



DISCRETE SURFACE OPTIMIZATION

Stefan Sechelmann
joint work with
Thilo Rörig and others

VaryLab[Ultimate]

File Viewer Camera Content Window XploreMath Python Tools Halfedge Look and Feel

Job Progress Monitor

Custom DDG Editing Generators Geometry NURBS
 Selection Subdivision Texture Texture Remeshing Topology Vector Fields

Content Presets
 Halfedge Interface
 VHDS: V1088 E4224 F1024

Name	V	E	F
New layer 3	▲	▲	▲
New layer 2	▲	▲	▲
New layer 1	▲	▲	▲
Default Layer	▲	▲	▲

Selection Interface
 Default Channel - 0/0/0
 Channel 1 - 0/0/0
 Channel 2 - 0/0/0

Surface Remeshing
 Expert Mode
 Pattern: Triangles
 Remesh

Discrete Conformal Parametrization
 Expert Mode
 Petsc/Tao Numerics
 Tolerance Exp: -9
 Max Iterations: 100
 Cut Strategy: Automatic
 Target Geometry: Automatic
 Create Uniformization
 Unwrap
 Check Gauß-Bonnet
 Recalculate Layout
 Reset Surface
 Boundary
 Cones
 Selected Nodes
 Tools

Texture Space Viewer 2D
 Texture Space Viewer 3D
 Optimization Protocol
 Halfedge Data Visualization

Configuration Histogram Table

Options
 Colors: Hue Inverse
 Clamp: 0,002 0,013
 Offset: 0,005
 Center Color of Zero

Optimizer Plugins
 Normalize Energies
 Opposite Edges Curvature: 0,1
 Planar N-Gons: 1
 Planar Quads: 5
 Planar Vertex Stars: 1
 Reference Surface Energy: 10
 Spring Energy: 5
 Touching Cot Incircles: 1
 Willmore Energy: 1

Plugin Options
 diag's c-update update
 const. avg. F-const.
 orig. range discr. CEIL
 Length: 0 0,7 5
 Strength: 1

Optimization
 Constraints
 Global: X Y Z
 Selection: X Y Z
 Boundary: X Y Z
 Allow Inner Boundary Movements
 Tangential
 Smooth Gradient
 SmoothSurface
 Tolerance: -12
 Iterations: 20
 Method: LMVM
 Live Geometry Updates
 Optimize Animate
 Finished DIVERGED_MAXITS

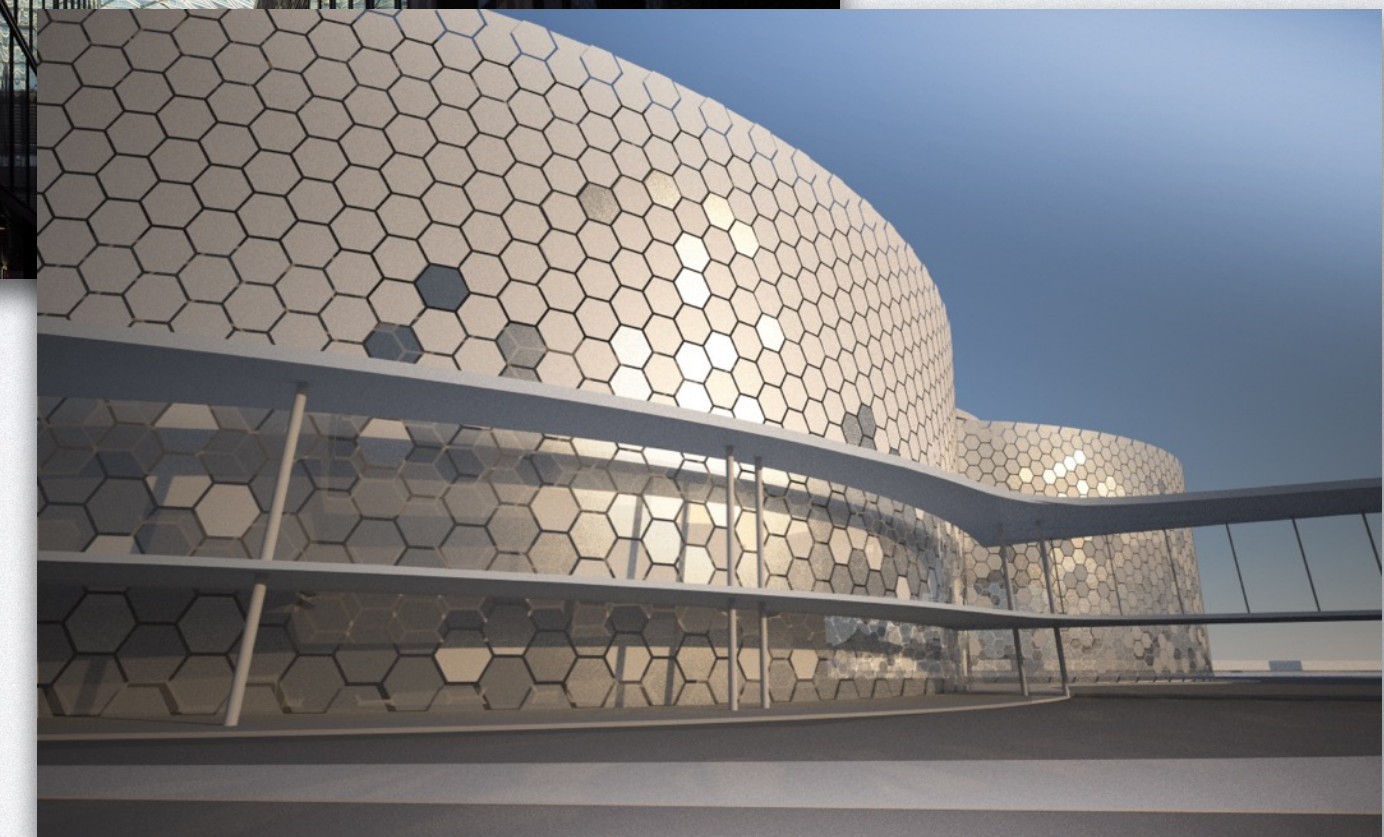
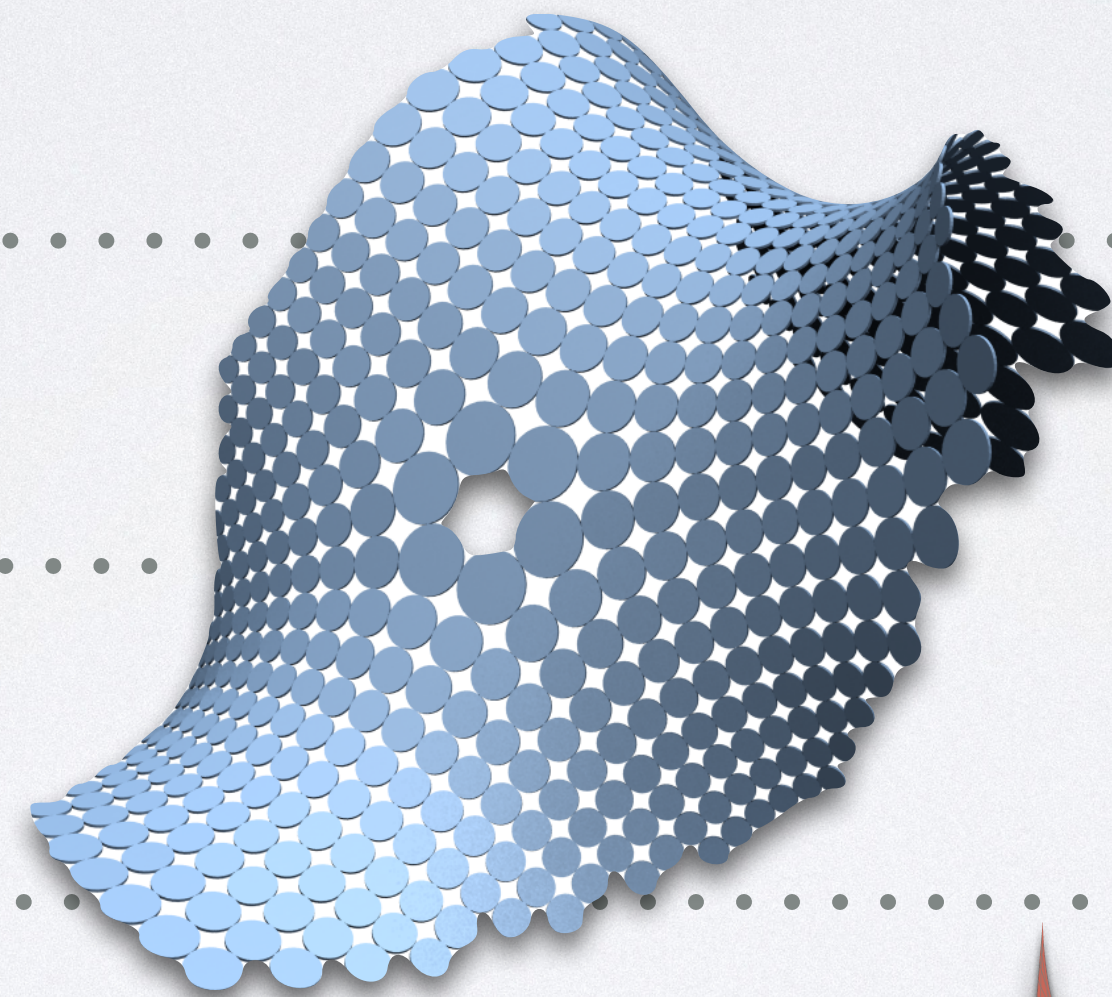
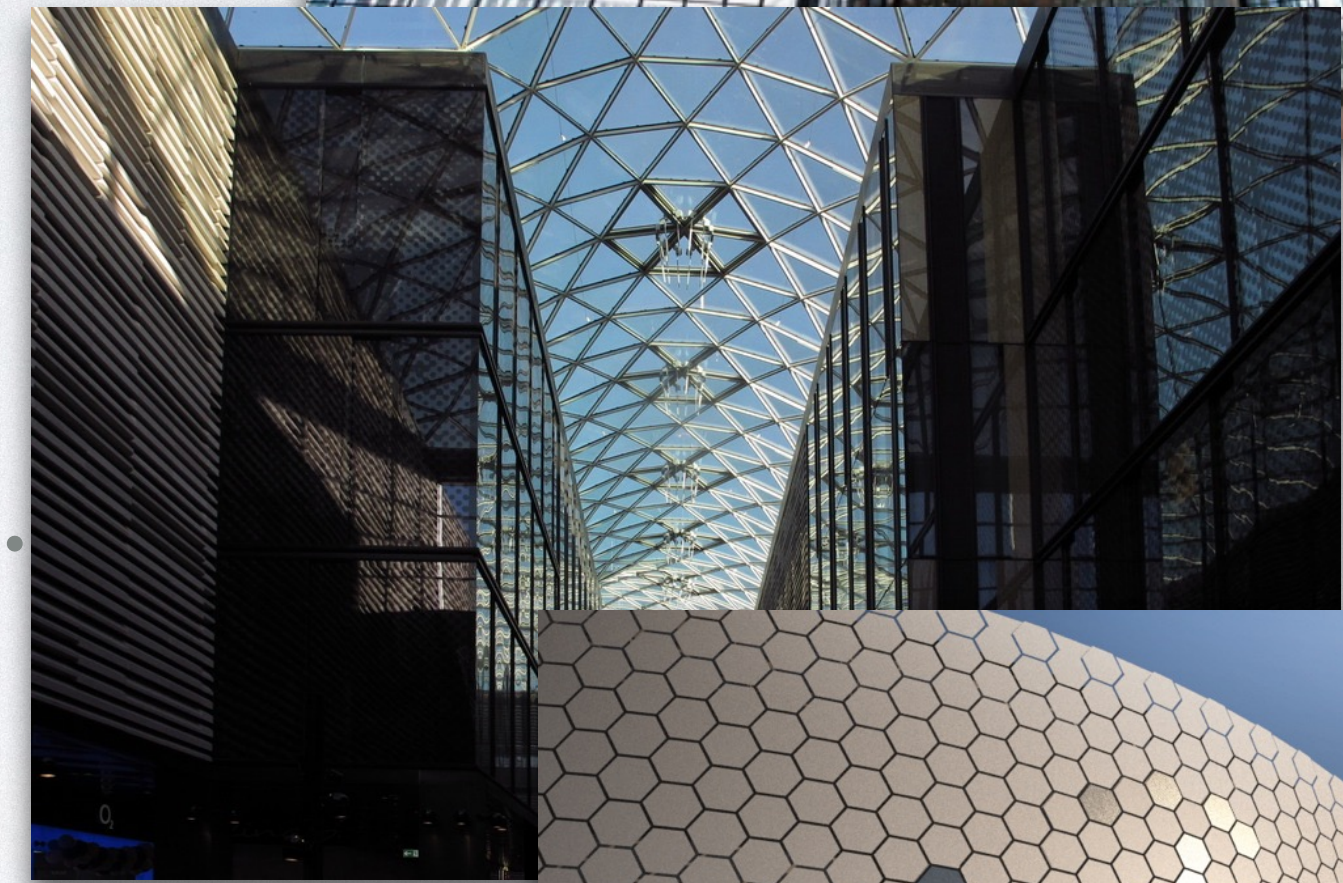
Content Appearance
 Faces
 Texture
 Lines
 Points

Job Monitor

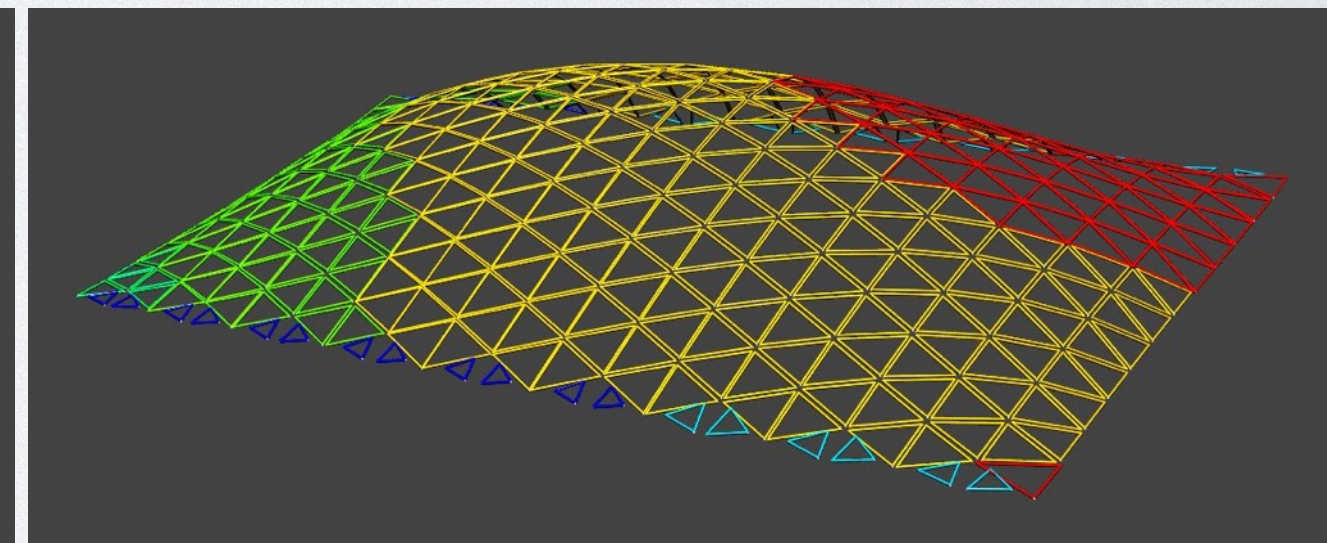
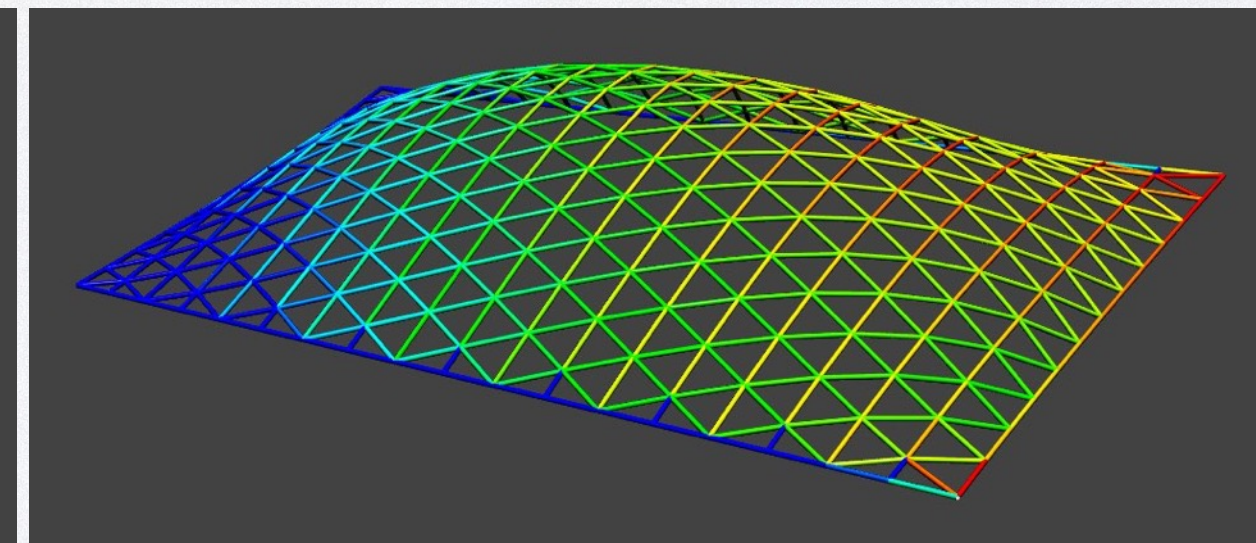
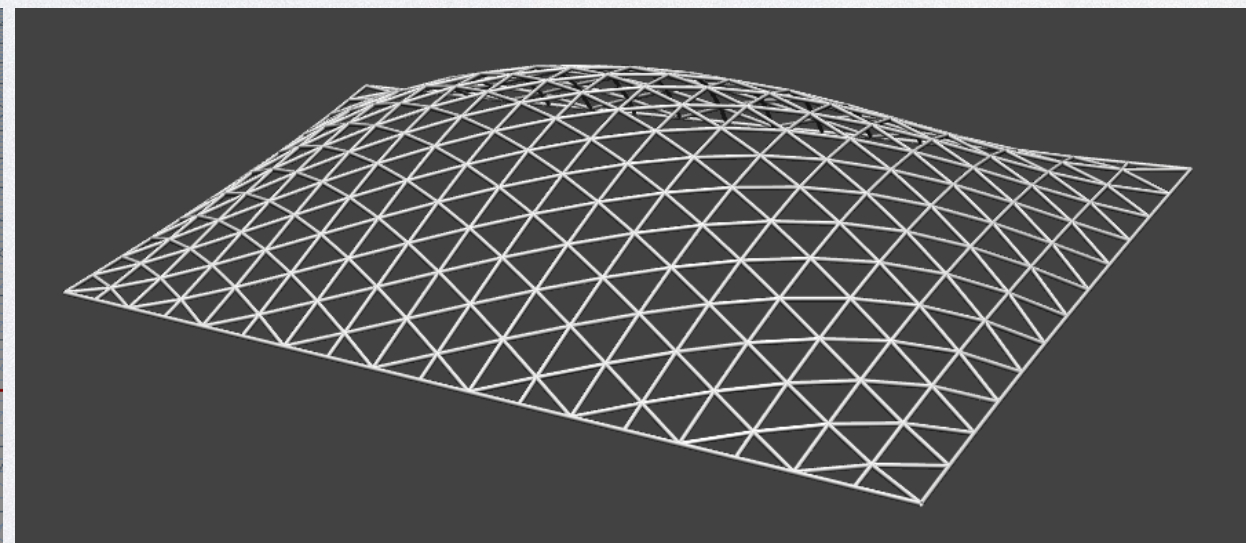
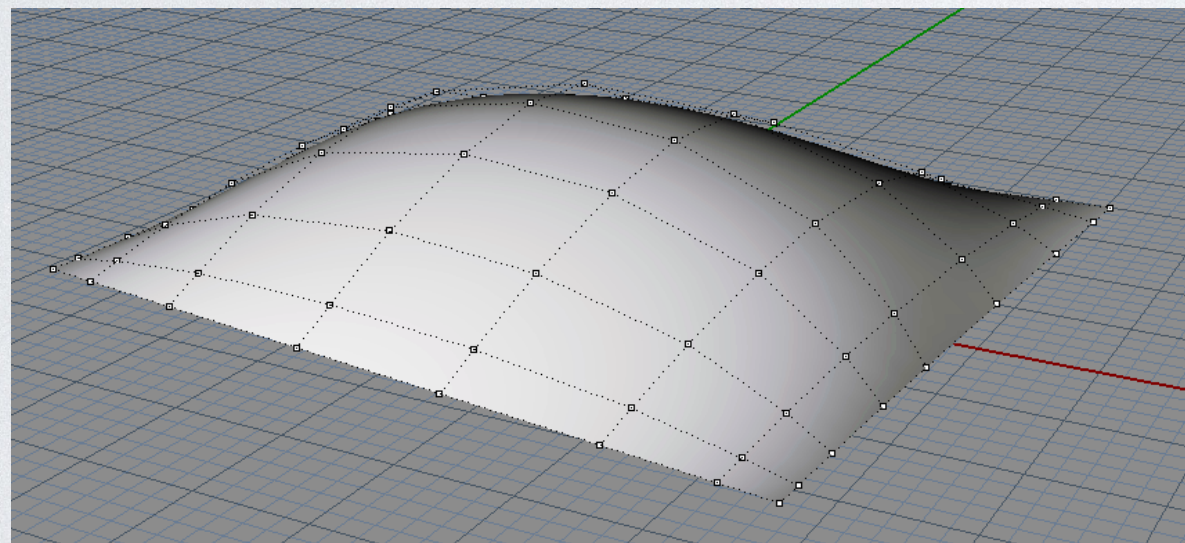
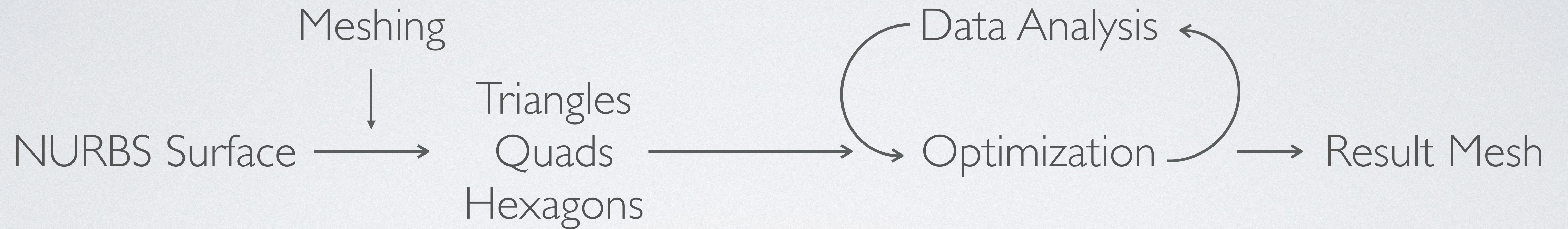
PythonConsole
 Console

