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EXTENDED HYBRIDIZABLE DISCONTINUOUS GALERKIN (X-HDG) FOR BIMATERIAL PROBLEMS

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High-order Discontinous Galerkin methods are nowadays very popular in the CFD community. DG methods inherit the advantages of Finite Volume methods (stability through numerical fluxes, local conservation, etc) but they allow for the use of high-order approximations with a straight-forward implementation of p-adaptivity. Among all DG methods, the novel Hybridizable Discontinuous Galerkin method (HDG [1]) has proved outstanding efficiency. The hybridization process allows reducing the degrees of freedom to the nodes in the element faces (sides in 2D), similarly to static condensation in CFE.

On other hand, the eXtended Finite Element method (X-FEM [2]) is a clever strategy to treat the discontinuities arising at interfaces in bimaterial problems. Interfaces are usually represented as the 0-level set of a signed distance function, the solution is enriched to represent weak or strong discontinuities across interfaces, and numerical integration is adapted to take care of the discontinuous approximation inside elements.

This work proposes a formulation for the efficient solution of bimaterial problems, based on these two advanced discretization techniques: the eXtended Hybridizable Discontinuous Galerkin (X-HDG) method. The X-FEM philosophy is introduced in an HDG formulation. The solution is enriched with Heaviside functions and, in the case of weak discontinuities, continuity is weakly imposed, emulating the imposition of continuity across element boundaries in standard HDG.

[1] B. Cockburn, J. Gopalakrishnan, R. Lazarov. "Unified hybridization of discontinuous Galerkin, mixed, and continuous Galerkin methods for second order elliptic problems", SIAM JNA 2009.

[2] T.P. Fries, T. Belytschko, "The extended/generalized finite element method: An overview of the method and its applications", IJNME 2010.