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Development of a consistent Lagrangian–Eulerian approach for particle–laden flows RAHUL GARG, Iowa State University, CHIDAMBARAM NARAYANAN, DJAMEL LAKEHAL, Swiss Federal Institute of Technology, SHANKAR SUBRAMANIAM, Iowa State University — The Lagrangian–Eulerian (LE) simulation approach for particle– laden flows represents the fluid phase as an Eulerian field while particles are tracked in a Lagrangian frame. The LE solution must satisfy a consistency condition arising from relating LE quantities to the Eulerian–Eulerian (EE) description. The standard assumption for volumetrically dilute flows ($\alpha_p \ll 1$) is to neglect the effects of volume displaced by the dispersed phase and enforce mass conservation in the fluid phase through a solenoidal fluid velocity field. Recent analysis shows that the use of this fluid–phase mass conservation equation is not justified merely based on dilute flow assumption. The goal of the study is to check whether the velocity field obtained by solving the exact fluid-mass phase conservation equation is considerably different from the current LE appproach. This is important for flows that are dilute but have locally steep gradients in the volume fraction. The test problem chosen is a particle–laden driven–cavity flow. Accurate estimation of the fluid-particle interaction force from Lagrangian particle properties is shown to be essential for ensuring consistency of the LE simulation. Accurate estimation methods to verify the consistency of LE method to EE description also extend the LE approach to dense particle-laden flows.

Rahul Garg
Iowa State University

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