11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

IMAGE-BASED SIMULATIONS USING THE UNFITTED DG METHOD

Christian Engwer

Institute for Computational und Applied Mathematics, University of Münster,
christian.engwer@uni-muenster.de, http://wwwmath.uni-muenster.de/u/christian.engwer/

Key words: *Unfitted Discontinuous Galerkin, Higher order Finite Element Methods, Cut-Cell Meshes, Multi-Physics Problems*

Modern imaging techniques yield high quality information of complex shaped microscopic structures. The unfitted discontinuous Galerkin method (UDG) offers an approach to solve PDEs on implicitly described sub-domains, e.g. obtained using micro-CT imaging, without the need to construct a geometry-resolving mesh. The domain description uses a level-set based formulation; still sub-domain boundaries are incorporated explicitly. While UDG allows an easy application to multi-domain problems, these techniques are not sufficient for many biological application, which involve coupling of volume and surface processes.

We discuss extensions of the UDG method to apply it to multi-physics settings. We discuss coupling to processes on manifolds and moving domains. UDG constructs basis functions from a simple background mesh and restrict the support according to the actual sub-domain boundaries, i.e. the implicitly prescribed domain. Using the explicit reconstruction of the implicit sub-domain boundary it is possible to couple level-set based surface problems on the interface with sub-domain problems.

Applications cover a wide range of applied problems, especially from medicine and biology. Recent efforts were made to incorporate the UDG method into a general multi-physics extension to the DUNE PDELab library.