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Direct Simulation of Particulate Flows with a 3D Explicit Finite-Difference Scheme HOWARD HU, University of Pennsylvania, ANDREW PERRIN, UNIVERSITY OF PENNSYLAVIA TEAM — A 3D explicit finite difference scheme has been developed to simulate moderately dense particulate flows at intermediate Reynolds numbers. The scheme solves the compressible Navier-Stokes equations at small Mach numbers to approximate the solution at the incompressible limit. It explicitly marches the fluid velocity and density in time without inverting any matrices. The solid rigid particles are moved according to the hydrodynamic forces and moments acting on them by the fluid. A spectral expansion method is implemented to exactly satisfy the no-slip boundary condition on the particle surface, such that the scheme is able to achieve good accuracy on coarse grids. The method has been validated by comparison to an implicit finite element particle solver, and by direct comparison with experiments. Using this scheme, we calculate the effective viscosity of a sheared suspension as a function of the particle volume fraction.

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