Finite Element Simulation of Particulate Flows

Howard Hu

University of Pennsylvania

Abstract: The talk will describe a finite element scheme for direct numerical simulations of fluid-solid system. For those simulations, local flow field around moving particles and particle?particle and particle?boundary interactions are resolved numerically without modeling. The hydrodynamic forces and moments acting on each of the solid particles are directly computed from the fluid flow, and the motion of the fluid flow and solid particles are fully coupled. The methods to be described are targeted for flows of fluid-solid systems at finite particle Reynolds numbers. The scheme is based on ALE (Arbitrary Lagrangian-Eulerian) Particle-Mover. The ALE Particle-Mover uses a technique based on a combined formulation of the fluid and particle momentum equations, together with an Arbitrary Lagrangian-Eulerian (ALE) moving unstructured finite element mesh technique to deal with the movement of the particles. The method has been used to solve particle motions in both Newtonian and viscoelastic fluids under two-dimensional and three-dimensional flow geometries. It also handles particles of different sizes, shapes and materials.