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DNS of Sheared Particulate Flows with a 3D Explicit Finite-Difference Scheme[1] ANDREW PERRIN, University of Pennyslvania, HOWARD HU, University of Pennsylvania — A 3D explicit finite-difference code for direct simulation of the motion of solid particulates in fluids has been developed, and a periodic boundary condition implemented to study the effective viscosity of suspensions in shear. The code enforces the no-slip condition on the surface of spherical particles in a uniform Cartesian grid with a special particle boundary condition based on matching the Stokes flow solutions next to the particle surface with a numerical solution away from it. The method proceeds by approximating the flow next to the particle surface as a Stokes flow in the particle's local coordinates, which is then matched to the finite difference update in the bulk fluid on a "cage" of grid points near the particle surface. (The boundary condition is related to the PHYSALIS method (2003), but modified for explicit schemes and with an iterative process removed.) Advantages of the method include superior accuracy of the scheme on a relatively coarse grid for intermediate particle Reynolds numbers, ease of implementation, and the elimination of the need to track the particle surface. For the sheared suspension, the effects of fluid and solid inertia and solid volume fraction on effective viscosity at moderate particle Reynolds numbers and concentrated suspensions will be discussed.

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