Modeling of fluctuations in algorithm refinement methods

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We consider an approach for hybrid algorithms based on an adaptive mesh refinement paradigm. In this approach a hierarchical adaptive mesh refinement framework is used to embed a particle algorithm within the finest grid of the mesh hierarchy. The coupling between the particle region and the overlaying continuum grid is functionally equivalent to that between fine and coarse levels of mesh refinement. In this presentation we consider the role of fluctuations in this type of hybrid algorithm. In particular, we discuss the impact of fluctuations on the dynamics. We demonstrate that it is necessary to include a stochastic forcing term to model fluctuations at the continuum level to accurately capture the correct behavior of the system. We illustrate the role of fluctuations on two model problems. In the first we consider an excluded random walk model whose mean field behavior is given by the viscous Burgers' equation. The second example discusses a hybrid of direct simulation Monte Carlo with the compressible Navier Stokes equations. For the Navier Stokes equations we include stochastic fluxes as given by Landau-Lifshitz fluctuation Navier-Stokes equations. We will also discuss some of the issues in designing numerical methods for systems of this type.

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