Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

Direct Numerical Simulation (DNS) of Suspensions in Spatially Varying Electric Fields M. JANJUA, SAI NUDURUPATI , PUSHPENDRA SINGH, New Jersey Institute of Technology, NADINE AUBRY, Carnegie Mellon University — We have developed a new direct numerical (DNS) scheme to simulate the motion of dielectric particles suspended in a dielectric liquid in uniform and nonuniform electric fields. The motion of particles is tracked using a distributed Lagrange multiplier method (DLM) and the electrostatic forces acting on the particles are calculated by integrating the Maxwell stress tensor (MST) over their surfaces. The MST is deduced from the electric potential which, in turn, is obtained by solving the electrostatic problem. We show that the error in the trajectories given by the point dipole method, which assumes that the presence of particles does not alter the imposed electric field, increases as the distance between the particles decreases. In addition, the error is relatively large when the particle radius is comparable to the domain size, and also increases as the difference between the dielectric constants of the particles and the fluid increases. The final steady positions of the particles, including the orientations of the line joining their centers relative to the electric field direction, obtained by using the MST method are different from those resulting from the point dipole method.

Nadine Aubry
Carnegie Mellon University

Date submitted: 03 Aug 2007 Electronic form version 1.4