Isogeometric Analysis with Trimmed CAD Models

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The treatment of trimmed CAD models is a key challenge regarding the interaction of CAD and numerical simulations. These models are ubiquitous in current CAD since trimming procedures provide the basis for fundamental geometric operations such as surface-to-surface intersections.

There are two essential problems: (i) trimming is primarily a visualization technique and (ii) it cannot be performed exactly. In other words, the related concepts are not designed for analysis purposes and lead to approximation errors within CAD models. The latter results in gaps and overlaps between the objects' surfaces. These inaccuracies are well-hidden from users, but can yield severe problems in isogeometric simulations, mesh generation, and other applications that receive CAD data [1].

The direct application of trimmed CAD models to an isogeometric analysis is presented. It is demonstrated that these models can lead to ill-conditioned system matrices. This issue is resolved by combining so-called extended B-splines [2] with a local refinement procedure [3]. The proposed approach modifies the spline basis in the vicinity of trimmed areas and can be applied Galerkin and collocation methods. The numerical examples are carried out by an isogeometric boundary element method.

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References

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