HISTORY

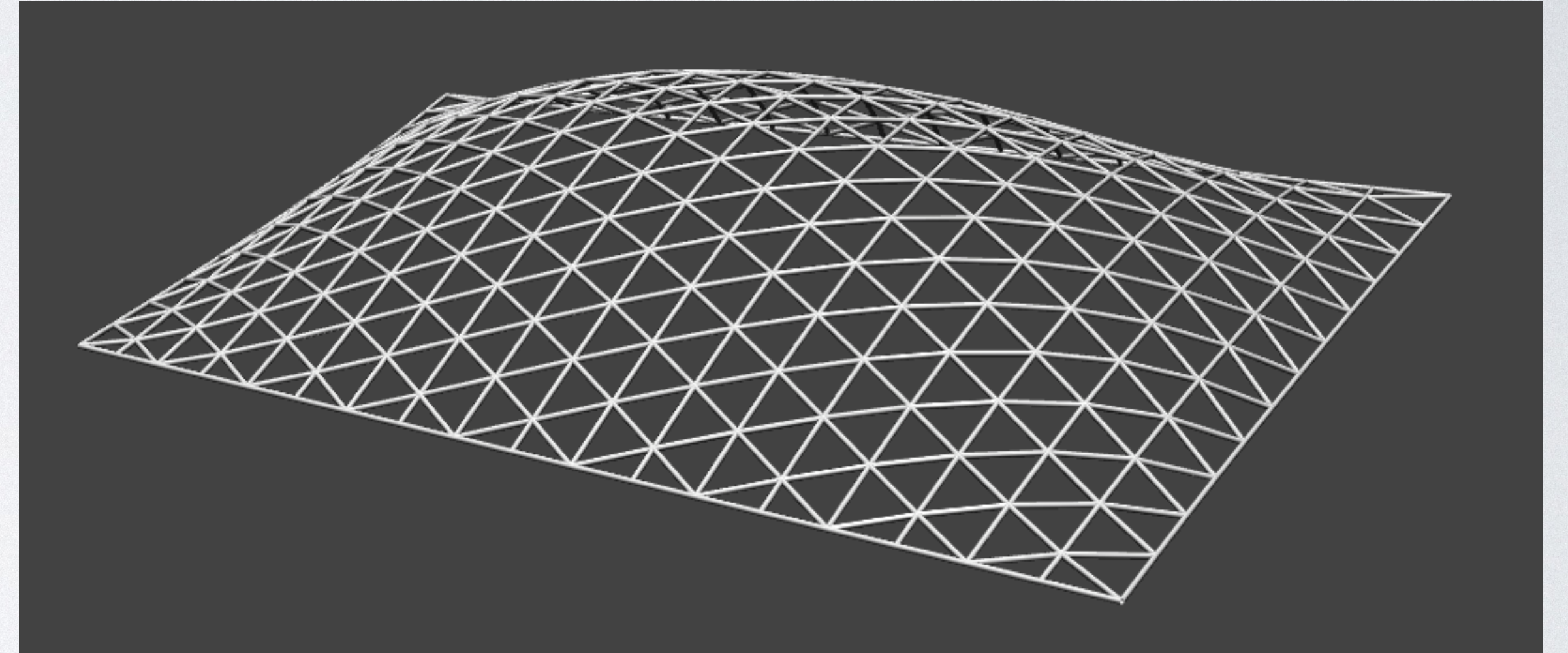
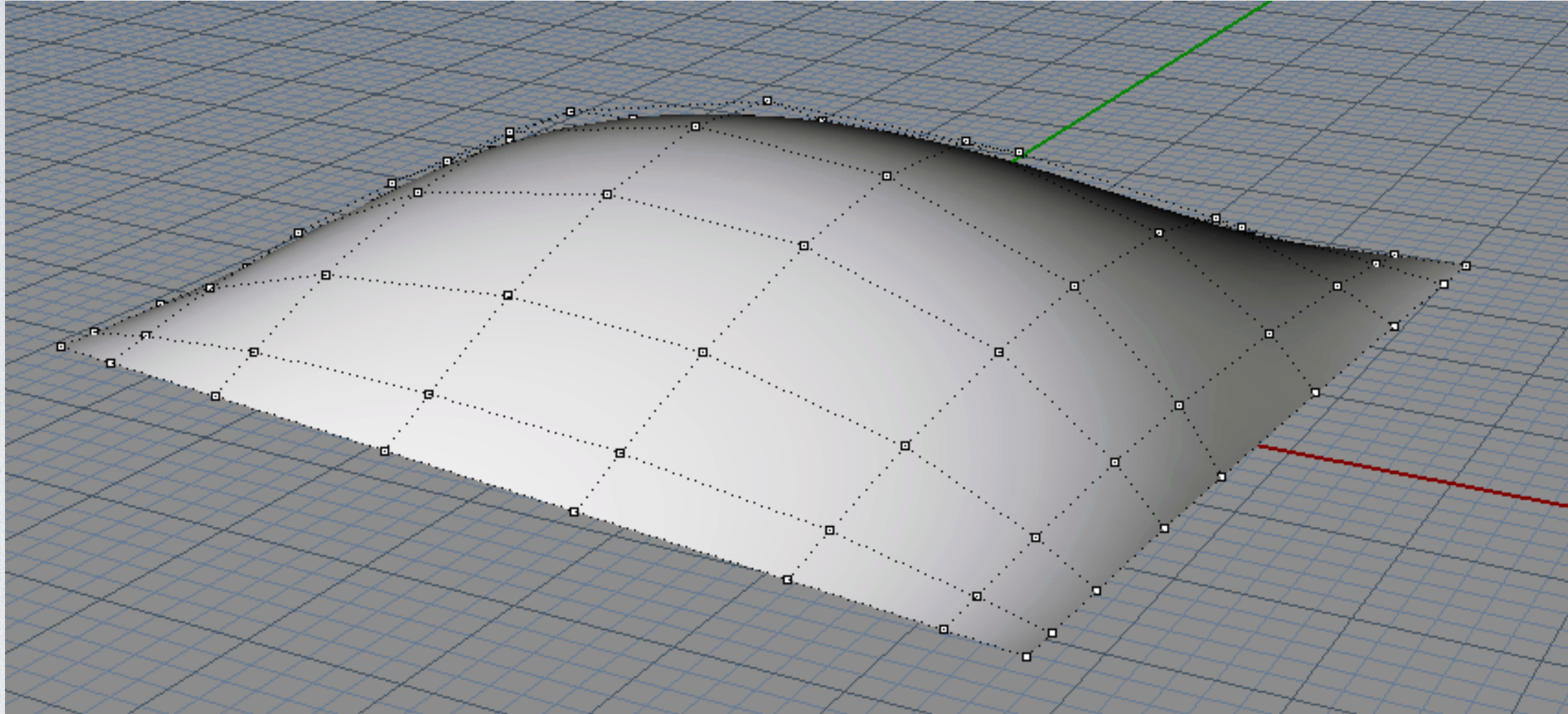
- 2007 - ADAC Building Munich
- 2010 - First version of VaryLab
- 2011 - Höfe am Brühl Leipzig
- 2012 - AAG
- 2014 - AAG with HENN
- 2015 - Start of invited Beta



