

Application of immersed boundary methods in the context of image-based simulations

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ABSTRACT

It has been shown that immersed boundary methods—such as the Finite Cell Method—can be applied effectively in the context of Isogeometric Analysis of trimmed geometries [1]. One advantage of FCM is that it does not necessarily need an explicit geometric description but also works on implicitly defined models or even voxel-based geometries. This property allows for simulations on domains stemming from volumetric imaging [2] or CSG models [3]. Recently, it was shown that the efficiency and accuracy of FCM can be greatly improved by applying advanced integration techniques instead of standard spacetrees for the integration of cut elements [4].

In this contribution we present a multi-stage procedure which aims at combining the advantageous features of FCM with photo-based shape measurement techniques. The proposed method progressively transforms the pixel data available on the images through multiple steps towards an analysis-suitable discretisation. This way, an almost seamless connection between photogrammetric reconstructions and high order numerical simulations is established. We demonstrate through numerical examples how the proposed pipeline is able to address problems encountered in common engineering practice.

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