PARTIALLY PENALIZED IMMERSED FINITE ELEMENT METHODS FOR ELLIPTIC INTERFACE PROBLEMS

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Abstract

This article presents new immersed finite element (IFE) methods for solving the popular second order elliptic interface problems on structured Cartesian meshes even if the involved interfaces have nontrivial geometries. These IFE methods contain extra stabilization terms introduced only at interface edges for penalizing the discontinuity in IFE functions. With the enhanced stability due to the added penalty, not only can these IFE methods be proven to have the optimal convergence rate in an energy norm provided that the exact solution has sufficient regularity, but also numerical results indicate that their convergence rates in both the H-1-norm and the L-2-norm do not deteriorate when the mesh becomes finer, which is a shortcoming of the classic IFE methods in some situations. Trace inequalities are established for both linear and bilinear IFE functions that are not only critical for the error analysis of these new IFE methods but are also of a great potential to be useful in error analysis for other related IFE methods.

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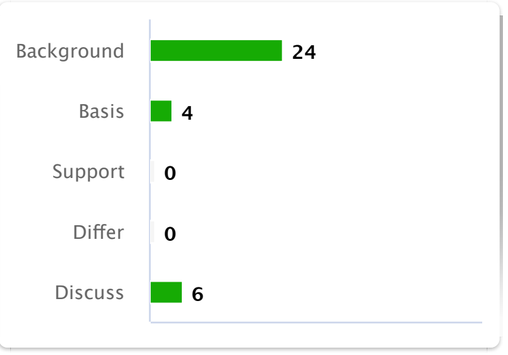

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