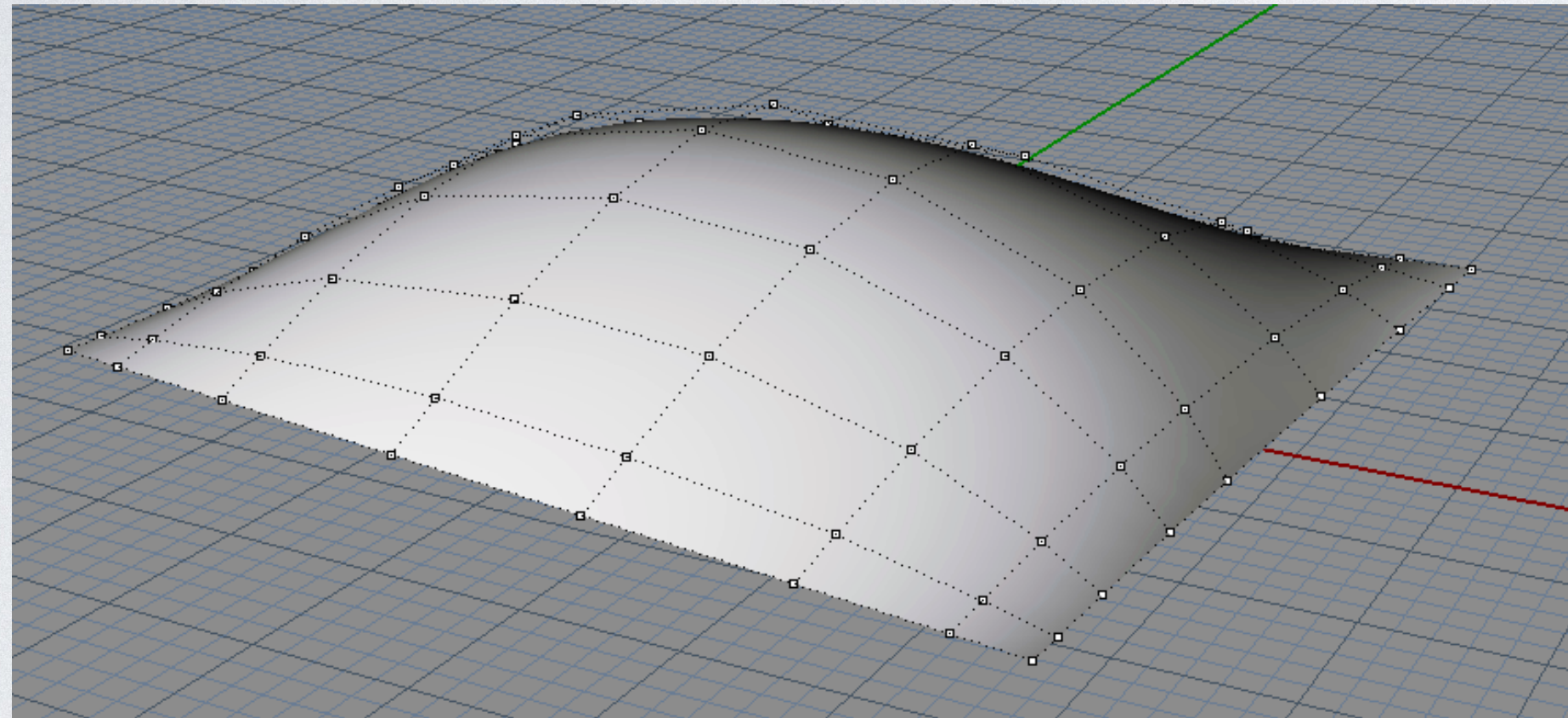
DISCRETE SURFACE OPTIMIZATION



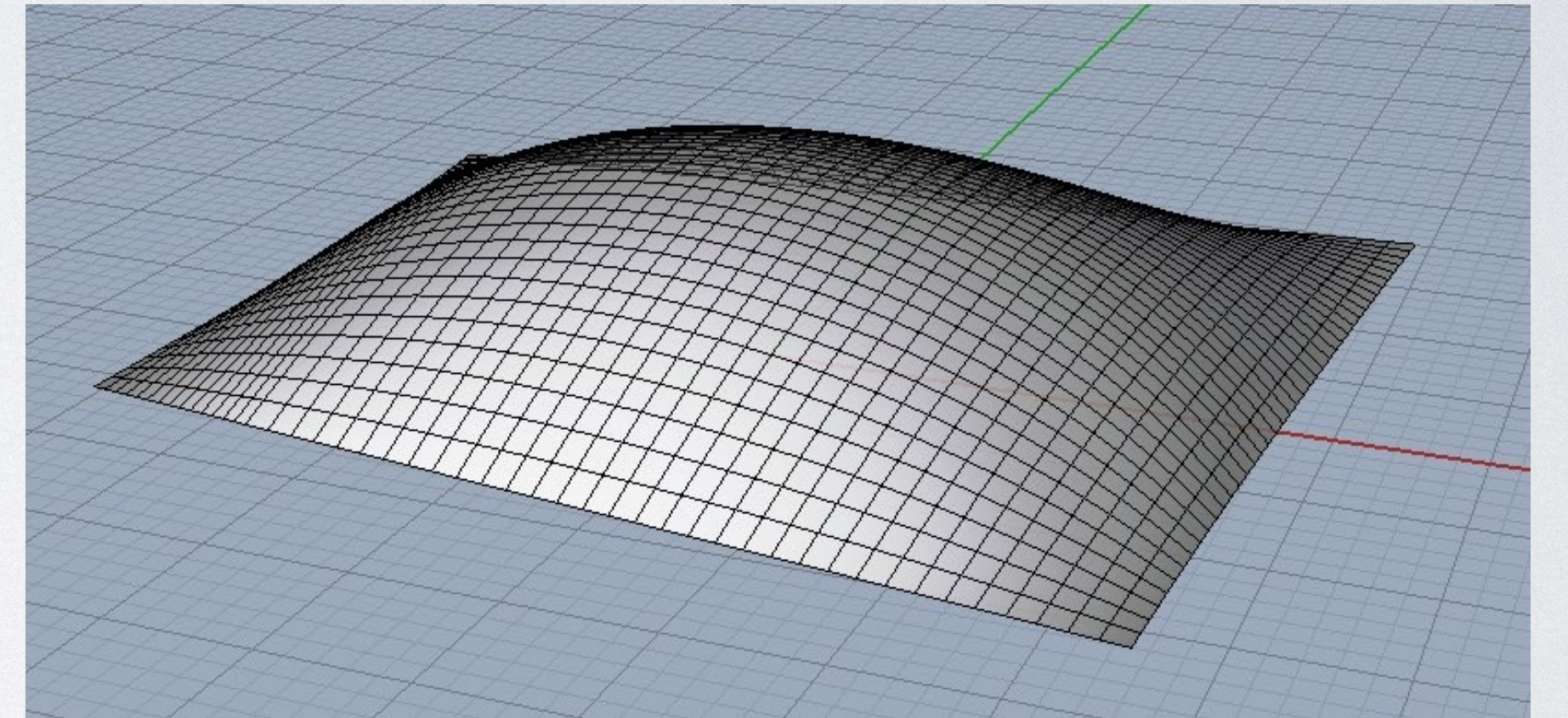
MESHING



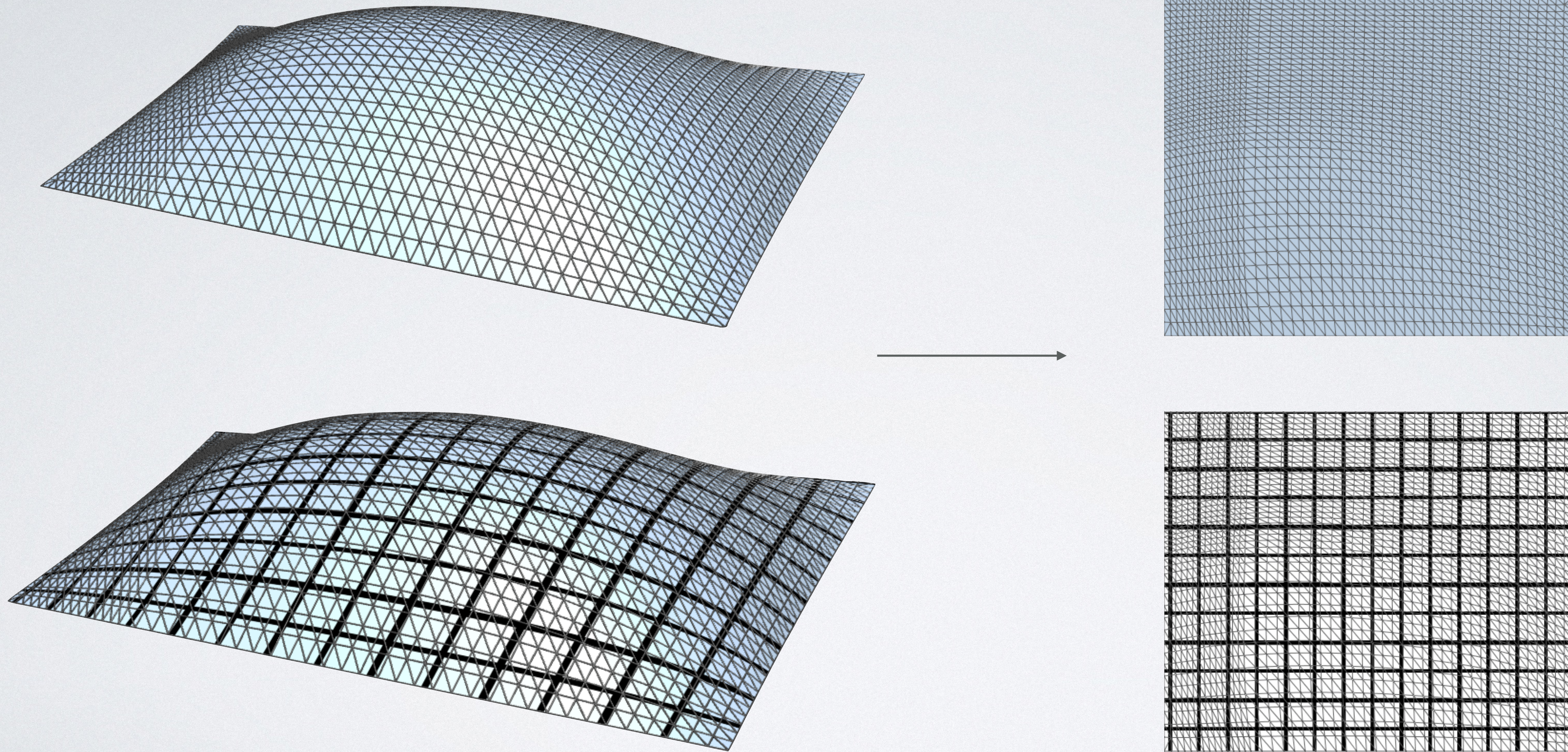
UV MESHING



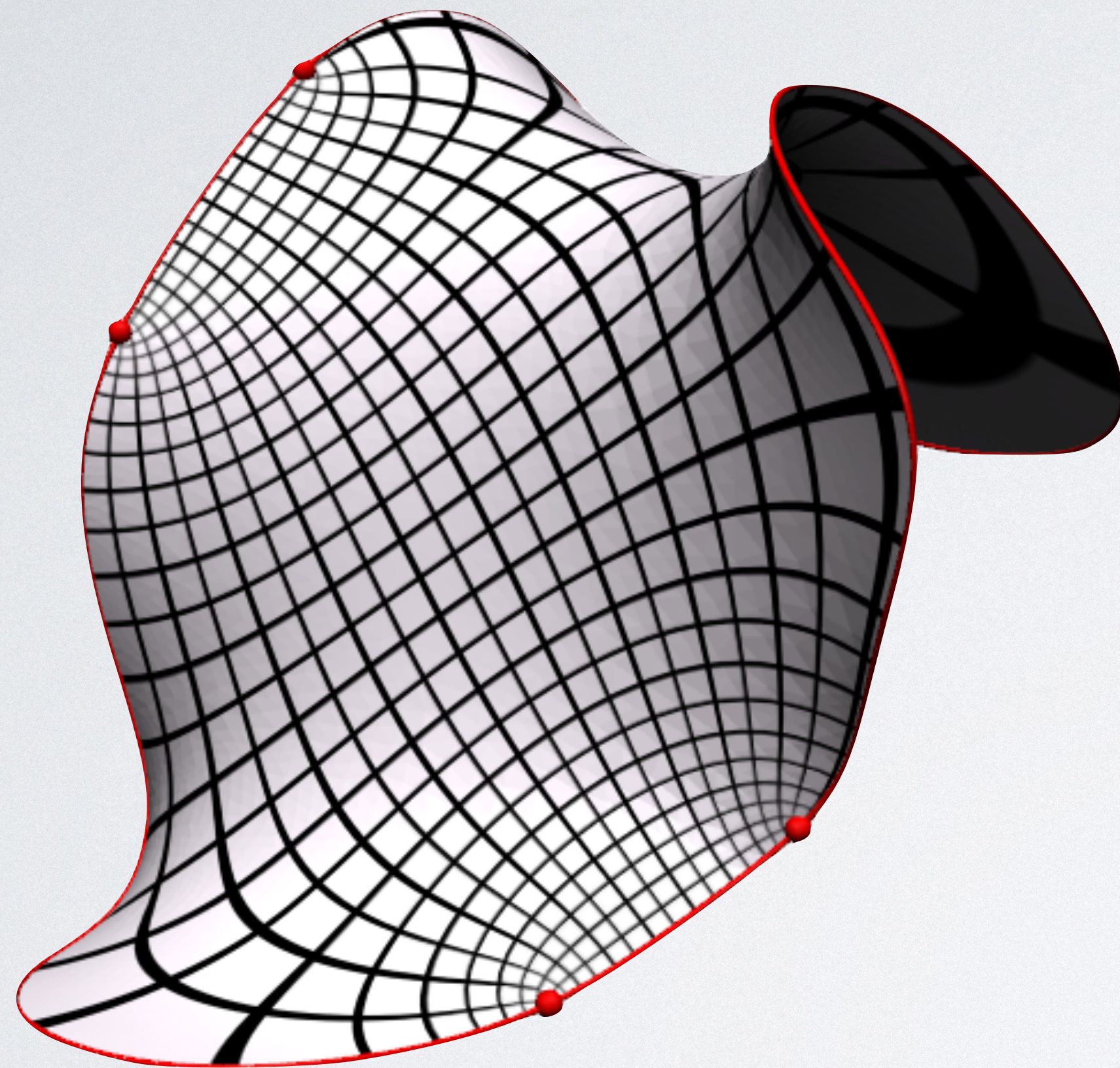
UV Meshing



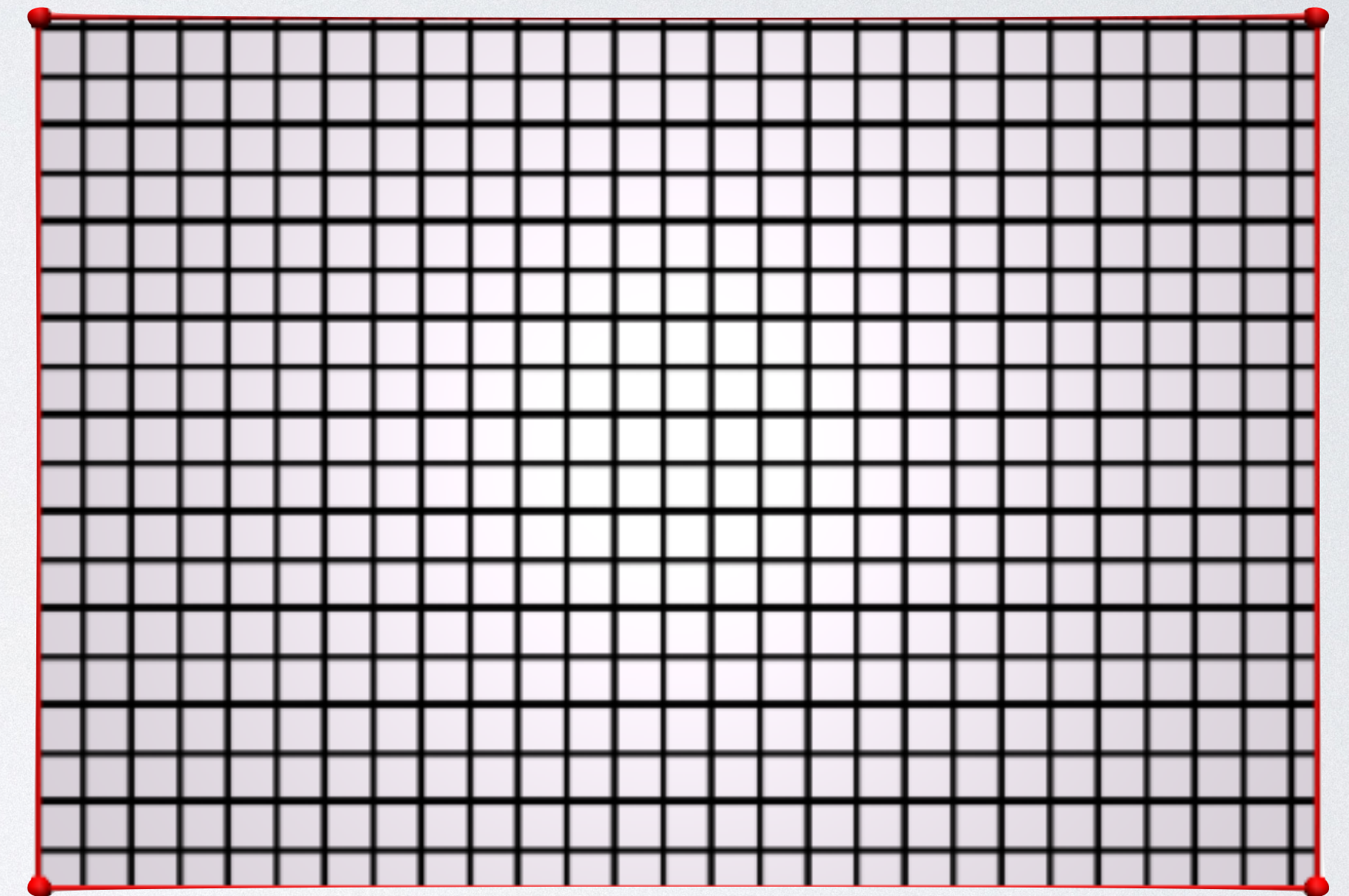
DISCRETE CONFORMAL MAPPING



