Lehrstuhl für Statik und Dynamik

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Master‘s Thesis:

CAD Reconstruction with Catmull-Clark Subdivision Surfaces

Node-based shape optimization is a powerful tool to explore a vast design space by employing the coordinates of the mesh‘s nodes as design variables. This leads to a great freedom of design. Regularization methods, such as the Vertex Morphing technique, have been developed to generate shape optimization results of great potential. However, the resulting geometry description is a mesh, whereas the workflow in industrial applications requires a CAD geometry for further development. This is where the advantages of node-based shape optimization techniques and subdivision-based CAD geometry descriptions can be fused to recreate a CAD geometry.

Employing the Vertex Morphing technique with linear filter functions inherently leads to an underlying bi-cubic B-spline surface description. In the realm of subdivision surfaces the Catmull-Clark scheme has been shown to converge to piecewise bi-cubic B-spline surface descriptions. Knowing this analogy, a geometry resulting from a regularization by Vertex Morphing can be reconstructed with Catmull-Clark subdivision surfaces. A suitable CAD reconstruction workflow should be implemented using the similarities in the properties of the shape description.

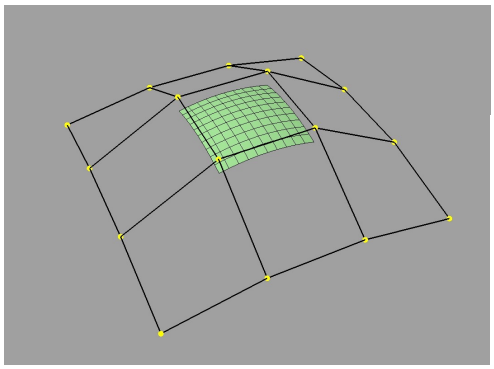

Figure 1: Bi-cubic B-spline surface for the Catmull-Clark subdivision scheme. Adapted from [1].

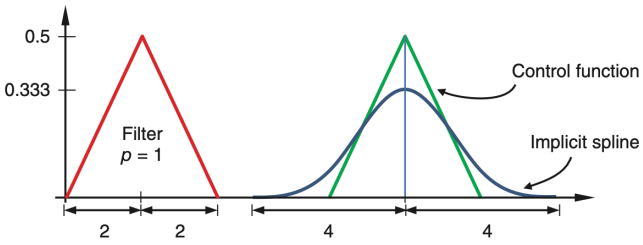

Figure 2: Cubic B-spline curve generation by the Vertex Morphing technique with linear filter functions. Adapted from [2].

[1] Pixar, OpenSubdiv documentation
https://graphics.pixar.com/opensubdiv/docs/subdivision_surfaces.html#piecewise-parametric-surfaces
[2] Bletzinger KU. Shape optimization. Encyclopedia of Computational Mechanics Second Edition. 2017 Aug 8:1-42.

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