, Department of Mechanical Engineering, Center for Multiphase Flow Research and Education (CoMFRE), Iowa State University — Spatially filtering the disperse two-phase flow equations results in the volume-filtered Euler-Lagrange (VFEL) method that can efficiently simulate large domains, and capture a wide range of scales including mesoscale structures corresponding to particle clustering. However, spatial filtering results in unclosed residual terms in the VFEL equations which need to be modeled. These are traditionally closed using ensemble-averaged models, such as the average drag on a particle in a suspension (Capecelatro and Desjardins (2013)) for the residual filtered interphase momentum exchange term. Here we quantify the unclosed terms in the filtered momentum equation for a particle-laden suspension using particle resolved direct numerical simulation (PR-DNS). Using the indicator function approach we derive the exact interphase momentum exchange term, which differs slightly from the approximate expression given by Capecelatro and Desjardins (2013) for the interphase momentum exchange term that was based on simplifying assumptions of Anderson and Jackson (1967). PR-DNS data from statistically steady flow past a statistically homogeneous particle assembly is filtered to quantify both exact and approximate versions of the interphase momentum exchange term for different filter widths.

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