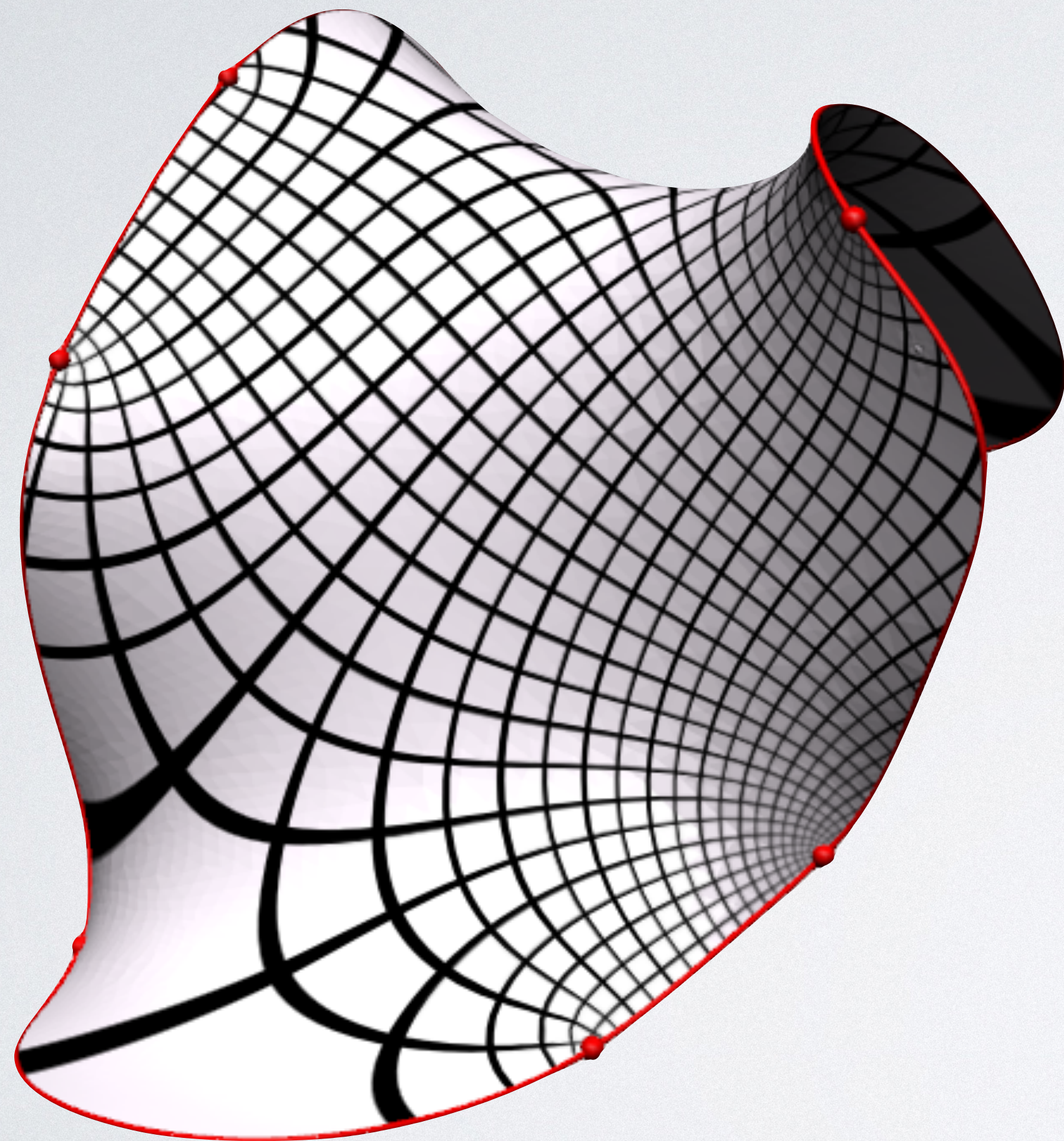
CONFORMAL PARAMETERIZATION



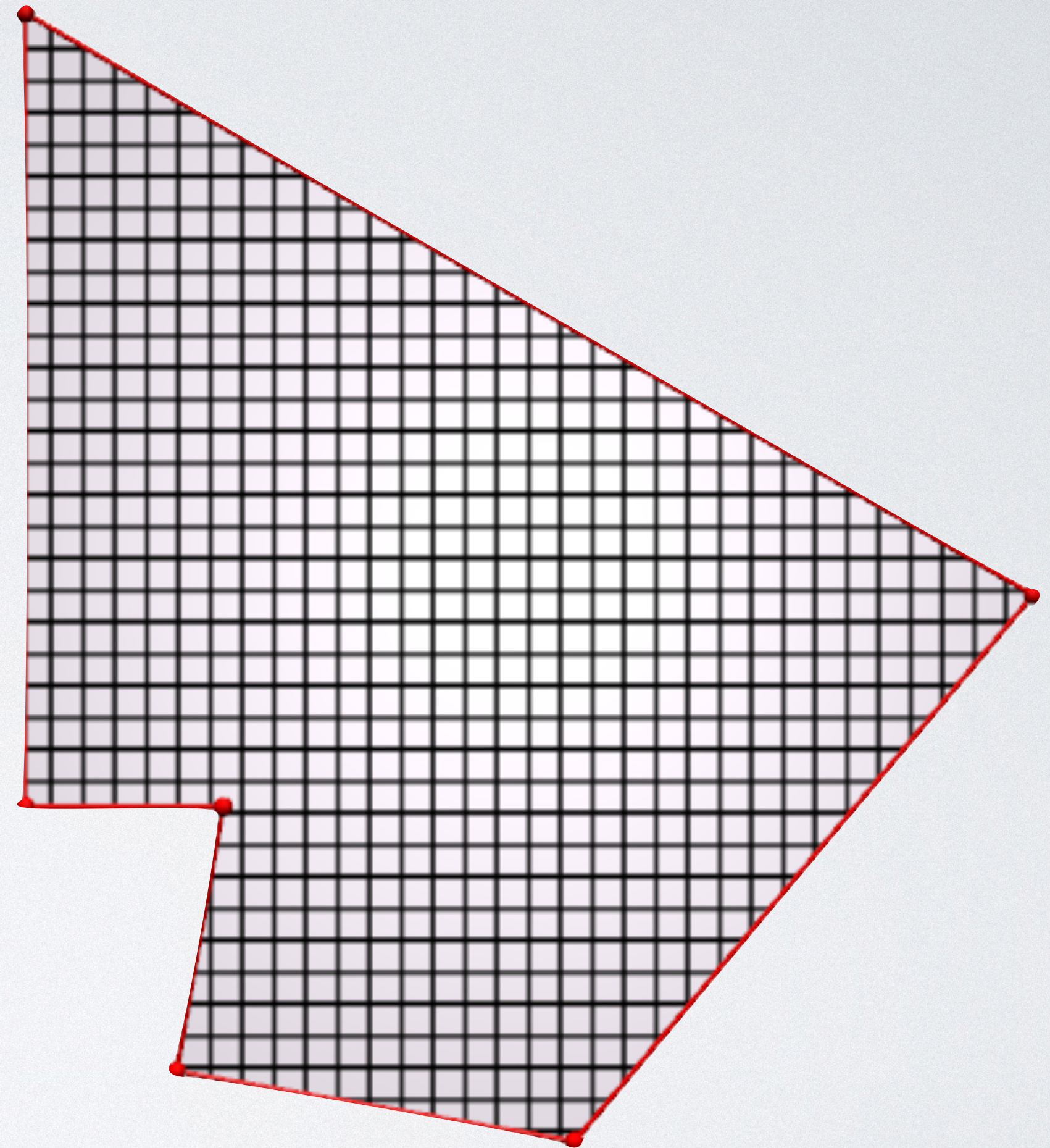
Parameterization



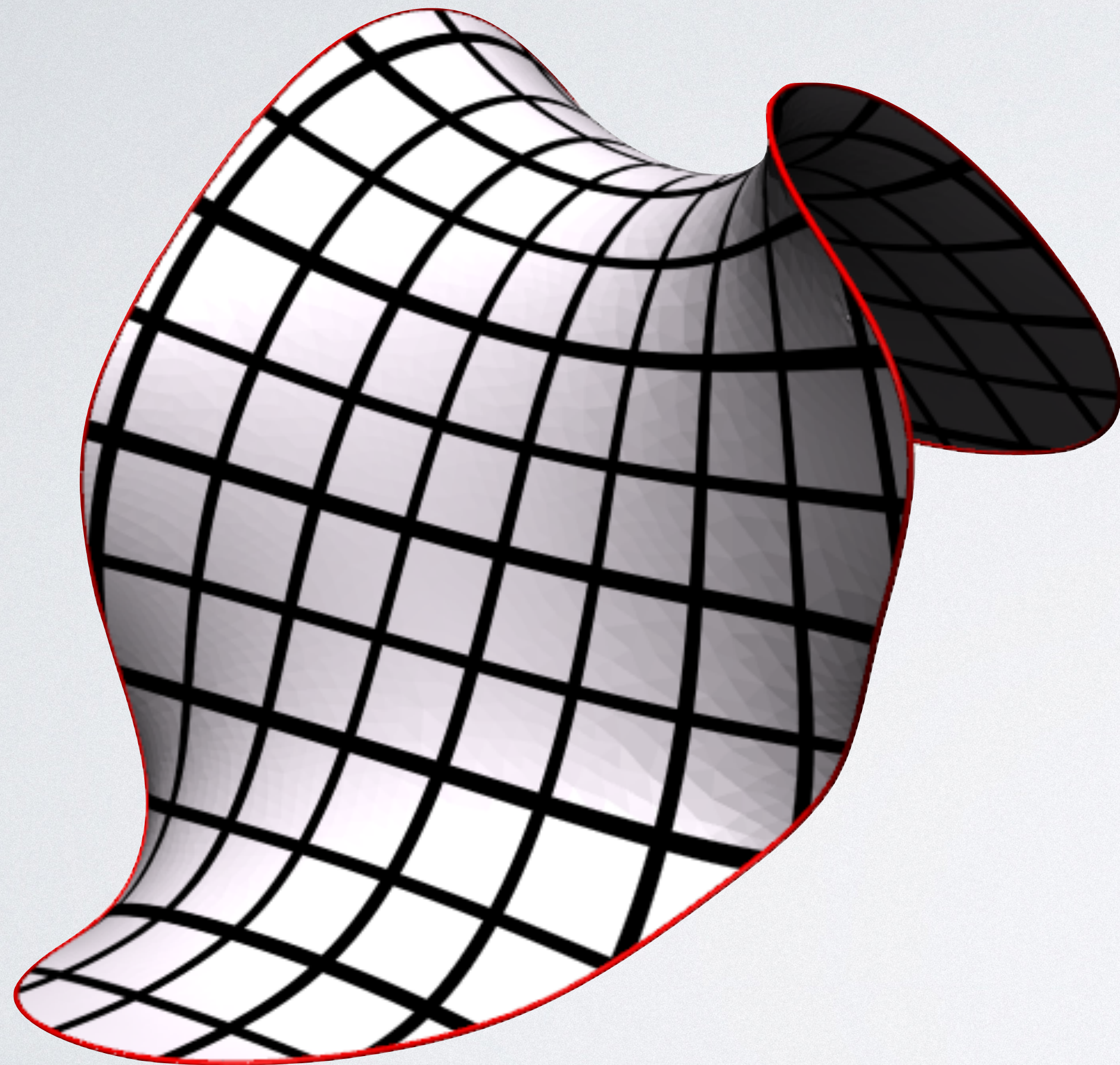
CONFORMAL PARAMETERIZATION



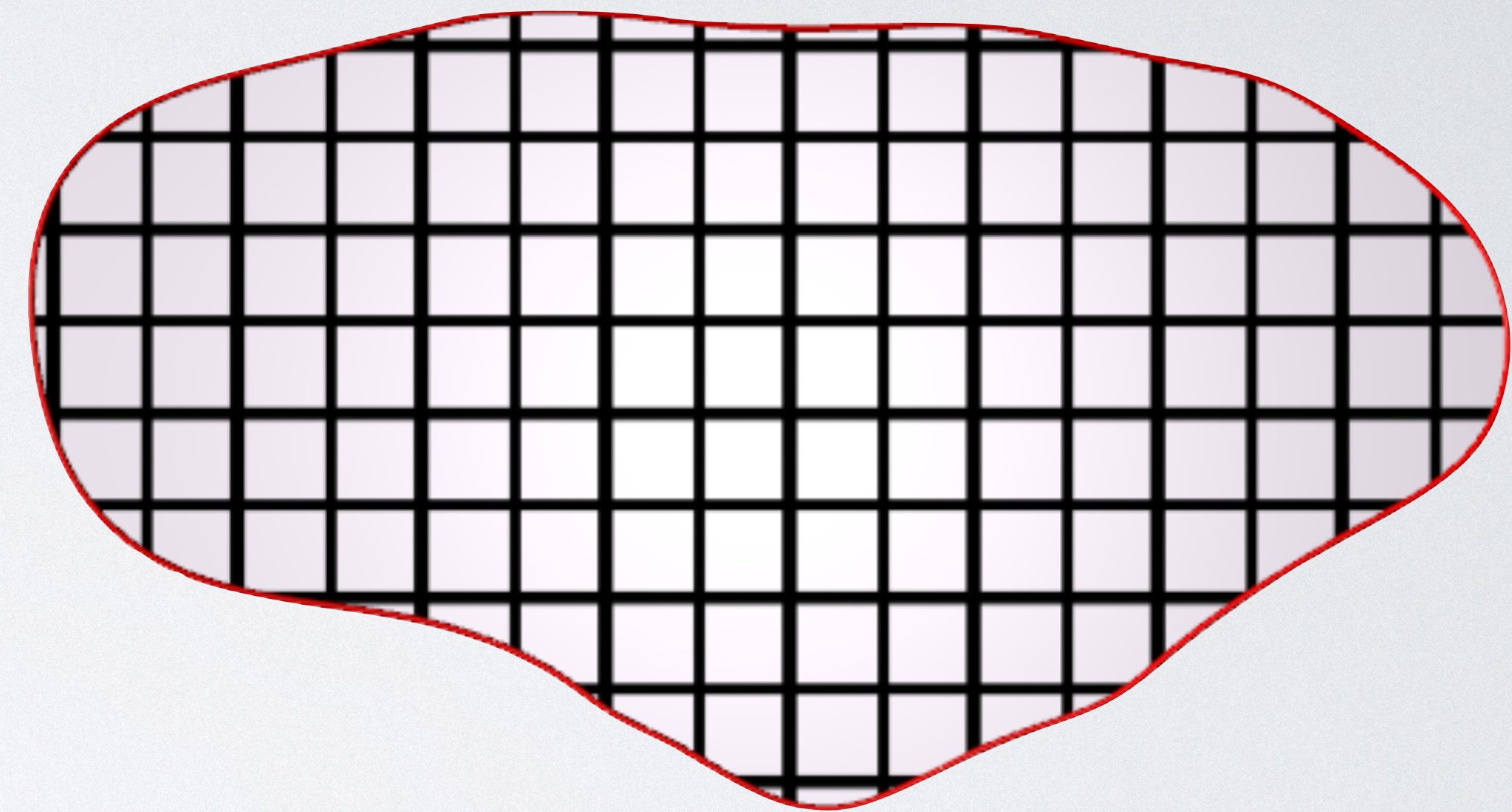
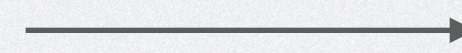
Parameterization



