The isogeometric finite cell method with ghost-penalty stabilization for incompressible viscous flow problems

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ABSTRACT

In the context of the isogeometric finite cell method [1, 2], we study the applicability of ghost-penalty type stabilization techniques [3] to incompressible viscous flow problems. The Stokes equation is considered as a prototype model. The motivation of this study lies in the fact that common approaches such as (isogeometric) Babuska-Brezzi stable velocity-pressure pairs as well as Galerkin-least square type stabilization techniques, when applied to unfitted settings, exhibit local pressure oscillations closed to the cut boundaries [4]. By appropriately augmenting with ghost-penalty stabilization techniques, we investigate the performance of these methods in terms of stability and accuracy. Dirichlet boundary conditions are weakly imposed by a Nitsche-type method. Numerical experiments are performed for both Stokes and viscous-dominated Navier-Stokes problems. An application to fluid flow in porous media with CT scan-based data in 3D is also illustrated.

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