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Modeling near-wall interphase exchanges for particle-laden flows

OLIVIER DESJARDINS, JESSE CAPECELATRO, Cornell University, NATIONAL RENEWABLE ENERGY LAB COLLABORATION — In Eulerian-Lagrangian and Eulerian-Eulerian modeling approaches of dispersed multiphase flows, proper treatment of mass and momentum transfer between the phases is required to capture the correct physical behavior. Coupling often involves the volume fraction and momentum exchange term based on correlations for drag. The accuracy of these terms diminishes at regions close to walls, where key assumptions that were used in the formulation of the models are often violated. Defining particle volume fraction close to a solid boundary could require using detailed information on the distance between the surface of the particles and the wall. No-slip boundary conditions are imposed on the fluid phase while particles may slip, complicating the momentum transfer. In addition, experiments have reported enhanced lift at the walls, corresponding to values greater than what can be estimated from Saffman shear-induced models. In this study, coupling between the phases is handled in an Euler-Lagrange framework using a two-step filtering process that ensures a conservative exchange, as well as convergence under mesh refinement. A turbulent spout fluidized bed is simulated, and compared to experimental data. Different strategies are explored to properly account for the presence of the walls.

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