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An accurate and efficient scheme for micro scale simulations of multi phase flow

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Pore scale simulations of multi phase flow in porous media present a promising approach in the development and verification of continuum scale models as well as in the understanding of the underlying processes of flow phenomena like hysteresis or the peculiarities of the capillary fringe. However, the applicability of modern numerical models is still significantly restricted by the vast computational effort related with complicated geometric domains that comprise at least a representative volume element. This implies both a minimum domain size and a minimum spatial resolution.

We present an unfitted discontinuous Galerkin discretization scheme for multi phase flow which allows the solution of the Navier Stokes equations within multiple transient domains. The support of the base functions is restricted to the domain boundaries which allows an accurate representation of both pressure and velocity interface conditions along the interface boundaries. The creation of the triangulation geometries is both highly efficient and sufficiently accurate to allow the simulation of surface tension forces depending on the interface curvature.