

Master's Thesis:

Shape Optimization with Subdivision Surface Control Polygons

Shape optimization has considerable potential for reaching sustainable goals in industrial applications. However, the acceptance is still low. Employing appropriate parameterizations of the geometries for the shape optimization could improve the acceptance rate, as the engineers could optimize geometries by maintaining the features they created in Computer Aided Design (CAD) programs. Subdivision Surfaces (SDS) are defined by a recursive subdivision process applied to a control polygon, see figure 1. Similar to B-Spline surfaces, the positions of the control points determine the shape of the underlying surface. The SDS control points are used as the design variables of the optimization problem.

However, the preferred way for numerical analysis still is the finite element method. This leads to the necessity of a proper gradient and update mapping between the SDS control polygon and the finite element mesh.

The focus of the thesis should be the investigation of the mapping procedure and finding a compromise between efficiency and precision for the SDS parameterization.

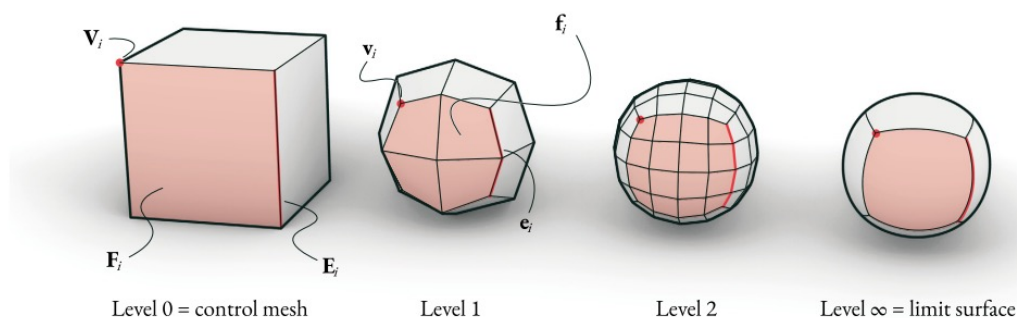


Figure 1: Subdivision scheme depicted on the example of the Catmull-Clark scheme. [1]

Requirements: Successful participation in the lectures on finite elements and structural optimization. Good knowledge of Python and C++ is required for the implementation of the methods in Kratos Multiphysics.

[1] Oberbichler, T. and Bletzinger, K.U., 2022. CAD-integrated form-finding of structural membranes using extended catmull–clark subdivision surfaces. *Computer-Aided Design*, 151, p.103360.

Supervision: Bastian Devresse
bastian.devresse@tum.de