

## Seminar

26. Januar 2011 15:30h HS 44-380



zu folgendem Vortrag wird herzlich eingeladen:

### Isogeometric Analysis and Shape Optimization

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Isogeometric analysis is a new method of computational analysis where the functions to describe geometries in CAD models are adopted as basis for analysis. Due to this unified geometric representation, the model transfer from design to analysis, called mesh generation, is omitted. The benefits are more efficiency in the design-through-analysis process as well as better accuracy in the analysis results due to an accurate geometric description. NURBS (Non-Uniform Rational B-Splines) are the most widespread technology in today's CAD modeling tools and therefore are adopted as basis functions for analysis.

A new, rotation-free shell element is presented [1], based on the Kirchhoff-Love shell theory and the isogeometric concept. Due to the higher-order nature of NURBS, this formulation is free from the typical shell locking phenomena. The element is formulated geometrically nonlinear and therefore applicable to problems with large deformations. Furthermore, a method, called bending strip method [2], is presented which enhances the application of this shell formulation to arbitrary structures consisting of multiple patches. Different examples show the good performance and accuracy of the method, for geometrically linear and nonlinear problems. The application in a fully coupled FSI simulation of rotating wind turbine blades demonstrates the relevance for realistic industrial structures [3].

The fact that both CAD description and shell analysis are surface-based, allows an effective integration of design and analysis, which is demonstrated by integrating the presented method into a commercial CAD software.

Furthermore, the presented method is extended to shape optimization. In traditional shape optimization using FE analysis, there are two different approaches for the parametrization of the optimization model, namely the CAD-based or FE-based approach. Isogeometric shape optimization is introduced as a combination of and enhancement to the existing approaches which provides more flexibility in choosing the design space.

#### References

- [1] Isogeometric shell analysis with Kirchhoff-Love elements, J. Kiendl, K.-U. Bletzinger, J. Linhard, and R. Wüchner, *Computer Methods in Applied Mechanics and Engineering*, 198:3902-3914, 2009.
- [2] The bending strip method for isogeometric analysis of Kirchhoff-Love shell structures comprised of multiple patches, J. Kiendl, Y. Bazilevs, M.-C. Hsu, R. Wüchner, K.-U. Bletzinger, *Computer Methods in Applied Mechanics and Engineering*, 199:2403-2416, 2010.
- [3] 3D simulation of wind turbine rotors at full scale. Part II: Fluid-structure interaction modeling with composite blades, Y. Bazilevs, M.-C. Hsu, J. Kiendl, R. Wüchner, and K.-U. Bletzinger, *International Journal for Numerical Methods in Fluids*, 65:236-253, 2011



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