Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

Simulation of Motion and Deformation of Elastic Objects in Flows

HOWARD HU, University of Pennsylvania — We present a numerical technique that simulates the dynamics of flexible bodies in moving fluids. We are interested in studying the motion and deformation of elastic particles, for example biological cells, which are flexible and liable to undergo large deformations along with translation and rotation. Our numerical technique uses the moving mesh finite element method to solve the initial value problem of moving objects. The movement and the deformation of the objects are handled with an Arbitrary Lagrangian Eulerian (ALE) scheme. The numerical scheme solves the equations of motion for an incompressible elastic solid (with non-linear strain tensor) inside the particles, and those for Newtonian fluids for the liquid phase. The coupling between the solid and liquid phase is enforced by assuming that the material velocity and the stress are continuous across the interface between the solid and the liquid. In addition, the displacement field inside the particles is solved, and its gradient in the form of Almansi strain tensor is used to evaluate the stress inside the particles. This numerical scheme is demonstrated to be stable and is capable to resolve large deformations of the particles.

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Date submitted: 02 Aug 2007 Electronic form version 1.4