Finite element techniques for the simulation of two-phase incompressible flows

Arnold Reusken
Chair for Numerical Mathematics, RWTH-Aachen

Abstract
We consider a flow problem with two different immiscible incompressible newtonian phases (fluid-fluid or fluid-gas). A standard model for this consists of the Navier-Stokes equations with a viscosity and density that are discontinuous across the interface and with a localized force at the interface that describes surface tension effects. This fluid dynamics model can be coupled with a model for mass transport between the phases and a model for transport of surfactants on the interface. There are several issues that are very challenging in view of an efficient and accurate numerical simulation of such models. We briefly address some of these. One of these issues will be treated in more detail, namely a finite element method for the accurate discretization of the mass transport equation. This method is based on a space-time discontinuous finite element method combined with an appropriate XFEM ("extended finite element") space and a Nitsche approach for handling the Henry condition at the interface.

[1] www.igpm.rwth-aachen.de/DROPS
[2] S. Gross, A. Reusken, Numerical Methods for Two-phase Incomprssible Flows Springer SCM Vol. 40, 2011.