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Adaptive isogeometric methods with optimal convergence rates

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The CAD standard for spline representation in 2D or 3D relies on tensor-product splines. To allow for adaptive refinement, several extensions have emerged, e.g., analysis-suitable T-splines, hierarchical splines, or LR-splines. All these concepts have been studied via numerical experiments. However, so far there exists only little literature concerning the thorough analysis of adaptive isogeometric finite element methods (IGAFEMs). [1] investigates linear convergence of an IGAFEM with truncated hierarchical B-splines, where optimal convergence of the proposed algorithm was only recently proved in [2].

This talk is based on our recent work [3]. We consider an adaptive IGAFEM for second-order linear elliptic PDEs. We employ hierarchical B-splines. We propose a refinement strategy to generate a sequence of locally refined meshes and corresponding discrete solutions, where adaptivity is driven by some weighted-residual *a posteriori* error estimator. The adaptive algorithm guarantees linear convergence of the error estimator (or equivalently: energy error plus data oscillations) with optimal algebraic rates. Unlike our strategy [3], the algorithm of [1, 2] was designed for truncated hierarchical B-splines only and the use of hierarchical B-splines may lead to non-sparse Galerkin matrices. Further, the analysis of [2] which appeared independently of [3] is restricted to symmetric PDEs.

Similar results were also obtained for an adaptive 3D boundary element method in [4].

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