Procedurally generated models for Isogeometric Analysis

In recent years, the definition of numerical models has become the bottleneck in the Finite Element Method. Characteristic features of the model generation are large manual efforts and a de-coupling of geometric and numerical model. In the highly probable case of design revisions, all steps of model preprocessing and mesh generation have to be repeated. This includes the idealization and approximation of a geometric model as well as the definition of boundary conditions and model parameters. Design variants leading to more resource-efficient structures might hence be disregarded due to limited budgets and constrained time frames. This thesis proposes a procedural approach for the generation of volumetric NURBS models. That is, a model is not described in terms of its data structures but as a sequence of modeling operations applied to a simple initial shape. In order to adapt this concept to NURBS geometries, only a compact set of commands is necessary, which, in turn, can be adapted from existing algorithms. A model can then be treated in terms of interpretable model parameters, which drastically simplifies the setup of model variants. For the assessment thereof, Finite Element mesh quality metrics are regarded. The considered metrics are based on purely geometric criteria and allow to identify model degenerations commonly used to achieve certain geometric features. They can be used to decide upon model adaptions and provide a measure for their efficacy.

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