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New Approaches for Microscopic Hydrodynamics for the Study of Fluid-Structure Interactions Subject to Thermal Fluctuations[1] PAUL ATZBERGER, UC Santa Barbara — Many problems in fluid mechanics involve the interaction of a hydrodynamic flow with an elastic structure. Recent advances in biology and engineering further motivate such studies at small length and time scales. At such scales traditional continuum mechanics descriptions must be augmented to take into account microscopic phenomena, such as spontaneous thermal fluctuations. This presents a variety of challenges both in formulating appropriate physical models and in computational simulation. In the context of fluid-structure interactions, additional challenges arise from the often subtle interplay between elastic mechanics, hydrodynamic coupling, and thermal fluctuations. In this talk, we present a set of new approaches which address central mathematical, physical, and computational issues for how to incorporate in the description of such fluid-structure interactions thermal fluctuations. We also address important numerical issues in the approximation of the resulting stochastic partial differential equations. We also discuss results for specific illustrative applications including studies of polymeric fluids, vesicles, gels, and lipid bilayer membranes.

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