Unfitted HHO method stabilized by polynomial extension for elliptic interface problems

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In this work, we propose the design and the analysis of a hybrid high-order (HHO) method on unfitted meshes. HHO methods rely on a pair of unknowns, combining polynomials attached to the mesh faces and the mesh cells [2]. In the unfitted framework, the interface can cut through the mesh cells in a very general fashion, and the polynomial unknowns are doubled in the cut cells and the cut faces [1]. In order to avoid the eventual ill-conditioning issues caused by the presence of small cut cells, the previously proposed unfitted HHO schemes were based on a cell agglomeration procedure. Here, the proposed formulation relies on polynomial extensions, a paradigm mainly explore in the continuous Galerkin (cutFEM) framework and extended to HHO methods in the present work. The idea with the polynomial extension is to use the degrees of freedom from the uncut or the well cut cells in the ill cut cells. In that way a modification of the stencil of the method is carried out while preserving the possibility of static condensation by maintaining a global problem coupling only the face unknowns. First theoretical and numerical results will be presented.

[1] E. Burman, M. Cicuttin, G. Delay, A. Ern. *An unfitted hybrid high-order method for elliptic interface problems*. SIAM Journal on Scientific Computing, **43(2)**, 2021.

[2] D. A. Di Pietro, A. Ern. *A hybrid high-order locking-free method for linear elasticity on general meshes*. Comput. Meth. Appl. Mech. Engrg., **283**, 2015.

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