Automatic conversion of complex boundary representations to analysis-suitable shell models

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ABSTRACT

Creating new or converting existing computer-aided design (CAD) models suitable for isogeometric analysis (IGA) is a challenging task that often represents a bottleneck in concurrent engineering design pipelines. To overcome this difficulty, we have developed a software tool that converts CAD designs created by traditional means to analysis-suitable geometries. In particular we focus on complex boundary representations (B-reps) used to define shell structures. The initial B-reps often comprise several hundreds of patches and are non-watertight. Also, the parameterization of the underlying patches is often impractical from the computational analyst perspective.

Our tool is capable of automatically converting B-rep data to four-sided watertight patches in three steps. In the first step, an optimized cross field is generated on the surface [1]. The optimization may invoke feature lines, e.g. fillets or sharp edges, as constraints. In the second step, the target patch layout is defined by tracing the cross field from detected singularities regardless of the original face segmentation. Finally, watertight patches are generated with predefined element size.

The software supports conversion to untrimmed as well as trimmed models [2] and direct export to LS-DYNA input deck is facilitated. Untrimmed designs frequently yield surfaces with many extraordinary points to satisfy boundary constraints around holes. Considering trimmed designs, internal boundary constraints are neglected during re-parameterization and the resulting model is reduced to one or just a few surfaces.

Through some illustrative examples, we demonstrate the efficacy of the automatic model generation, discuss current limitations, and highlight ongoing developments to address those.

REFERENCES

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[2] A. Nagy, D. Benson, “On the numerical integration of trimmed isogeometric elements”, *Computer Methods in Applied Mechanics and Engineering*, Vol. **284** (2015).