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Multi-scale Numerical Simulations of Magnetic Fluids[1] PHILIP YECKO, Montclair State University, New Jersey, RUBEN SCARDOVELLI, Universita di Bologna, Italy, HOLLY TIMME, Virginia Tech, A. DAVID TRUBATCH, Montclair State University, New Jersey — We develop, validate and apply a new Height Function (HF) based Volume of Fluid (VOF) code to the simulation of ordinary and magnetic fluids in two-dimensional and three-dimensional axisymmetric geometries. The HF algorithm provides second-order accurate curvature and interface normal formulation, improving surface tension and magnetic stress accuracy. Motivated by our recent experimental results on ferrofluid rheology dominated by field-induced magnetic particle threads we have applied this code to the meso-scale problem of the interaction of flow with threads. The multiscale approach allows us to model solid particles embedded in bulk fluid, approximating the magnetic particle threads –which are several microns (thousands of magnetic nanoparticles) wide– by means of a chain of several (from 3 to 11) pseudo-particles with magnetic properties intermediate between the ferrofluid and the magnetic particles. In the presence of an imposed uniform field, these pseudo-particles form chains (threads) along the field direction. By placing a single pseudo-particle chain in a uniform flow, simple shear flow and/or a pure straining flow we can directly examine the equilibrium chain orientation and hydrodynamic stresses which characterize the interaction between thread and shear. Our simulation results allow us to compute the energy dissipation and thus model the enhanced drag effected by a thread on fluid flow.

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