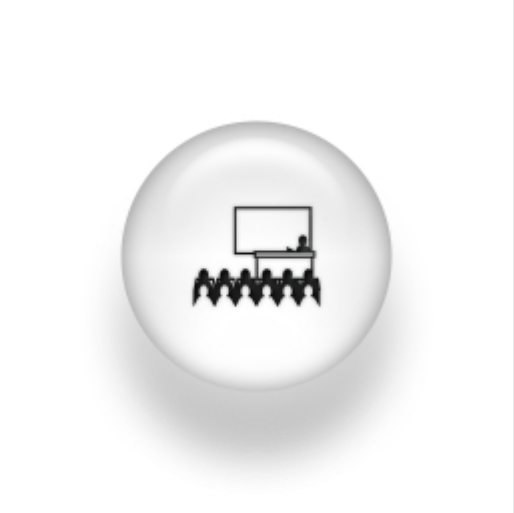
A new tool for particle hydrodynamics at different scales

Wednesday, 19th October 2011. 12:00-13:00



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ABSTRACT:
In this informal talk I will present a new algorithm for particle hydrodynamics recently developed in the Dept. Fisica Teorica de la Materia Condensada (UAM). It is ideally suited to solve colloidal or polymeric suspensions at small Reynolds or even dispersions of larger particles in turbulent flow. The general framework consists on solving the solvent (fluctuating) hydrodynamics in an Eulerian mesh, while the solute Lagrangian dynamics are solved in continuum space. The scheme is quite general, also allowing for fluid-structure interactions, however I will focus on the so called “pointparticle” representation, where each particle is determined by an effective volume and the dynamics of its center of mass translation (rotation can also be added). In these kind of schemes, the force between particle and fluid have been usually assumed to be frictional and of the same form of the Stokes drag. However, such approximation limits the applicability of the method to times larger than the friction response (i.e. slow forcing frequencies) and moreover it is only valid for particles presenting some fluid slip at their surface. We present an alternative approach which obtains the fluid/particle force by enforcing the no-slip condition on the averaged fluid velocity at the particle domain. In doing so, particle/fluid momentum is exchanged instantaneously and inertia is taken into account. We are able to describe acoustic forces on colloidal particles, and grasp the effects of the finite size of the particle in the flow. Thermal fluctuations are also properly solved, as there is no extra dissipative channel associated to the particle friction. The code is written in CUDA and it is now running in local GPU’s. Some information on the (wonderful) speed up of this architecture shall also be given. Possible generalizations and applications of the method shall be discussed.

F. Balboa and J. Bell and R. Delgado-Buscalioni and A. Donev and T. Fai and B. Griffit and C. S. Peskin. Staggered Schemes for Fluctuating Hydrodynamics, arXiv:1108.5188v1, (submitted, 2011)

F. Balboa and R. Delgado-Buscalioni, Particle Hydrodynamics using Hybrid Models: from Molecular to Colloidal Fluids, Particles 2011 (to appear)
F. Balboa, I. Pagonabarraga and R. Delgado-Buscalioni, Inertial coupling for point particle fluctuating hydrodynamics, (submitted, 2011).