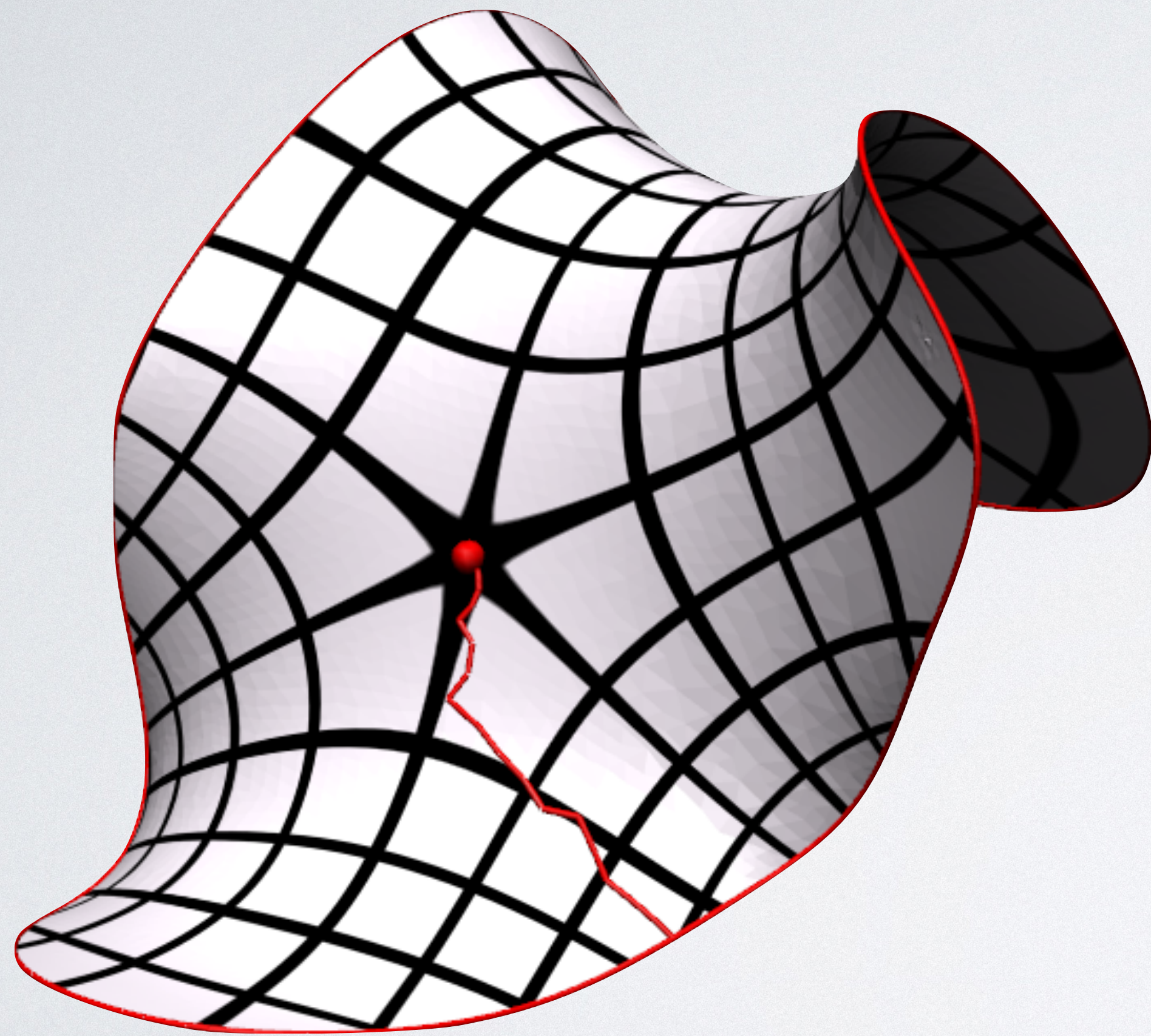
CONFORMAL PARAMETERIZATION



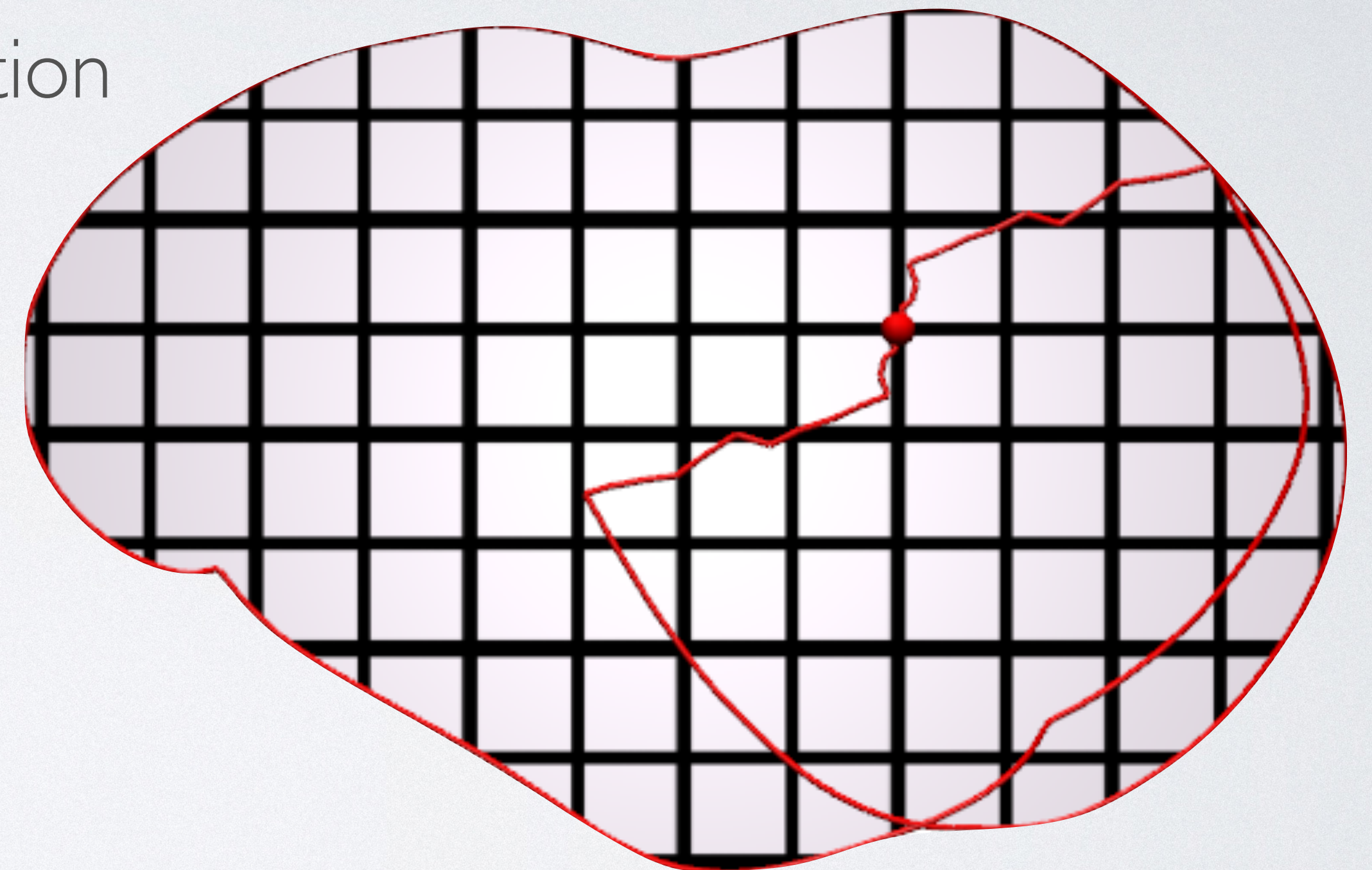
Parameterization



CONFORMAL PARAMETERIZATION

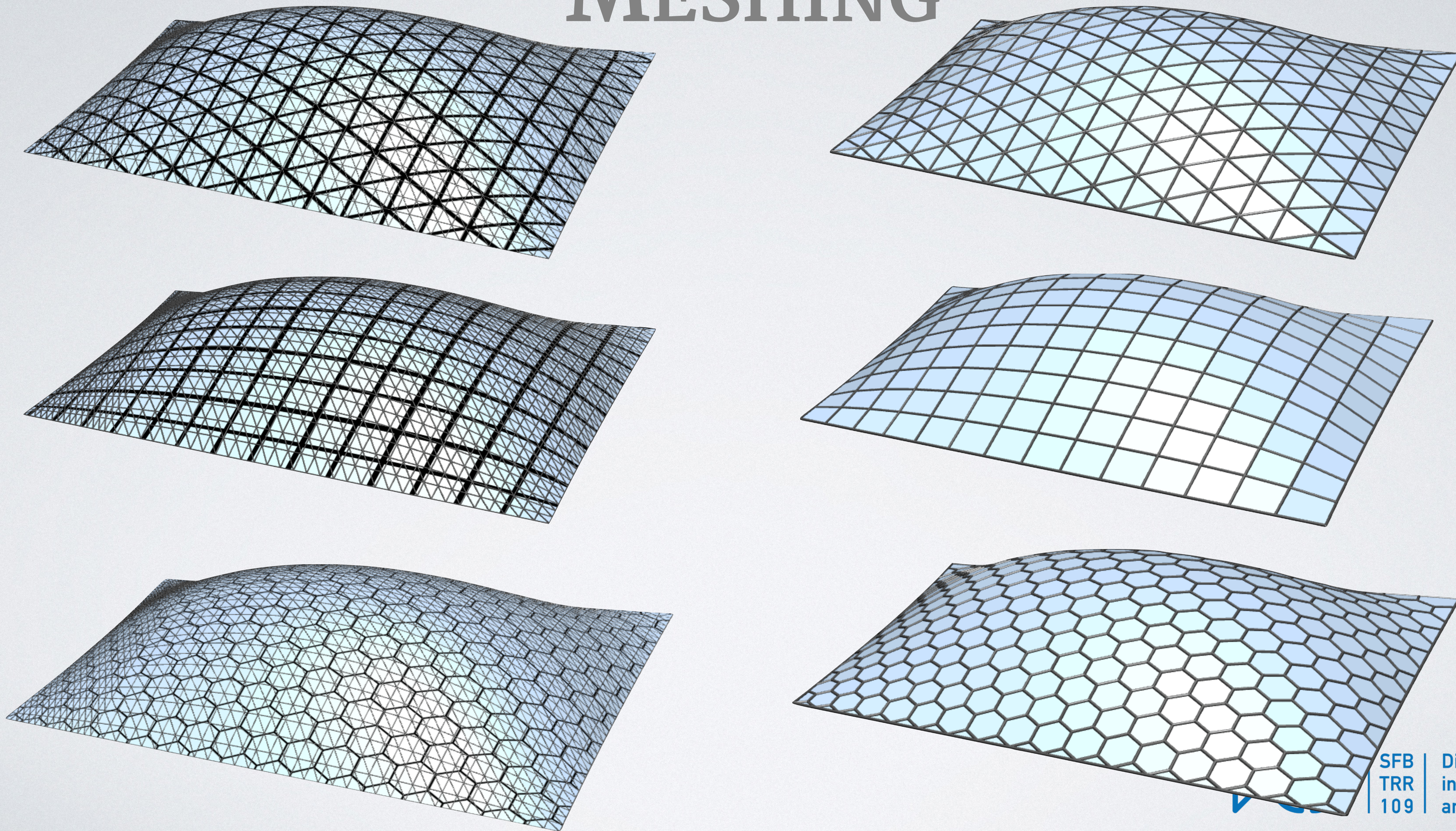


Parameterization

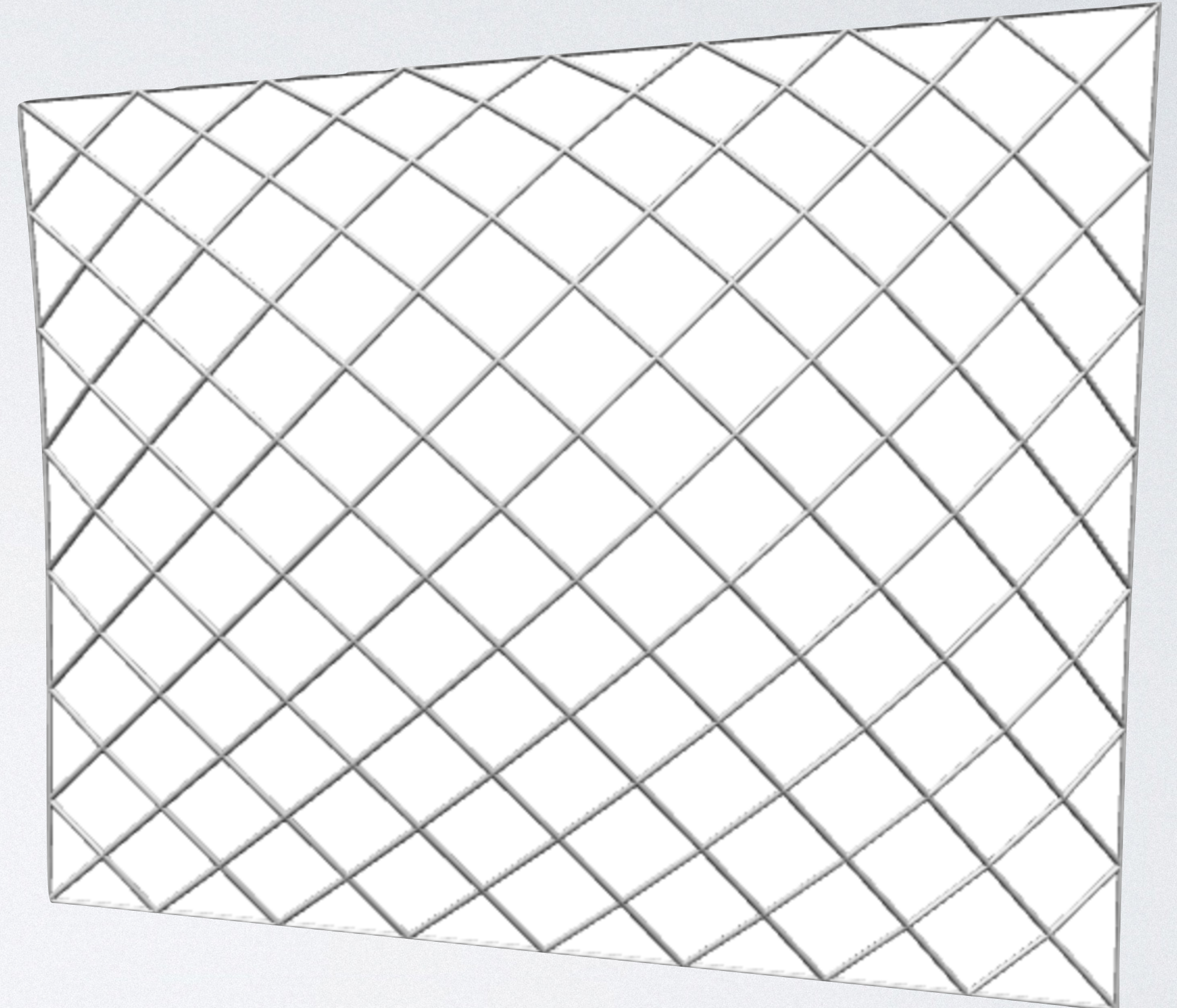
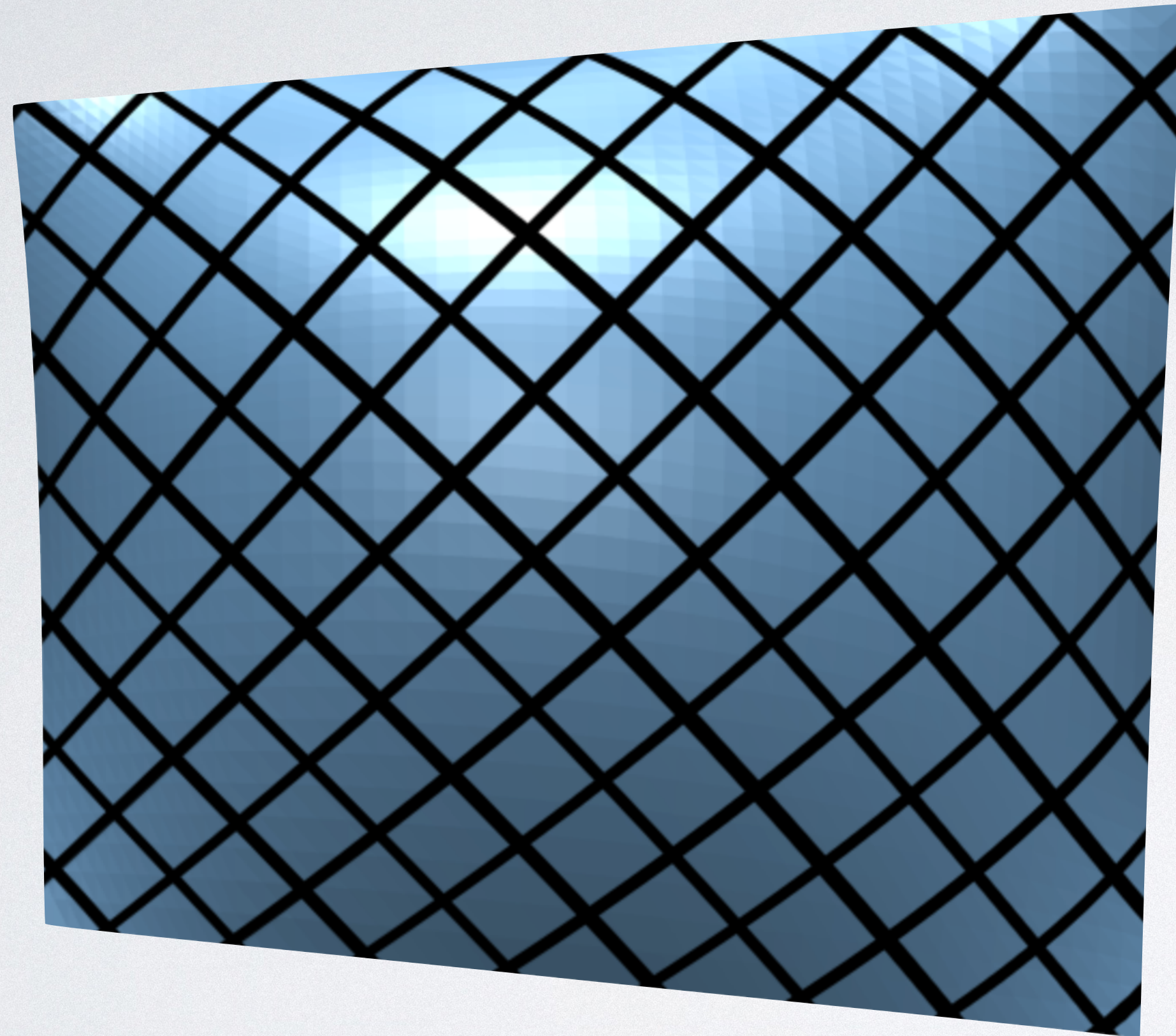


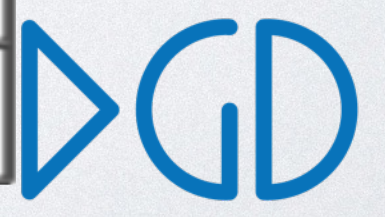
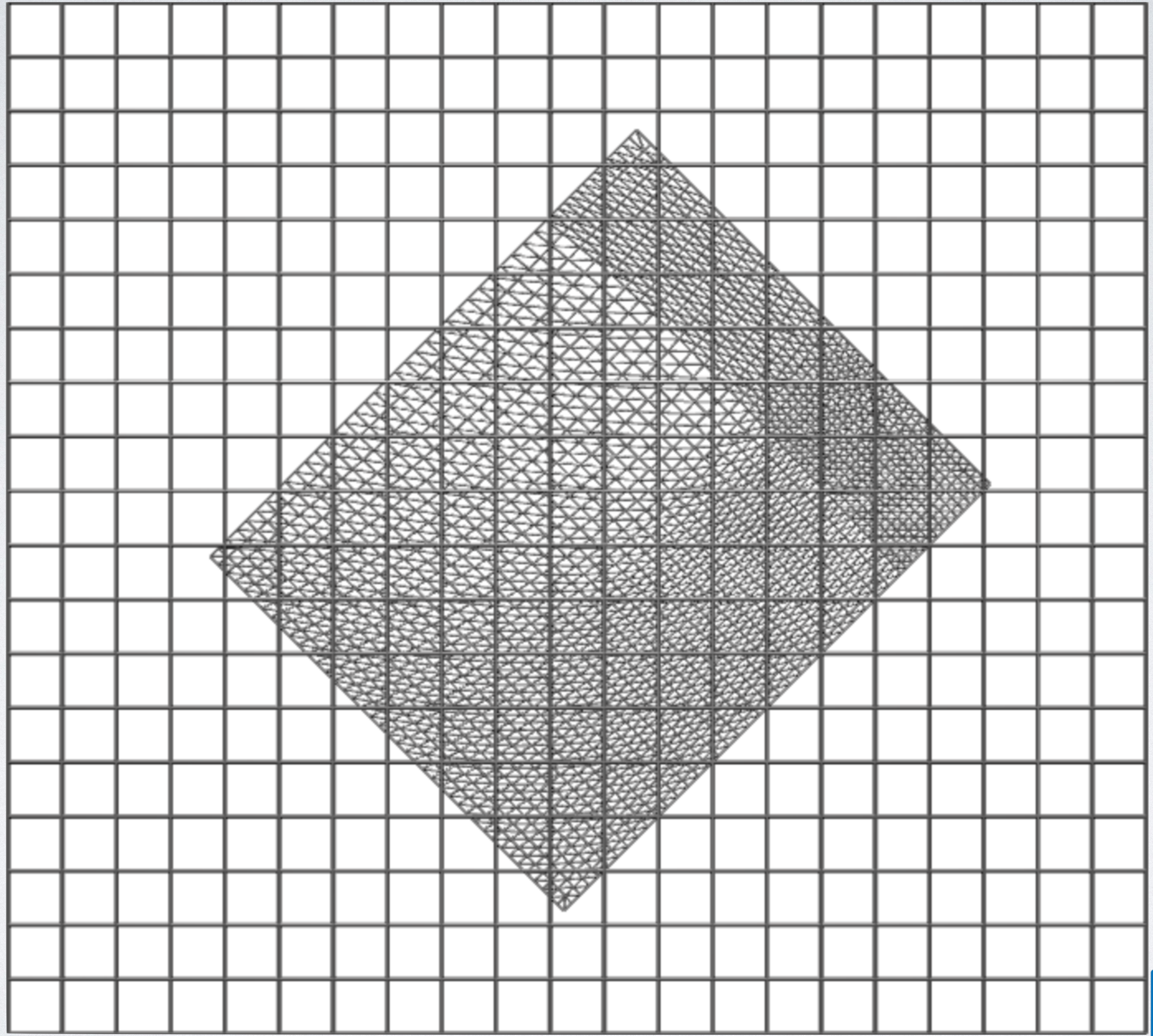
CONFORMAL MAPPING DEMO

