An Error-estimate-based Adaptive Integration Scheme For Immersed Isogeometric Analysis

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ABSTRACT

Finite Cell Method (FCM) – an immersed finite element method introduced by Rank and co-workers [2] – together with Isogeometric analysis (IGA) – a spline-based finite element framework proposed by Hughes et al. [1] – has been applied successfully in various problems in solid mechanics, in image-based analysis [3], fluid-structure interaction and in many other applications.

A challenging aspect of the isogeometric finite cell method is the integration of cut cells. In particular in three dimensional simulations the computational effort associated with integration can be the critical component of a simulation. A myriad of integration strategies has been proposed over the past years to ameliorate the difficulties associated with integration, but a general optimal integration framework that suits a broad class of engineering problems (particularly in 3D) is not yet available.

In this contribution we will investigate the accuracy and computational effort of the octtree integration scheme [4], which in this study is supplemented with a triangulation procedure at the lowest level of bisectioning [3] to construct an explicit approximation of the geometry. We study the contribution of the integration error using the theoretical basis provided by Strang's first lemma. Based on this study we propose an error-estimate-based adaptive integration scheme for immersed isogeometric analysis. Additionally, we will apply and investigate the proposed integration technique to flow problems.

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