**TEMPLE UNIVERSITY**
Department of Mathematics

# Applied Mathematics and Scientific Computing Seminar

Room 617 Wachman Hall

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## Some Problems in Numerical Methods for Surface Tension

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**Abstract.** Consider two fluids separated by an interface. Surface tension arises on the interface of two immiscible fluids as a result of the asymmetry in attractive forces between molecules of two fluids, which is the origin of the surface excess energy. For the liquid to minimize its energy state, the interface should then assume the smoothest shape possible. When deriving boundary conditions appropriate for a fluid-fluid interface, surface tension gives rise to a normal stress across the interface linearly proportional to the local curvature and a tangential stress associated with gradients in the surface tension.

A time-explicit discretization of the surface tension has a stringent stability constraint. Here, I introduce a semi-implicit scheme, based on an Eulerian description of the interface, and show that the discretization scheme is equivalent to adding a diffusion, supported by the interface, that would lead to stabilization. I will then present a numerical scheme we devised to include surface gradients into our Eulerian interface description, to discretize the Laplace-Beltrami operator that enters when formulating the surface diffusion. I demonstrate improvement in the stability and discuss how the explicit update of the Eulerian description still poses a major numerical challenge. I will also point out the opportunities for the construction of efficient solvers for the associated system of equations resulted from the semi-implicit numerical scheme.