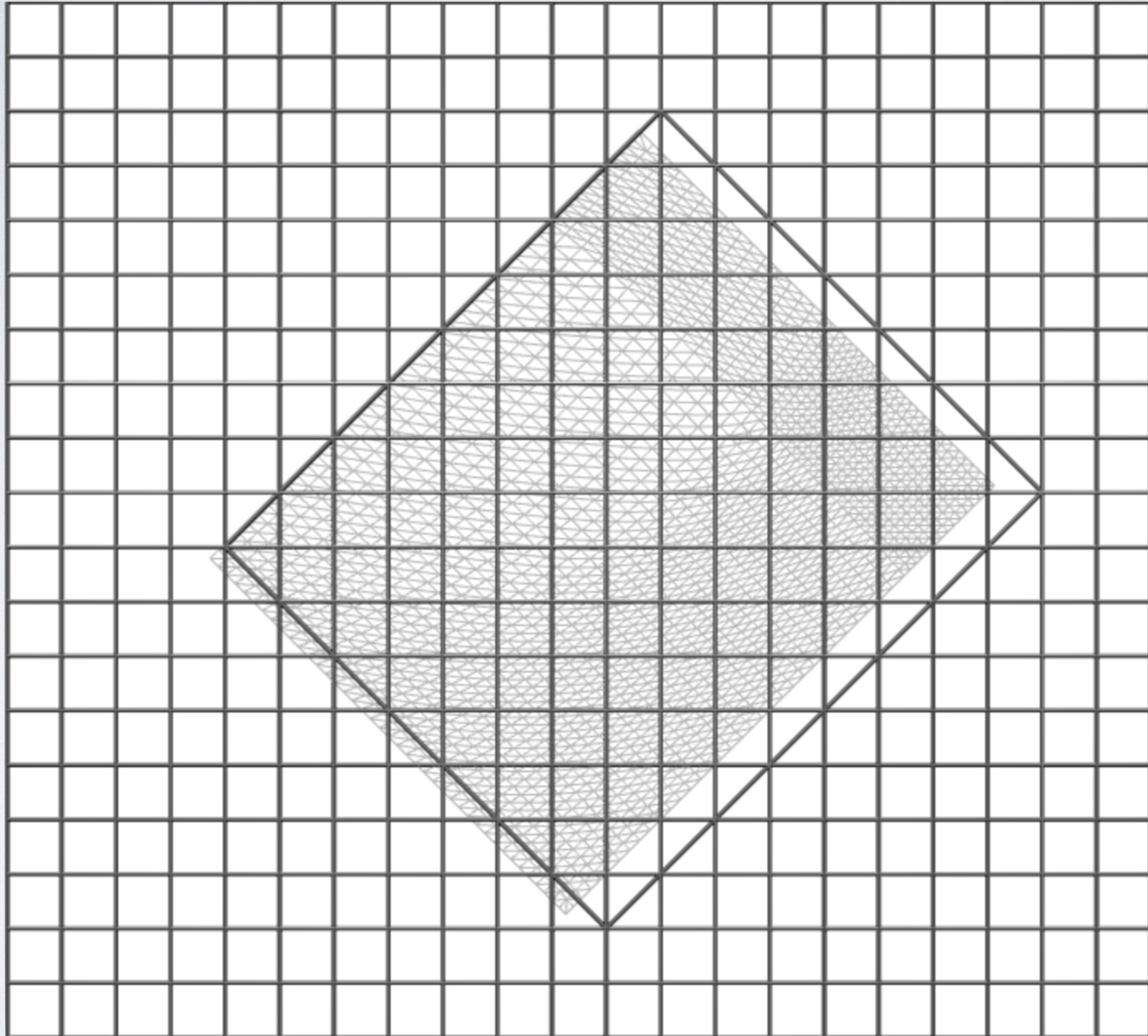
MESHING

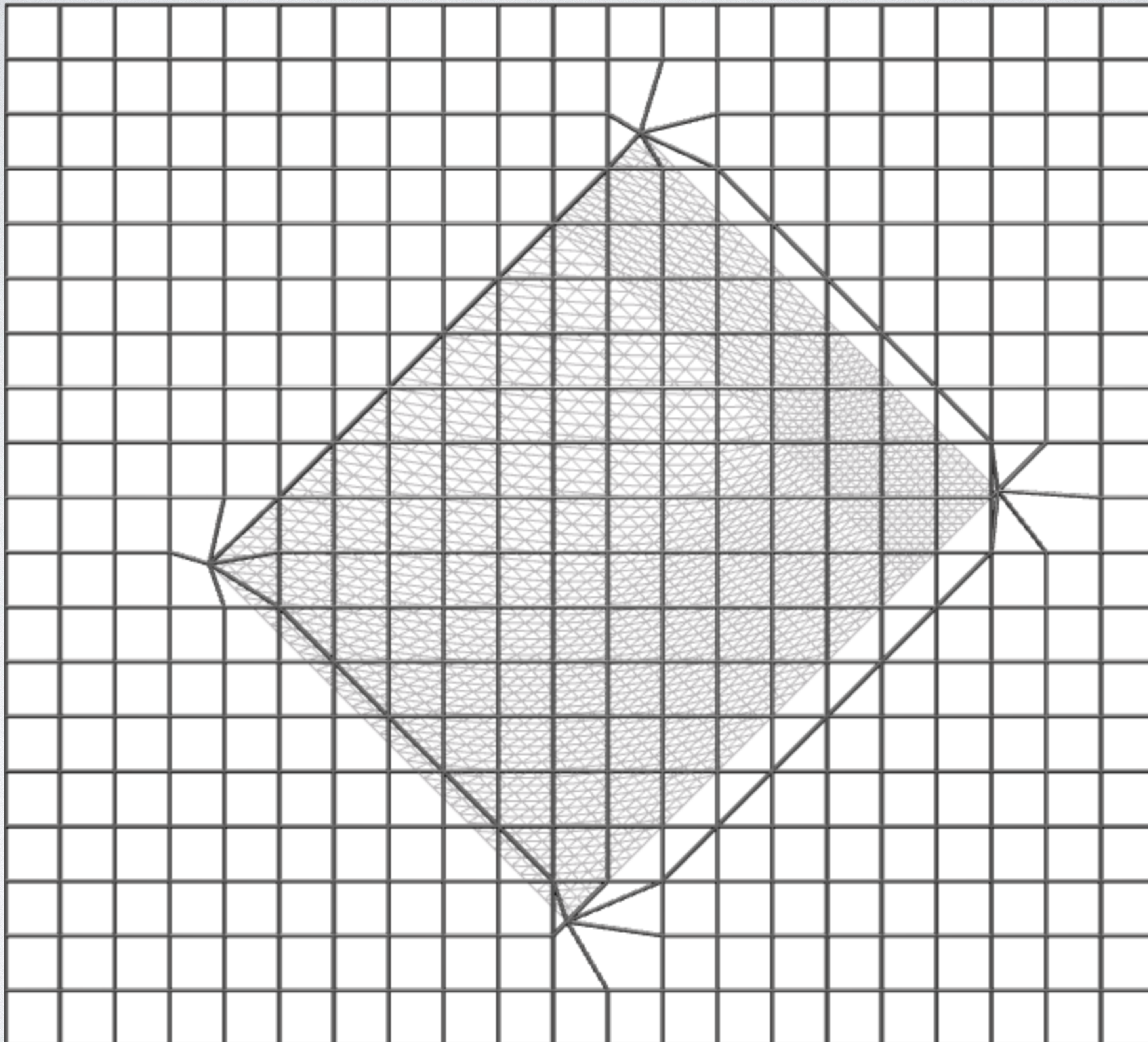


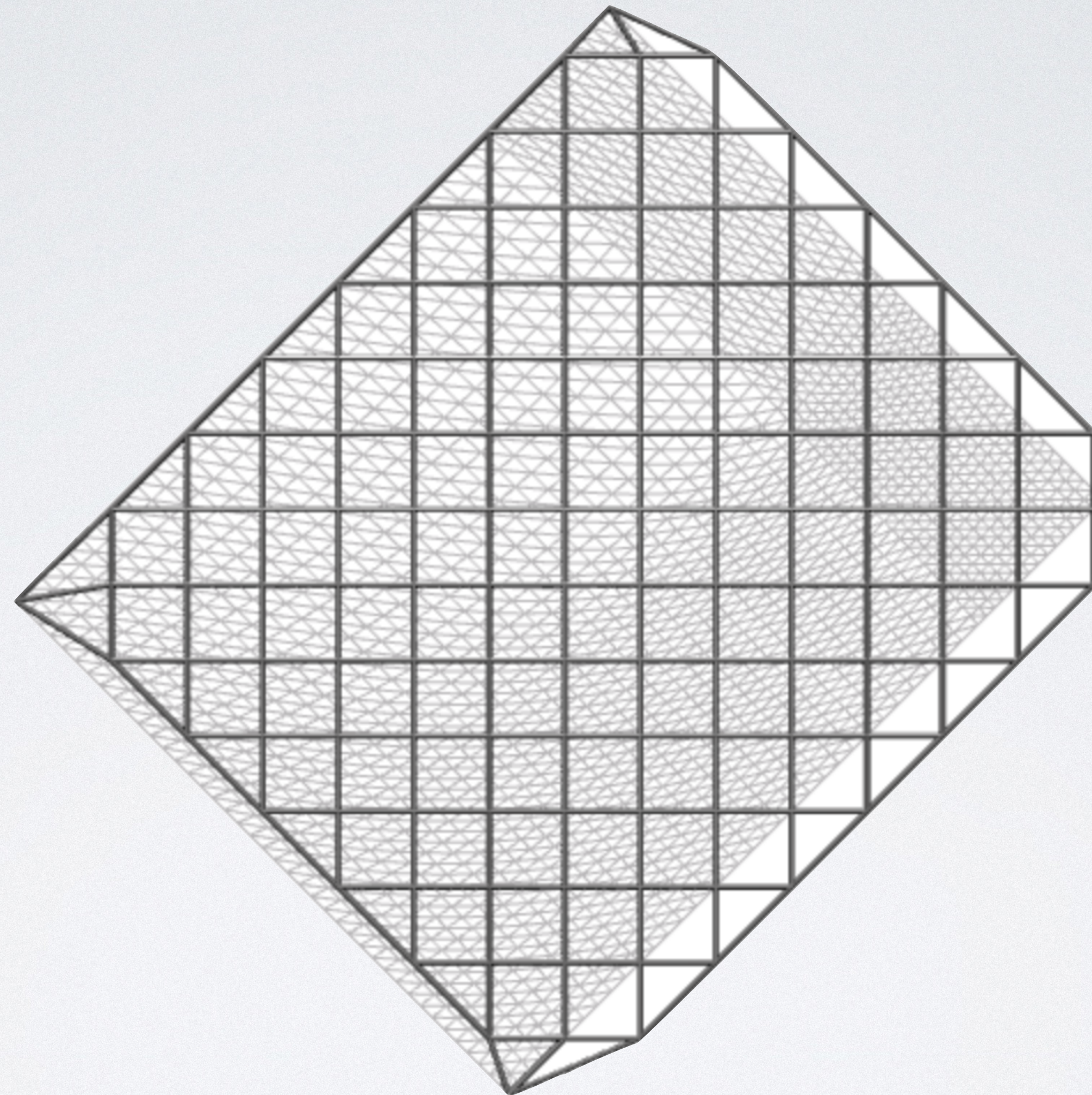
BOUNDARY ALIGNED MESHING

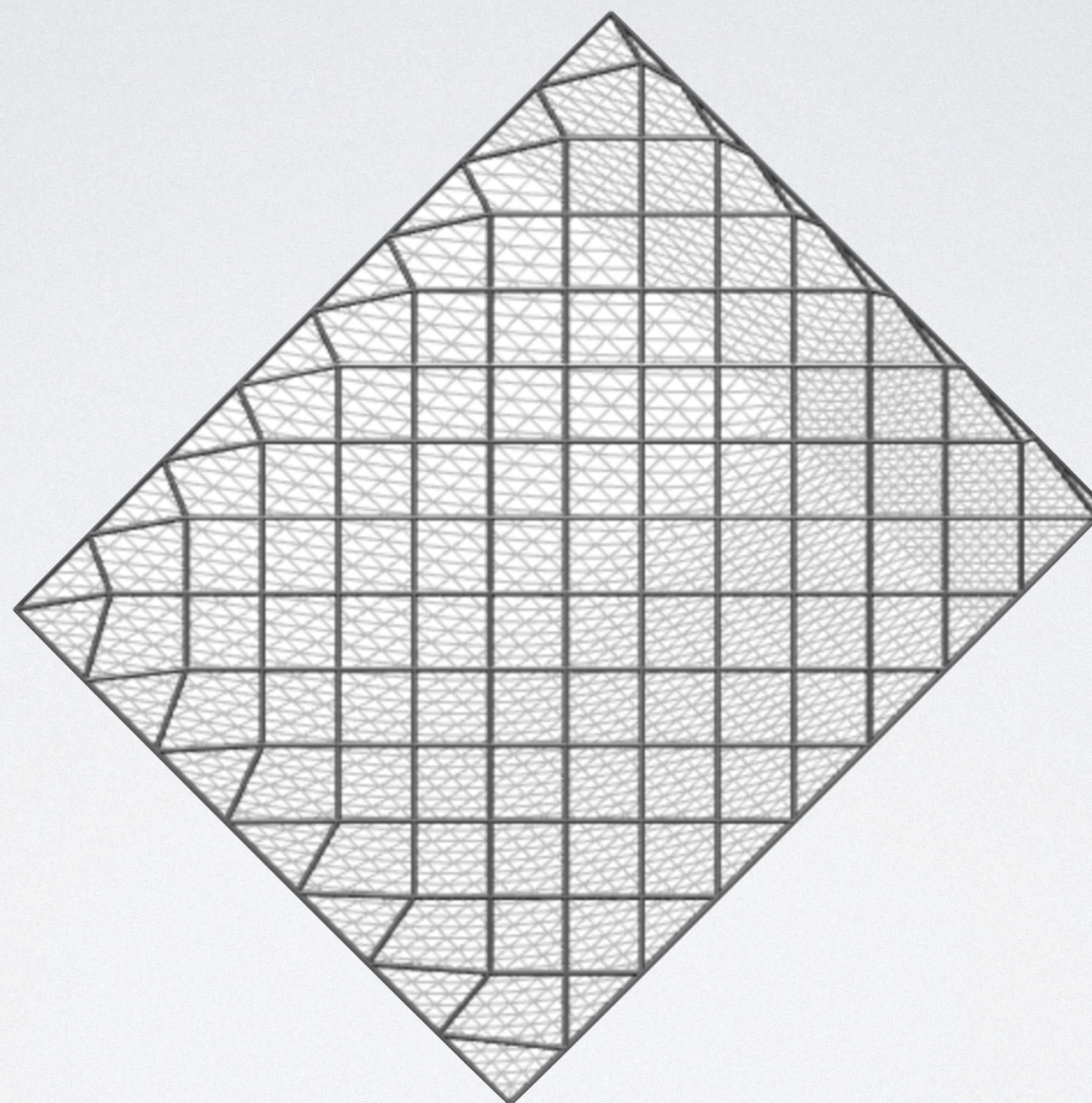


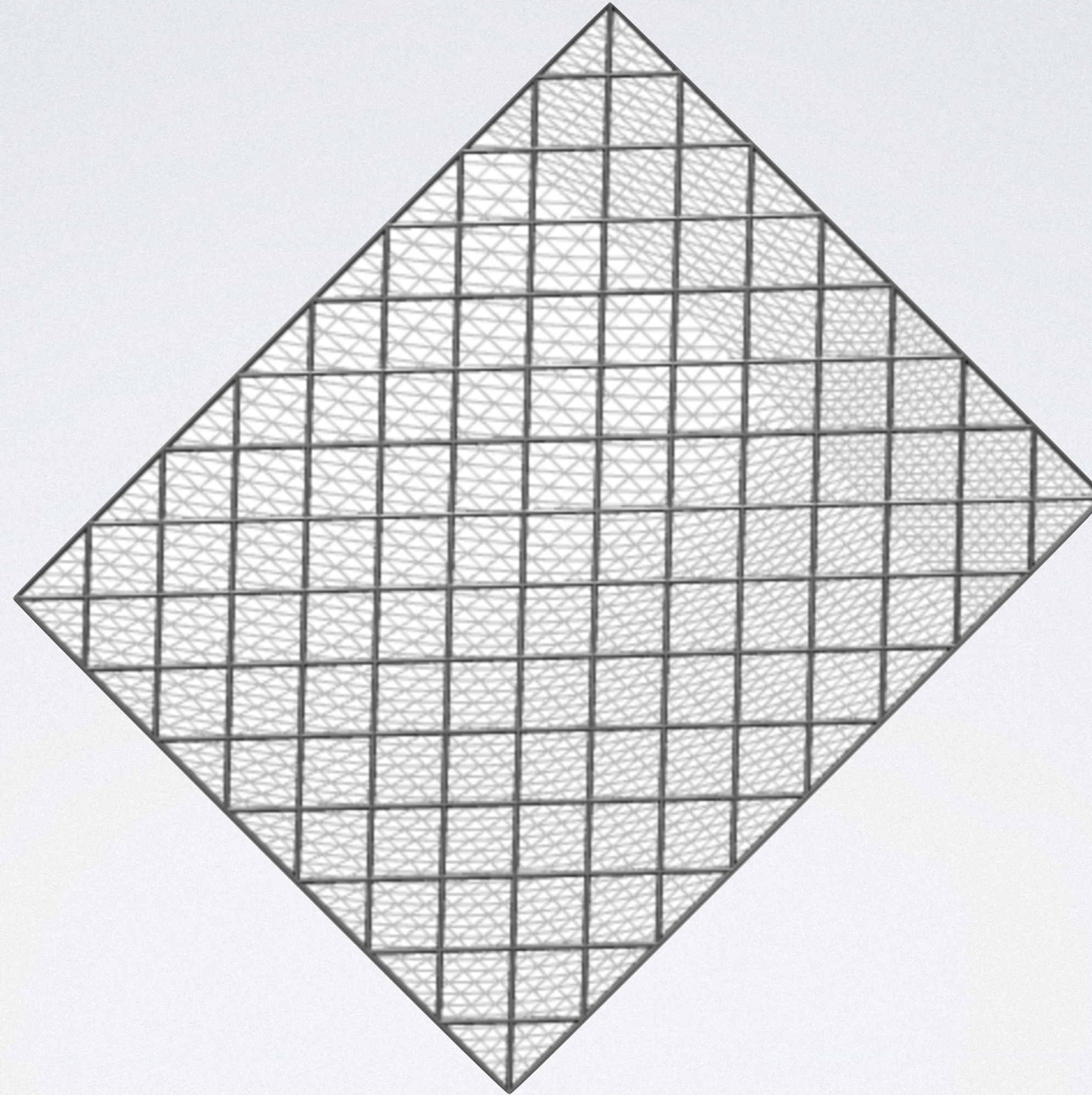






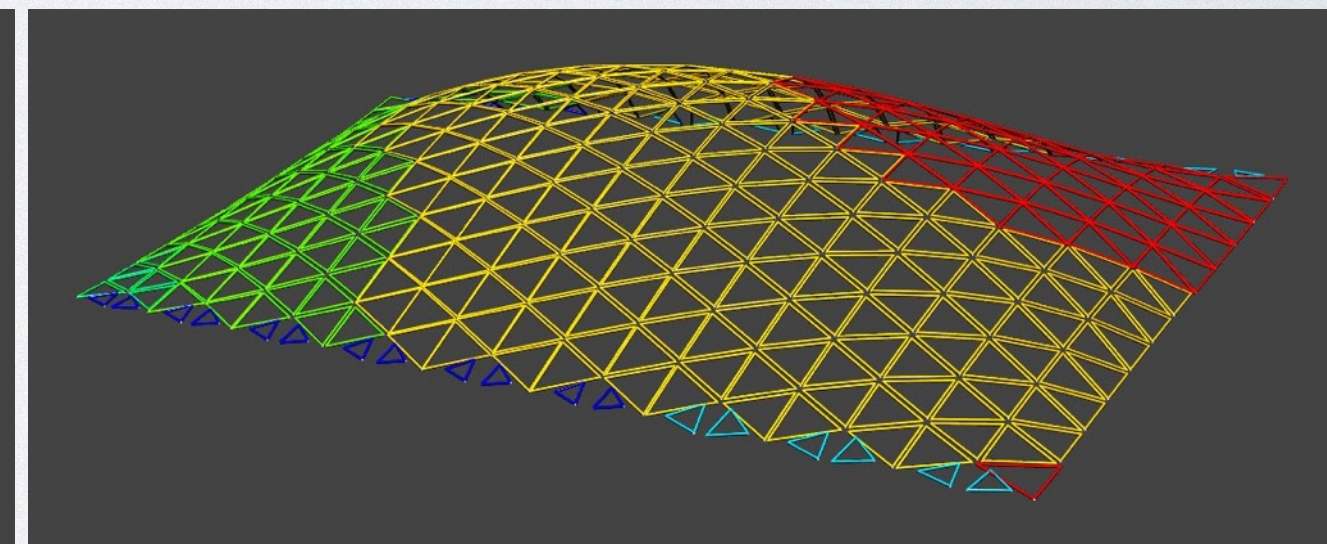
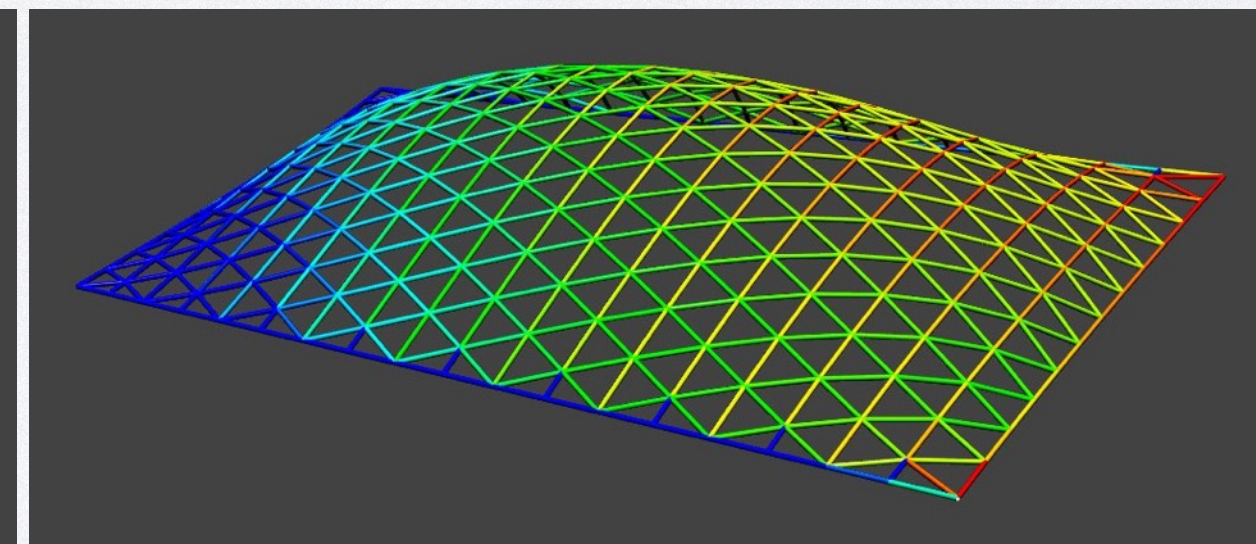
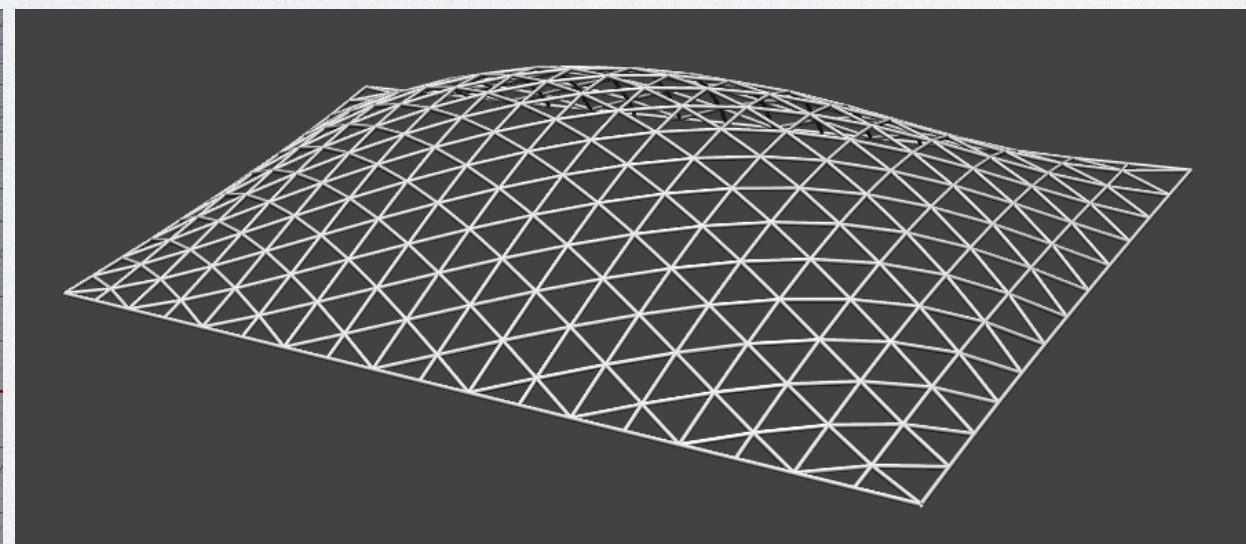
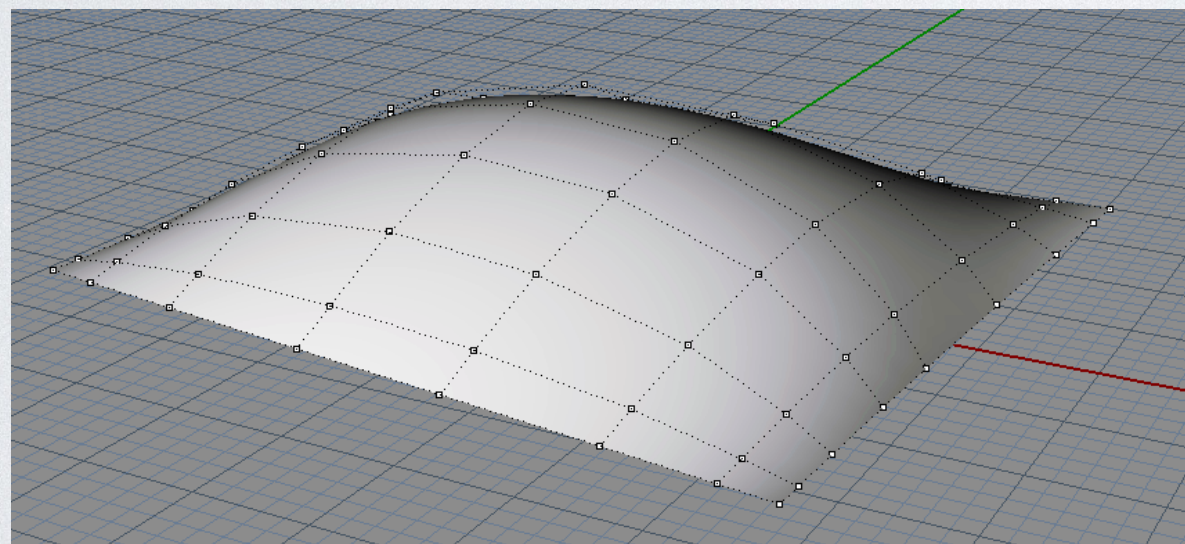
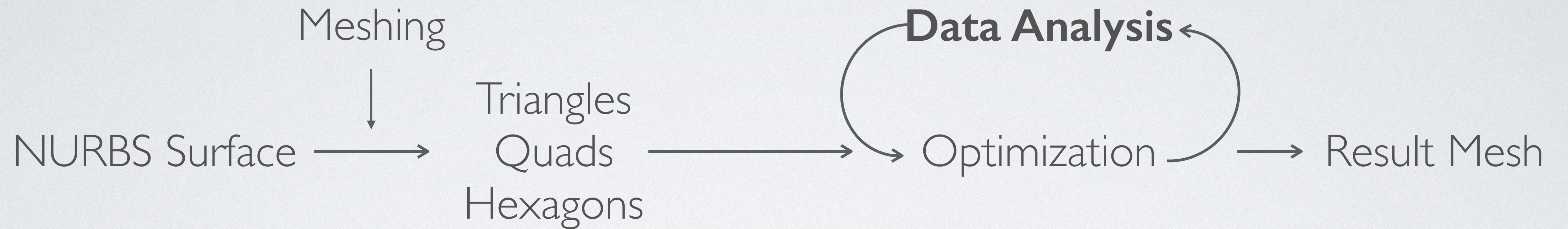






