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A generalized isogeometric analysis of elliptic eigenvalue and source problems with an interface. (English) Zbl 07474408

Summary: The $C^0$ stable generalized finite element methods (SGFEM) were recently developed for the elliptic source and eigenvalue problems with interfaces. This paper generalizes the SGFEM construction from its underlying $C^0$ finite element basis to isogeometric analysis (IGA) with $C^{p-1}$ B-spline basis. The main challenge is how to construct globally (except where at the interfaces) $C^{p-1}$ enriched functions while restraining the resulting condition number from faster growth. A technique based on transformations between the B-splines and the Bernstein-Bézier polynomials is applied to meet the $C^{p-1}$ continuity requirement for enriched functions of arbitrary degree, and ensure good conditioning when the underlying IGA space is linear or quadratic. We establish the optimal error convergence of the approximate solutions for the elliptic source and eigenvalue problems with an interface for arbitrary degree. We verify our theoretical findings in various examples including both source and eigenvalue problems. We also make comparisons of the method with the SGFEM on computational time efficiency, scaled condition numbers(SCN), spectrum approximation and error convergences.

MSC:
65Nxx Numerical methods for partial differential equations, boundary value problems
74Sxx Numerical and other methods in solid mechanics
41Axx Approximations and expansions

Keywords:
SGFEM; isogeometric analysis; B-splines; eigenvalue problem; interface

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References:
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