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A Cut Finite Element Method for the Stokes Problem on Anisotropic Background Meshes

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In this contribution, we present a Cut Finite Element Method (CutFEM) for solving the incompressible Stokes' equations on anisotropic background meshes. With CutFEM [1], the physical domain of interest is immersed in a background mesh. Up until now, the elements of the background mesh have been assumed to be isotropic, so that the width of the elements is approximately the same in each coordinate direction. However, if the physical domain is thin, or if boundary layers are present, anisotropic background meshes are needed. Such anisotropic meshes can be advantageous in the computational modelling of for instance ice sheets and glaciers [2].

Our approach is based on equal order bilinear elements stabilized with a Continuous Interior Penalty (CIP) method [3] to circumvent the inf-sup condition. Guided by the stability and a priori error analysis of the proposed scheme, we demonstrate how to design suitable Nitsche terms, ghost penalty terms and CIP terms when the background mesh is highly anisotropic. Finally, we present numerical experiments comparing errors of a standard CutFEM formulation and the anisotropic formulation for a thin body immersed in an anisotropic background mesh.

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