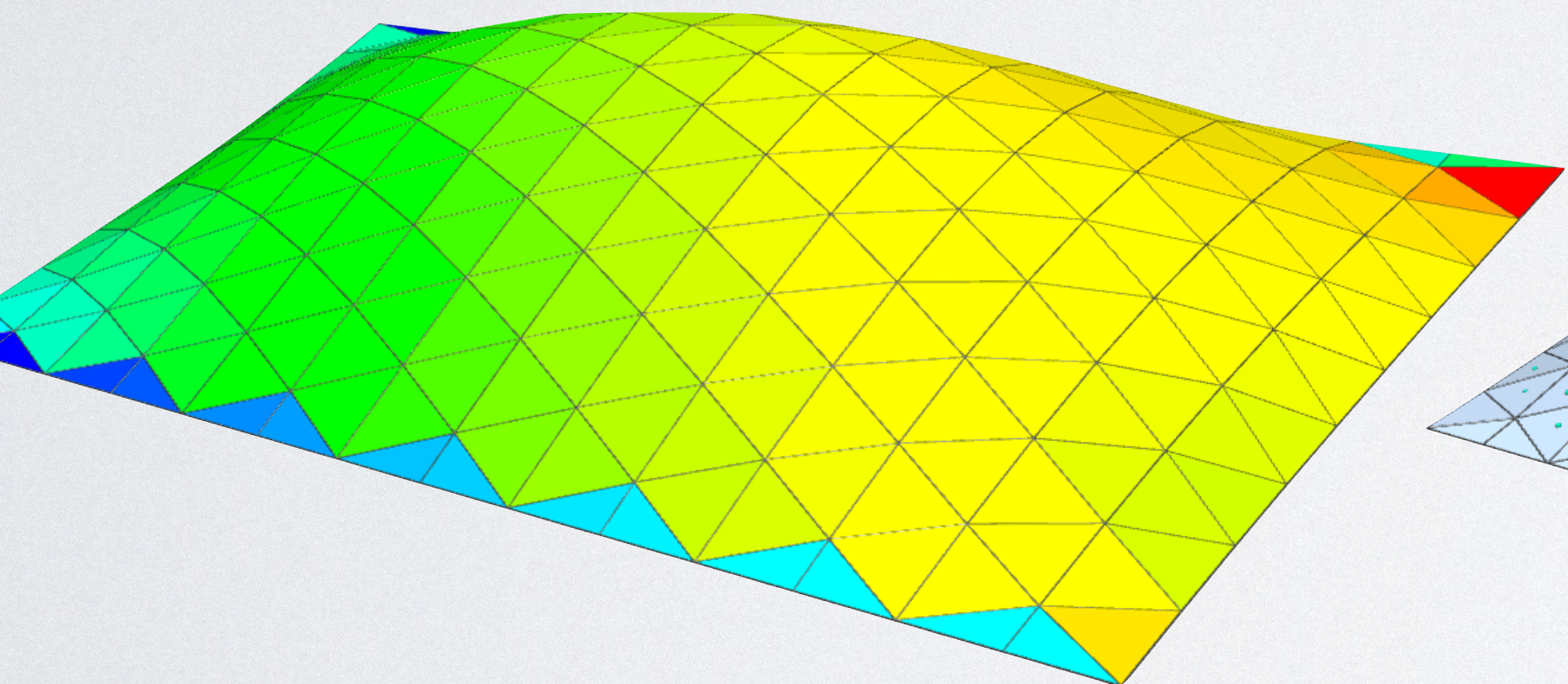
MESHING DEMO

DISCRETE SURFACE OPTIMIZATION

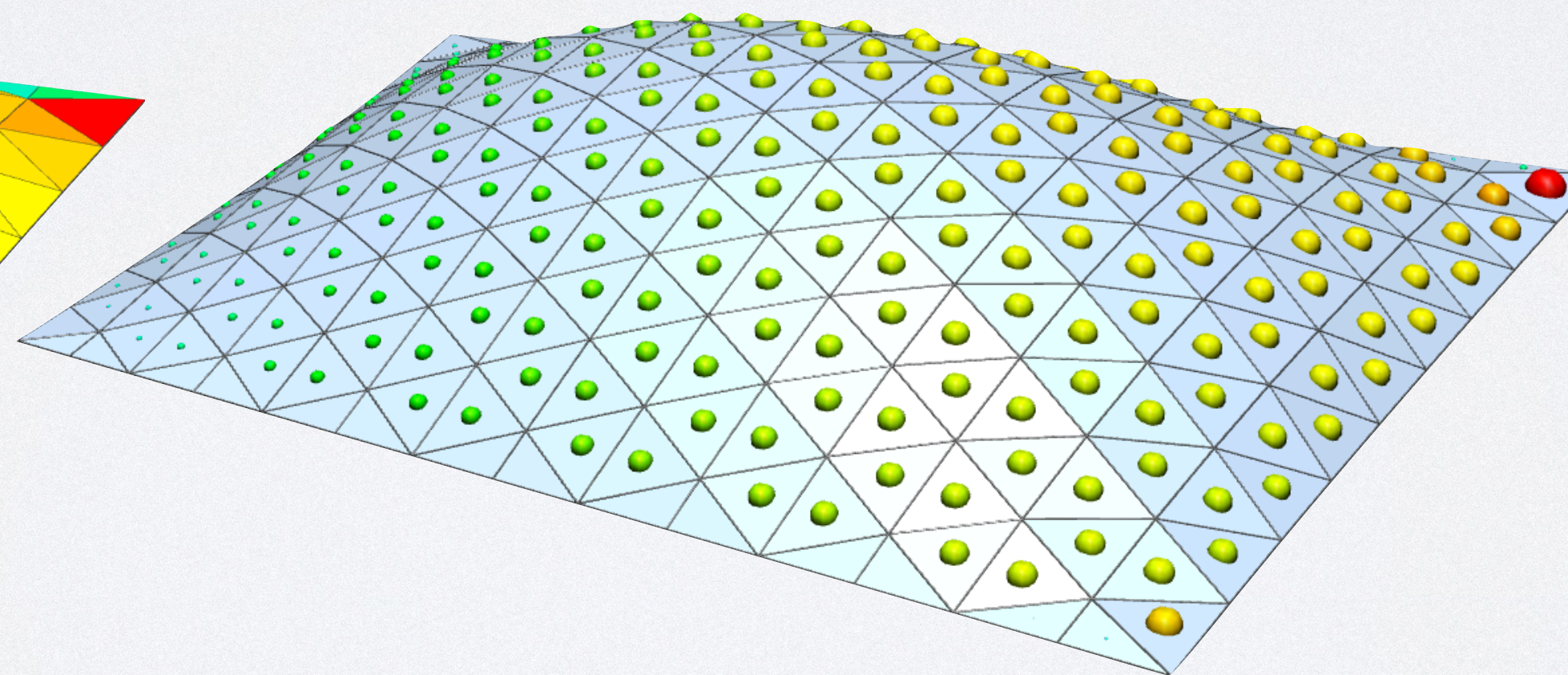


MESH DATA VISUALIZATION

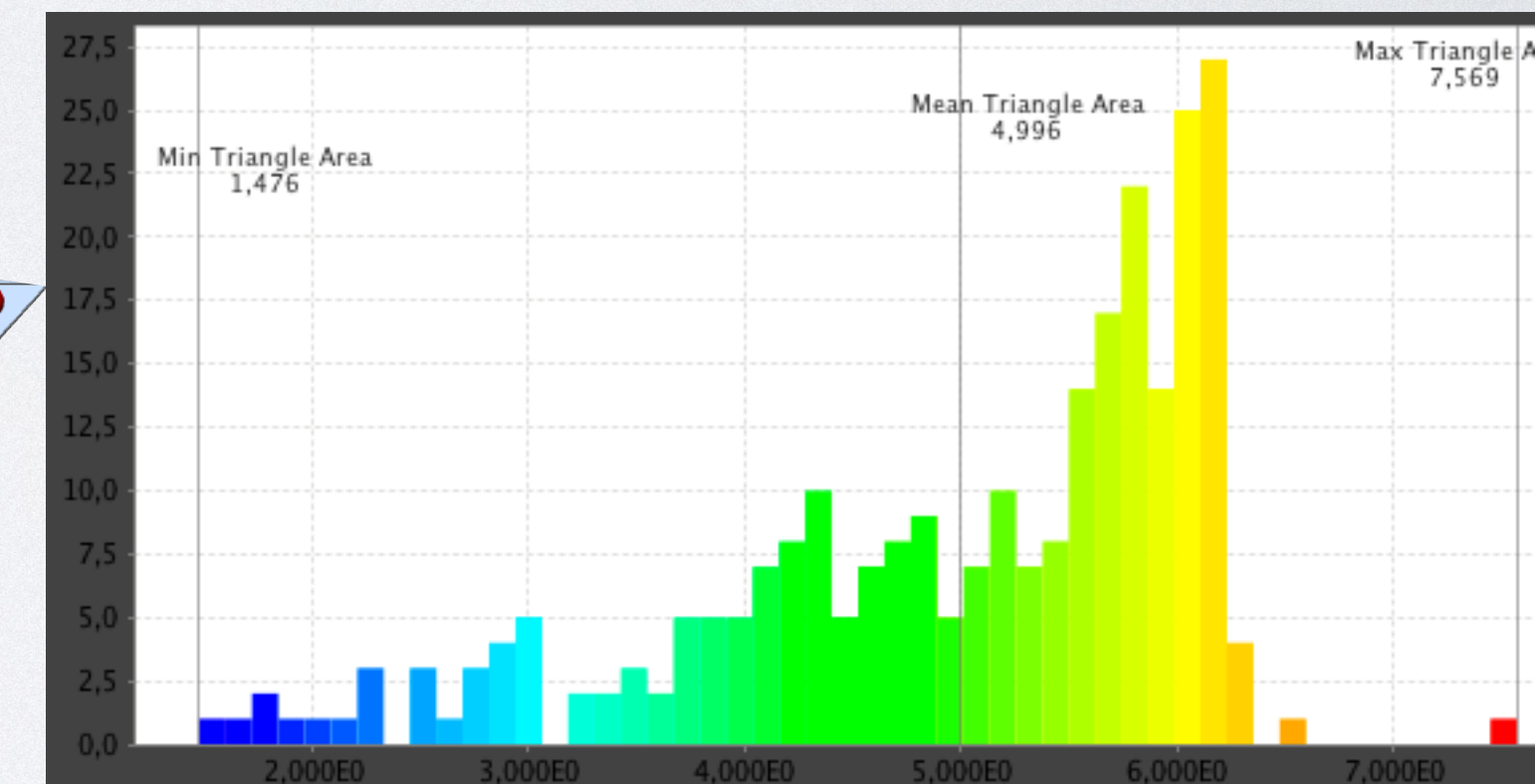
Colors



Spheres

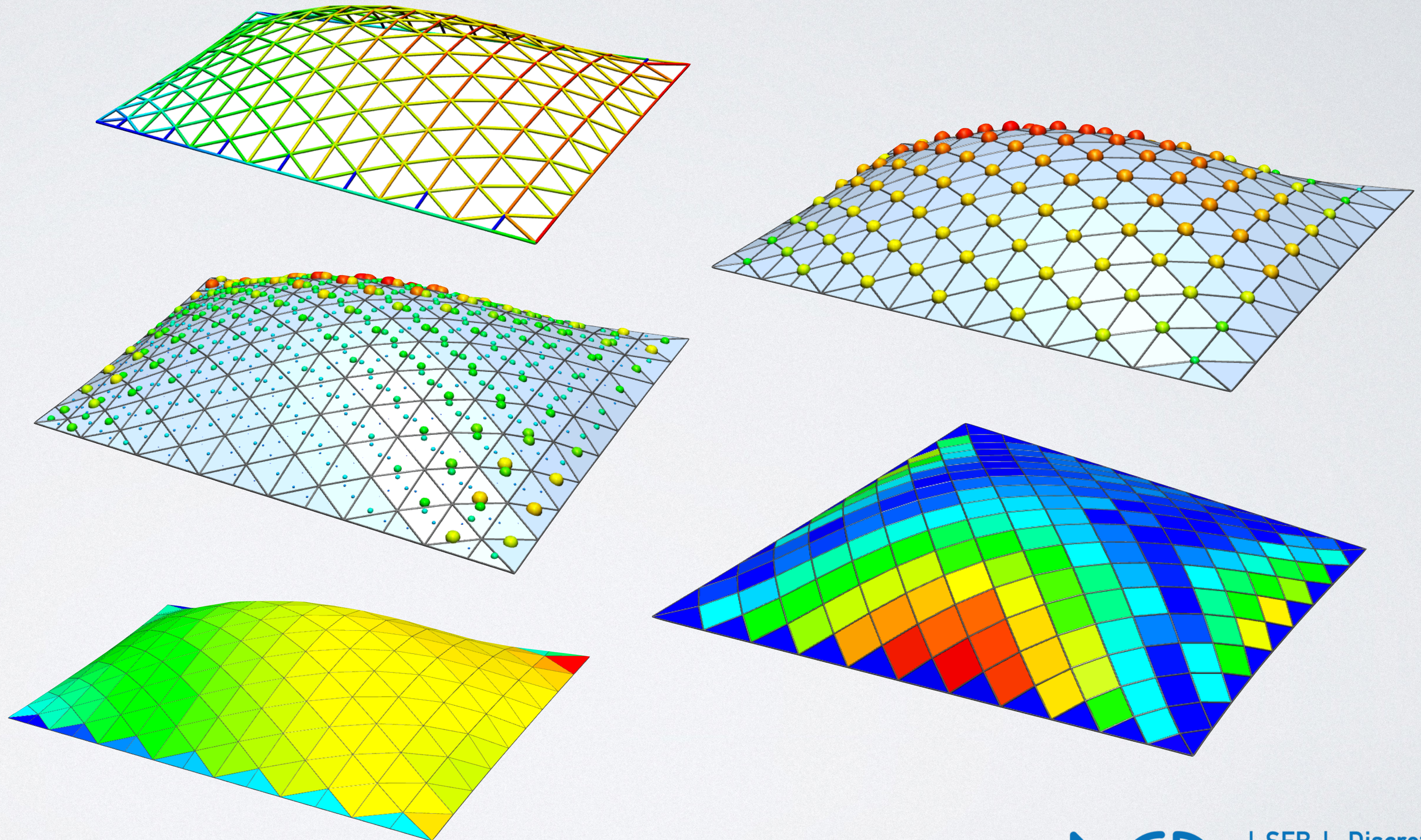


Histogram



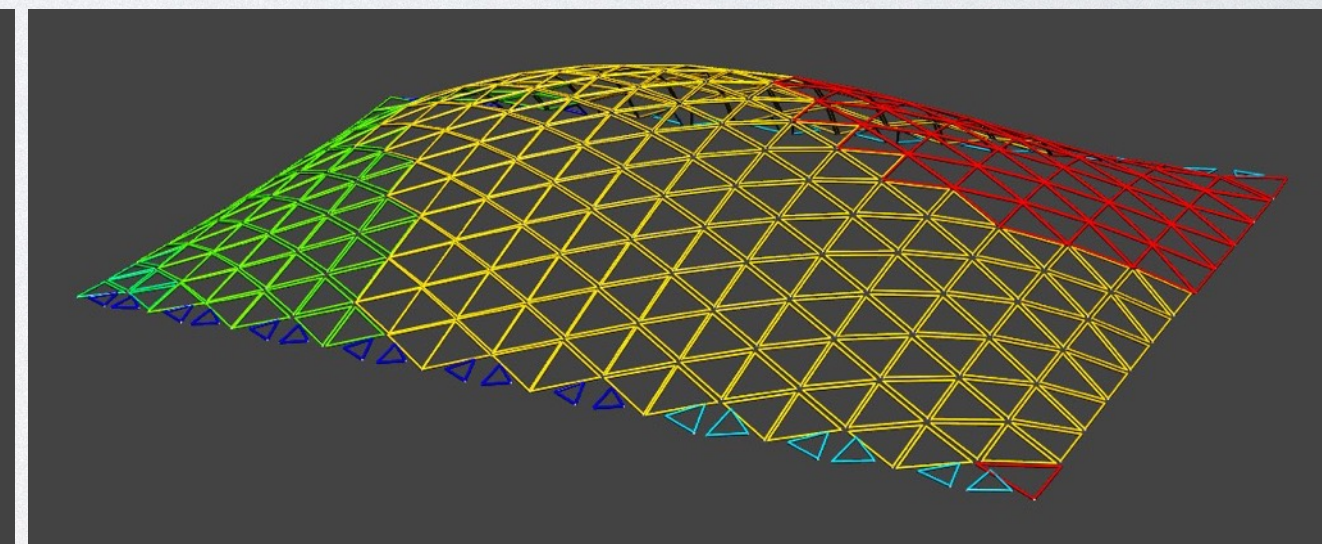
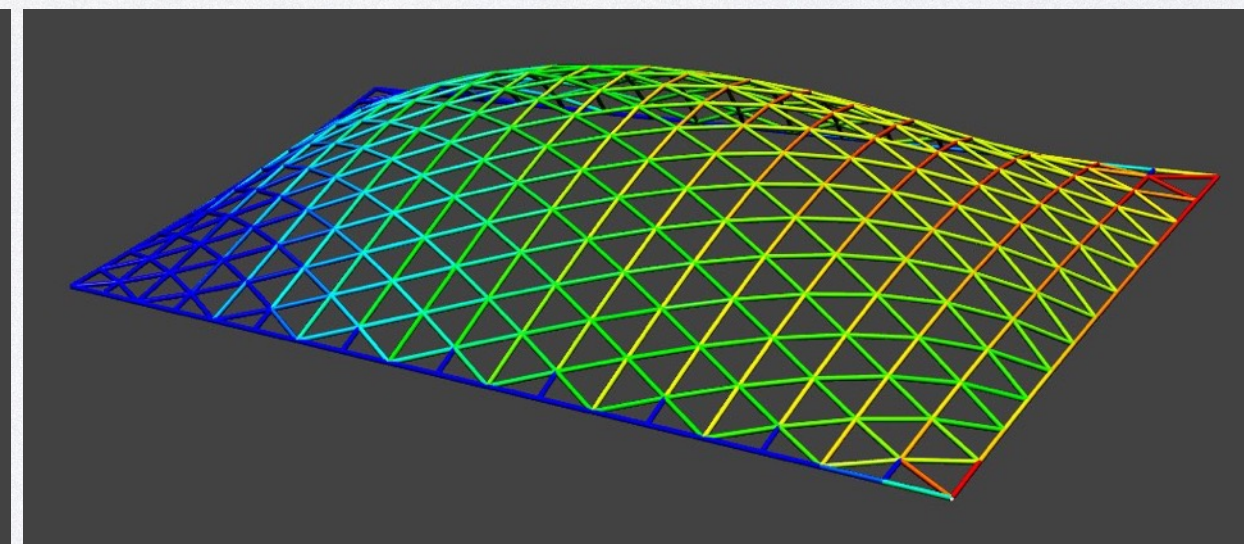
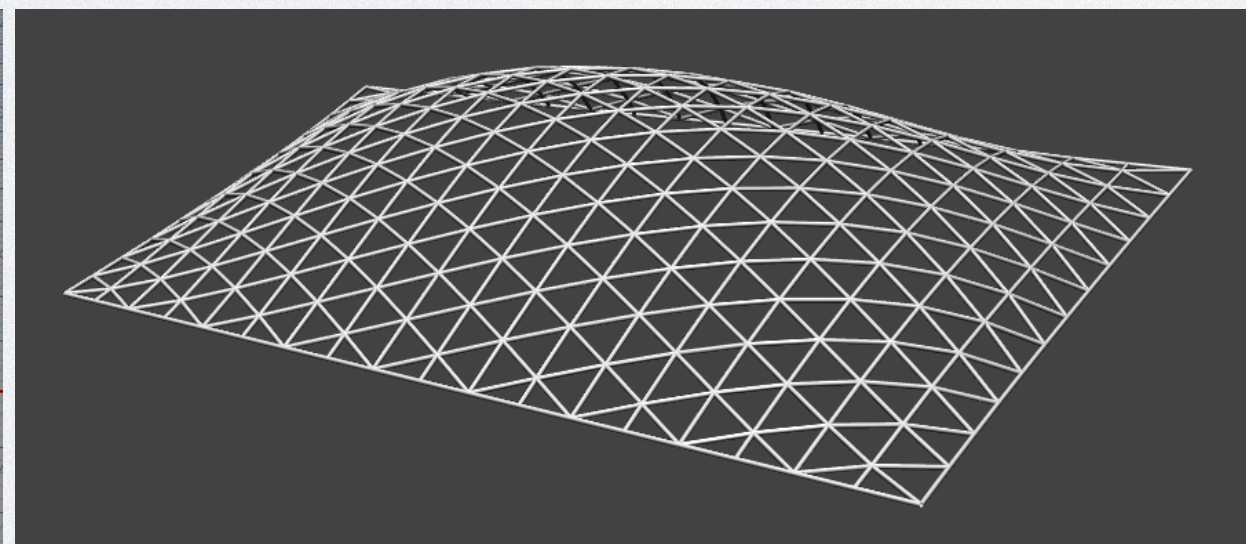
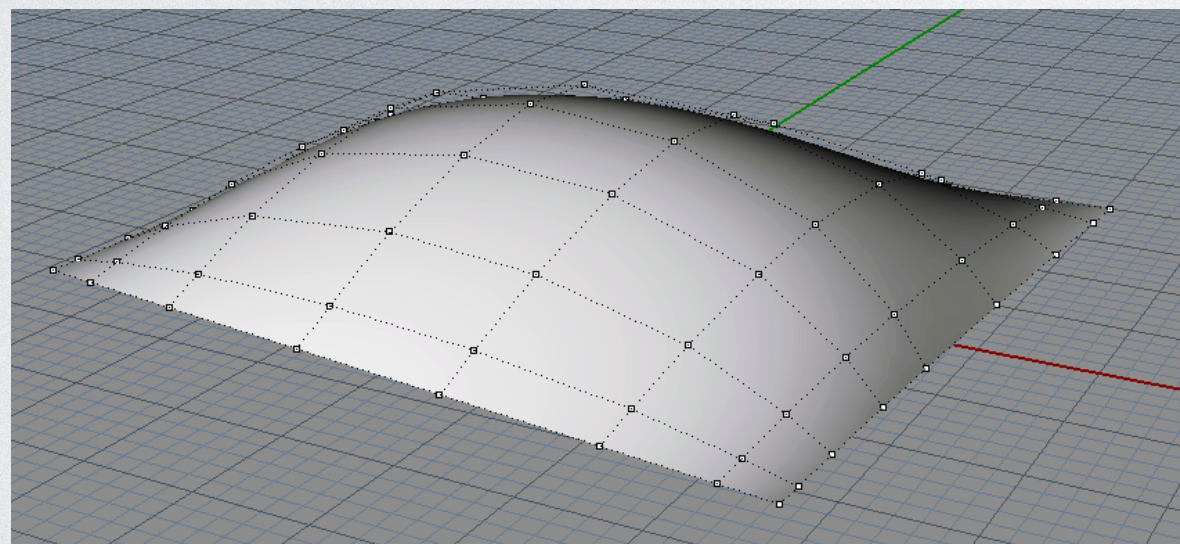
