Watertight Boolean Operations: A Framework for Creating Analysis-Suitable CAD-Models

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ABSTRACT

Boolean operations are a fundamental tool for creating complex CAD models but result in geometric discontinuities between the underlying models surfaces. In fact, the intrinsic trimming concept is incapable of explicitly representing the connection between the resulting trimmed surfaces geometrically and hence, the corresponding models are termed "non-watertight". Making these CAD objects analysis-suitable is quite challenging [1] and a severe obstacle for the integration of design and analysis.

In this work, we present a step towards an analysis-driven design paradigm [2] by providing geometric operations that yield analysis-suitable CAD models. The proposed *watertight Boolean operations* [3] process the output of conventional Boolean operations to update intersecting surfaces and geometrically join them explicitly at their approximated intersection. The related approximation error is controlled by the same user-defined model tolerance employed for trimmed models. The basic form of this new framework is built upon standard spline technology already present in modern CAD systems, and it can be applied as a modeling technique during the construction of a geometric model or to convert a trimmed model into a watertight representation.

We investigate the properties of CAD models obtained by watertight Boolean operations in the context of isogeometric simulations. Numerical experiments considering different problems are discussed and verify the analysis-suitability of these geometries.

REFERENCES

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