Numerical Methods for Optimal Control Problems governed by incompressible two-phase flows

Benjamin Tews, Universität Kiel

We consider an optimal control problem subject to incompressible, immiscible two-phase flows. The equations of motion in each fluid are given by the incompressible Navier-Stokes equations with different density constants and additional surface tension forces on the interface.

There are different possibilities to track or capture the interface propagation in time.
In this talk, we consider two widely used interface models, namely the Allen-Cahn model and a level set approach, which are both capable of simulating topological changes such as breakup and coalescence.
However, there are different problems associated with both models. The level set method needs additional re-initialization procedures to keep the interface thickness uniform. These procedures do not correspond to a Galerkin formulation and may affect the convergence of gradient based optimization solvers. The Allen-Cahn model keeps the interface thickness uniform, but violates the mass conservation law. Here, adaptive finite elements are applied to resolve the interface and reduce the mass loss.