Adaptive isogeometric analysis on trimmed domains in the context of Kirchhoff-Love shells.

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ABSTRACT

Isogeometric Analysis (IGA) [1] has been a thriving area of research since its introduction in 2005, aiming at closing the gap between design and analysis. In Computer Aided Design (CAD) the standard representation of shapes is obtained via trimmed surfaces, which allows for an easy description of complex geometries by performing boolean operations.

However, trimming yields severe challenges in the context of a smooth Design-Through-Analysis work flow and the proper treatment of trimmed models has been one of the main focus of research in the IGA community in recent years [2].

Moreover, due to the tensor product nature of IGA, local refinement is a pivotal area of research as well. Indeed, how to properly capture sharp features in the solution and how to trigger an adaptive algorithm to resolve those features, are still wide open questions in mechanical problems.[3]

In this contribution, we discuss a novel a-posteriori error estimator for elliptic problems defined on a trimmed domain. In particular, we focus on the Kirchhoff-Love shell formulation. This method is computationally cheap and does not require the evaluation of the residual in a strong sense, which in general involves the computation of high order derivatives of shape functions. Specifically, expanding on the work presented in [4], we develop an adaptive algorithm for elliptic partial differential equations on trimmed geometries, which is simple and performs well in steering adaptive simulations. Through several numerical examples on both smooth and singular benchmarks we show the reliability and efficiency of the proposed method. Finally, we demonstrate the applicability of our strategy to the simulation of complex trimmed structures of industrial relevance.

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