

Isogeometric Analysis in the Design Process of Lightweight Structures

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Abstract

This contribution will give a brief overview of isogeometric analysis (IGA) and the respective requirements and challenges. IGA, as introduced by Hughes et al. [1] is a rather new approach within finite element analysis. In contrast to long-established approaches, that require a substitution of the CAD model by a finite element model, IGA skips this step by using the same parametric description also for the analysis. The basis functions used are usually Non-uniform Rational B-Splines (NURBS). Isogeometric B-Rep Analysis (IBRA) as introduced by Breitenberger et al. [2] takes this a step further and includes the topology information as well. The smooth basis functions and the seamless link to CAD generate a lot of possibilities in the design of structures. Especially for lightweight structures, where form and force are highly interactive, this clear link is beneficial. Geometric design and mechanical properties are available in the same environment and can be manipulated simultaneously in order to optimize the final state of equilibrium with respect to shape and stress distribution. Furthermore, inverse methods can easily be used in order to design the mounted structure. Forward-analysis, such as a simulation of the mounting, has to be considered in the second step only to compute potential normal forces. This can be applied to lightweight structures, e.g. for bending-active structures and form-finding of tensile membrane structures.

References

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- [2] M. Breitenberger, A. Apostolatos, B. Philipp, R. Wüchner and K.-U. Bletzinger, Analysis in computer aided design: Nonlinear isogeometric B-Rep analysis of shell structures, *Computer Methods in Applied Mechanics and Engineering*, vol. 284, pp. 401-457, 2015.