Chair for Computation in Engineering
Chair of Computational Modeling and Simulation

Software Lab:

Mechanics: ★★★★☆
Mathematics: ★★★★☆
Programming: ★★★☆☆

Optimization of layered structures using high order finite elements

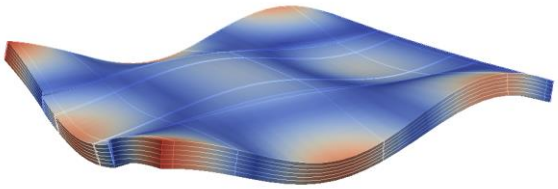
Setting

The vibrational behavior of structures comprised by layers made of anisotropic materials can be predicted accurately with volumetric finite elements. Very efficient is the use of hexahedral high order finite elements on the basis of a coarse extruded mesh. Here, each layer can be represented by only one row of elements. Moreover, due to large possible aspect ratios of a high order finite element its thickness and thus the thickness of a layer can vary in a wide range without changing the mesh in in-plane direction. Therefore, this approach is very suitable for solving structural optimization problems where layer properties are the design variables. These may include the layer thicknesses, the material orientation and the volume fractions of the constituents, if composites are used.

Task

Develop a software to optimize layered structures by extending the high order finite element program AdhoC. Therefore, the following tasks must be completed:

- Derivation of elasticity tensors of anisotropic composites with respect to a reference coordinate system depending on the volume fractions of the constituents and the orientation of the material.
- Enabling AdhoC to read arbitrary elasticity tensors and to handle them correctly.
- Generation of extruded three-dimensional meshes.
- Application and comparison of different optimization methods to find the layer thicknesses, material orientations and volume fractions of composite constituents which lead to a minimal static displacement or vibration within a certain frequency range.



Supervisor

Alexander Paolini, alexander.paolini@tum.de

References

[1] G. Müller, “Structural Dynamics”, Chair of Structural Mechanics, Technische Universität München, lecture notes, 2015
[2] U. Heißerer, “AdhoC 4–Technical Guide.” Lehrstuhl für Bauinformatik, Technische Universität München, 2010
[3] J. Berthelot, “Composite Materials.” Springer, 1999