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DIRECT NUMERICAL SIMULATION OF FLUIDIZATION OF SOLID PARTICLES DUE TO LIFT FORCES

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Accurate numerical representation of particle-laden flows is important for fundamental understanding but also for design optimizion of complex processes. Liquid-solid flows are fundamentally different from gas-solid flows because of lower density ratio and non-negligible lubrication and lift forces on solid particles. An accurate and efficient numerical method is presented here, which covers a wide range of parameter space of fluid-solid flows. In this interface resolved model, accurate fluid-solid coupling is achieved by incorporating the no-slip boundary condition at the particle surface using an efficient 2nd-order ghost-cell immersed boundary method implemented directly at the level of the discretized fluid equations. A fixed Eulerian grid is used for solving the Navier-Stokes equations and the particle-particle and particle-wall interactions are implemented using the soft sphere collision model. Moreover, the lubrication force is included as a sub-grid scale model due to its range of influence on a smaller scale than the grid size. The particles considered in this study are non-ideal, where the particle surface has roughness and the collisions are dissipative. Finally, the validated numerical model is used to simulate fluidization phenomena due to lift. The results are compared with findings from the literature.

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