THE MULTISCALE HYBRID-MIXED FINITE ELEMENT METHOD IN POLYGONAL MESHES

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Abstract. In this talk the recent extension of the Multiscale Hybrid-Mixed (MHM) method, originally proposed in [1], to the case of general polygonal meshes (that can be non-convex and non-conforming as well) will be presented. We present new stable multiscale finite elements such that they preserve the well-posedness, super-convergence and local conservation properties of the original MHM method under mild regularity conditions on the polygons. More precisely, we show that piecewise polynomial of degree $k-1$ and k, $k \geq 1$, for the Lagrange multipliers (flux) along with continuous piecewise polynomial interpolations of degree k posed on second-level sub-meshes are stable if the latter is refined enough. Such one- and two-level discretization impact the error in a way that the discrete primal (pressure) and dual (velocity) variables achieve super-convergence in the natural norms under extra local regularity only. Numerical tests illustrate theoretical results and the flexibility of the approach.

Keywords: Multiscale finite element method; hybrid formulation; polygonal mesh; optimal convergence.

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References

[1] R. Araya, C. Harder, D. Paredes, and F. Valentin: Multiscale hybrid-mixed method. SIAM *Journal on Numerical Analysis*, 51(6), 3505–3531, (2013).

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