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A local projection stabilization of fictitious domain method for elliptic boundary value problems

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ABSTRACT

The fictitious domain methods is a technique which allows to use regular structured meshes on a simple shaped fictitious domain containing the real domain. Generally, this technique is used for solving elliptic problems in domains with unknown or moving boundary without having to build a body fitted mesh. In this paper, we perform a study similar to [1] for a new stabilization technique applied to the fictitious domain method inspired by the X-FEM introduced in [1], [2], [3]. The principle of this new stabilization technique is to penalize the difference of the multiplier with its projection on some pre-defined patches. The advantage of this method is of at least threefold: the method is fully consistent, their is no use of another mesh than the (possibly cartesian) one of the fictitious domain and the additional term concerns only the multiplier and is not model dependent such as the Barbosa-Hughes stabilization technique. In this work we present theoretical convergence analysis of our new stabilization technique. We also validate this result by two and three-dimensional numerical experiments and we make comparison with the use of Barbosa-Hughes stabilization technique.

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