DISCRETE SURFACE OPTIMIZATION

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joint work with
Thilo Rörig and others
History

- 2007 - ADAC Building Munich
- 2010 - First version of VaryLab
- 2011 - Höfe am Brühl Leipzig
- 2012 - AAG
- 2014 - AAG with HENN
- 2015 - Start of invited Beta
DISCRETE SURFACE OPTIMIZATION

NURBS Surface → Meshing → Triangles

Data Analysis → Optimization → Result Mesh

Hexagons

Quads
Meshing
DISCRETE CONFORMAL MAPPING
CONFORMAL PARAMETERIZATION
CONFORMAL PARAMETERIZATION
CONFORMAL PARAMETERIZATION
CONFORMAL MAPPING DEMO
Boundary Aligned Meshing
Meshing Demo
DISCRETE SURFACE OPTIMIZATION

Meshing → NURBS Surface

Triangles → Quads
Hexagons → Optimization

Data Analysis → Result Mesh
Mesh Data Visualization

Colors

Spheres

Histogram
BUILD-IN DATA SOURCES

- Edge Length
- Gauss Curvature
- Edge Curvatures
- Face Planarity
- Triangle Area
- …
Visualization Demo
DISCRETE SURFACE OPTIMIZATION

NURBS Surface → Meshing → Triangles

Quads → Hexagons → Optimization → Result Mesh

Data Analysis
Mesh Optimization

\[ f_1, \ldots, f_n : S \rightarrow \mathbb{R} \]

\[ f(S) = \sum_{i=1}^{n} \lambda_i f_i(S) \quad \nabla f(S) = \sum_{i=1}^{n} \lambda_i \nabla f_i(S) \]
Springs Demo

\[ E_{spring} = \sum_{e_{ij} \in E} \left( \| \mathbf{v}_i - \mathbf{v}_j \| - l \right)^2 \]
QUANTIZED EDGES

\[ E_{spring} = \sum_{e_{ij} \in E} (\|v_i - v_j\| - l)^2 \]
PLANARITY DEMO
FAIRING DEMO

\[ E_{ega} = \sum_{v_i \in V} \sum_{e_{ij} \in E} \left( \pi - \angle (e_{ij}, \tilde{e}_{ij}) \right)^2 \]
VaryLab and Grasshopper
VaryLab is a software developed at Berlin Institute of Technology by members of the geometry group. It is supported by DFG SFB/TR 109 Discretization in Geometry and Dynamics. It is designed to be an extendable and modular tool for experiments with discrete surfaces in pure mathematics and applications in industrial geometry.

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www.varylab.com

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