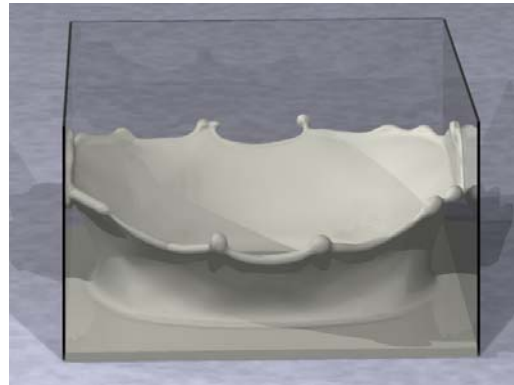


## Numerical Methods for Simulating Fluids and Solids

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This talk will start with a brief introduction of the level set method for handling interfaces in fluid flows followed by a discussion of the particle level set method, which is a newly proposed technique for alleviating the inherent numerical dissipation in the level set method that leads to a nonphysical loss of mass. Then we will briefly discuss the ghost fluid method which allows for the treatment of boundary conditions at multimaterial interfaces. In particular, we will consider the extensions to this method that allow for generalized boundary condition capturing for the Poisson equation. The version of the method that handles jump conditions can be used to simulate multiphase incompressible flow and incompressible flame discontinuities, while the version that handles Dirichlet boundary conditions allows one to solve Stefan problems with second order accurate symmetric or fourth order accurate nonsymmetric discretizations. This later technique is relevant for free surface flows as well, and we will show examples of fluid simulations on both uniform and adaptive grids.



Then we will turn our attention to solids briefly discussing meshing, collisions, etc. before focusing our attention on two new algorithms. The first is a technique that relies on a robust SVD of the underlying Lagrangian mapping in order to treat finite elements that have collapsed or inverted under high stress. This is a simple alternative to ALE, mesh generation and untangling techniques. The second is a discrete virtual node algorithm that provides the degrees of freedom necessary to topologically separate a mesh along arbitrary (possibly) branching curves to second order accuracy. Examples include elasticity, plasticity and fracture for both shells and volumes with isotropic and anisotropic materials including both active and passive components.

