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Projection and Transfer Operators in Adaptive Isogeometric Analysis with Hierarchical B-Splines

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Abstract

We present projection methods and transfer operations required for adaptive mesh refinement/coarsening in problems with internal variables. We extend the results of Hennig et al. 2016 on Bézier extraction of truncated hierarchical B-splines and its application to adaptive isogeometric analysis. It is shown that isogeometric analysis improves the performance of transfer operations as already the coarsest mesh represents the exact geometry and the hierarchical structure allows for quadrature free projection methods. We propose two different local least squares projection methods for field variables and compare them to existing global and semi-local versions. We discuss the application of two different transfer operators for internal variables. An alternative new operator inspired by superconvergent patch recovery is also proposed. The presented projection methods and transfer operations are tested in benchmark problems and applied to phase-field modelling of spinodal decomposition and brittle and ductile fracture.

Keywords: Least squares projection, Isogeometric Analysis, Adaptivity, Refinement, Coarsening, Truncated hierarchical B-splines, Phase-field modelling

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