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An Unfitted Discontinuous Galerkin Method for Two-Phase Navier-Stokes Flow

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Models for multiphase flow in porous media on the continuum scale have to provide descriptions for phenomena like hysteresis and immobile residual water saturation. These are essentially determined by the pore geometries of the media. Hence, numerical simulations of flow processes on the pore scale are of fundamental importance for model understanding and development. For the science of porous media, such simulations are significant only if they are applicable to domains that represent at least a representative volume element. This however, implies both a minimum domain size and a minimum spatial resolution. This results in a vast numerical effort, even for state-of-the-art scientific computing.

The Unfitted Discontinuous Galerkin method was specifically designed for applications in complicated domains and has been successfully applied to the single-phase Stokes problem within pore scale geometries. As the simulation of Navier Stokes flow with more than one phase entails the curvature dependent movement of phase boundaries, the extension of the UDG method to multiphase flow is not straight-forward. We present a UDG method for two-phase flow without a interface-solid contact line and point out a path to efficient multiphase flow simulations on the pore scale.