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Numerical study of the particle motion with 6 degree of freedom in a flow ERICH ESSMANN, PEI SHUI, University of Edinburgh, RAMA GOVINDARAJAN, International Centre for Theoretical Sciences, TIFR, STEPHANE POPINET, Institut Jean le Rond d'Alembert Universit Pierre et Marie Curie, PRASHANT VALLURI, University of Edinburgh — Traditionally solid-fluid simulations used an incomplete physics model, with only a one-way coupling between the solid and fluid domains. The basis for our work is Gerris, an open-source fluid solver, (Popinet et al, 2003). Its adaptive Cartesian mesh scores over traditional algorithms in convergence. We augmented Gerris with a fully-coupled solver for fluid-solid interaction with 6 degrees-of-freedom (6DOF). This was done by using the immersed boundary method, which allows the solid boundary to move or deform while requiring few mesh adaptations. Our new solver, Gerris Immersed Solid Solver (GISS), accounts for collisions with a novel composite contact model (Ness & Sun, 2016) for solid-solid interactions. We have validated our methodology against published experimental data. We are thus enabled to reveal some deep correlations between the hydrodynamic force and particle motion in inviscid flow. (Aref, 1993) had shown that the dynamics should be chaotic under certain conditions and our inviscid results agree with these findings. Our analysis includes analytic solutions and recurrence quantification (Marwan et al, 2007), to quantify the chaos and to evaluate the nature of that behaviour.

Erich Essmann
University of Edinburgh

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