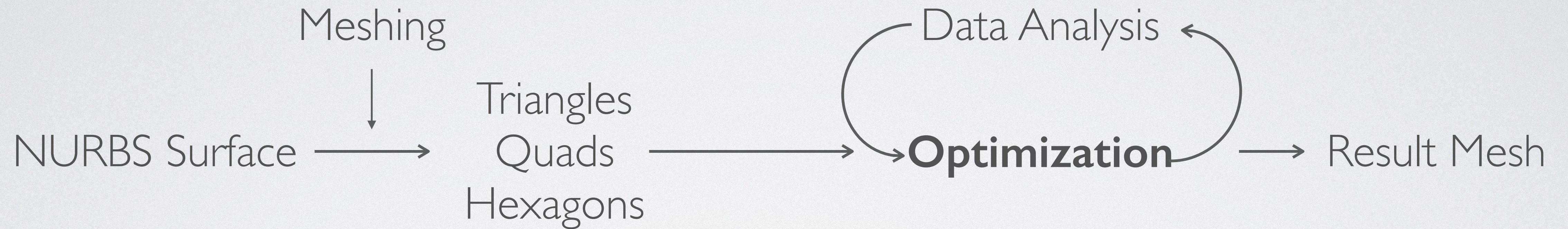
BUILD-IN DATA SOURCES

- Edge Length
- Gauss Curvature
- Edge Curvatures
- Face Planarity
- Triangle Area
- ...



VISUALIZATION DEMO

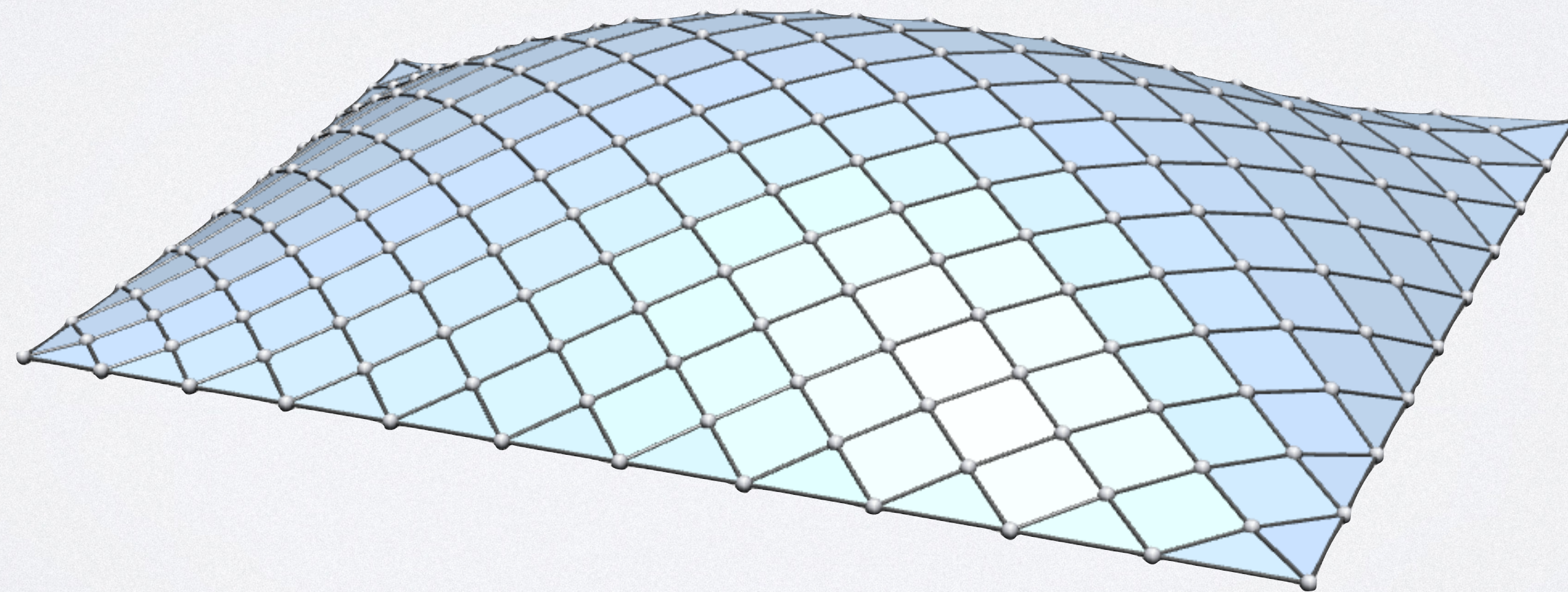
DISCRETE SURFACE OPTIMIZATION



MESH OPTIMIZATION

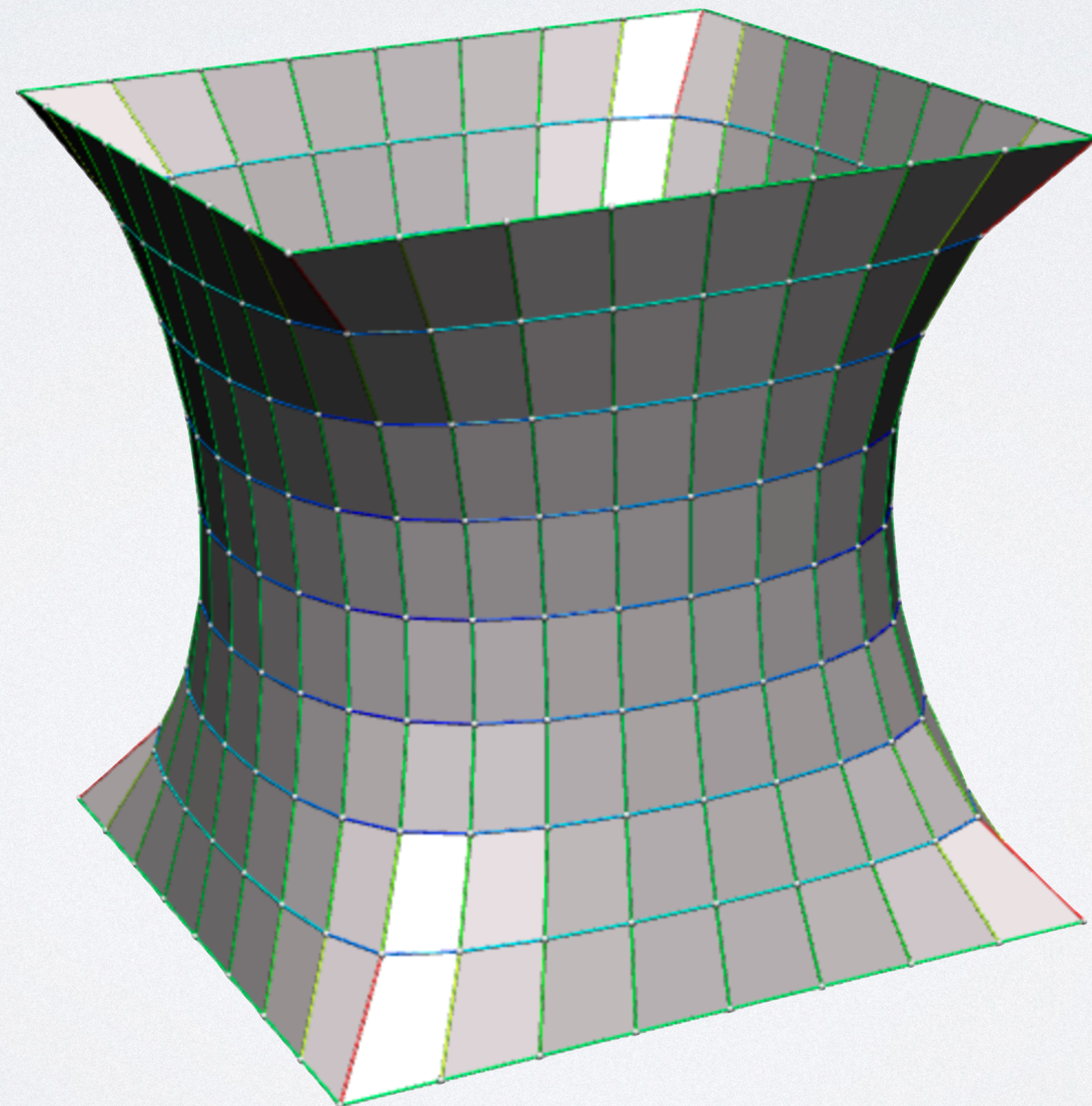
$$f_1, \dots, f_n : S \rightarrow \mathbb{R}$$

$$f(S) = \sum_{i=1}^n \lambda_i f_i(S) \quad \nabla f(S) = \sum_{i=1}^n \lambda_i \nabla f_i(S)$$



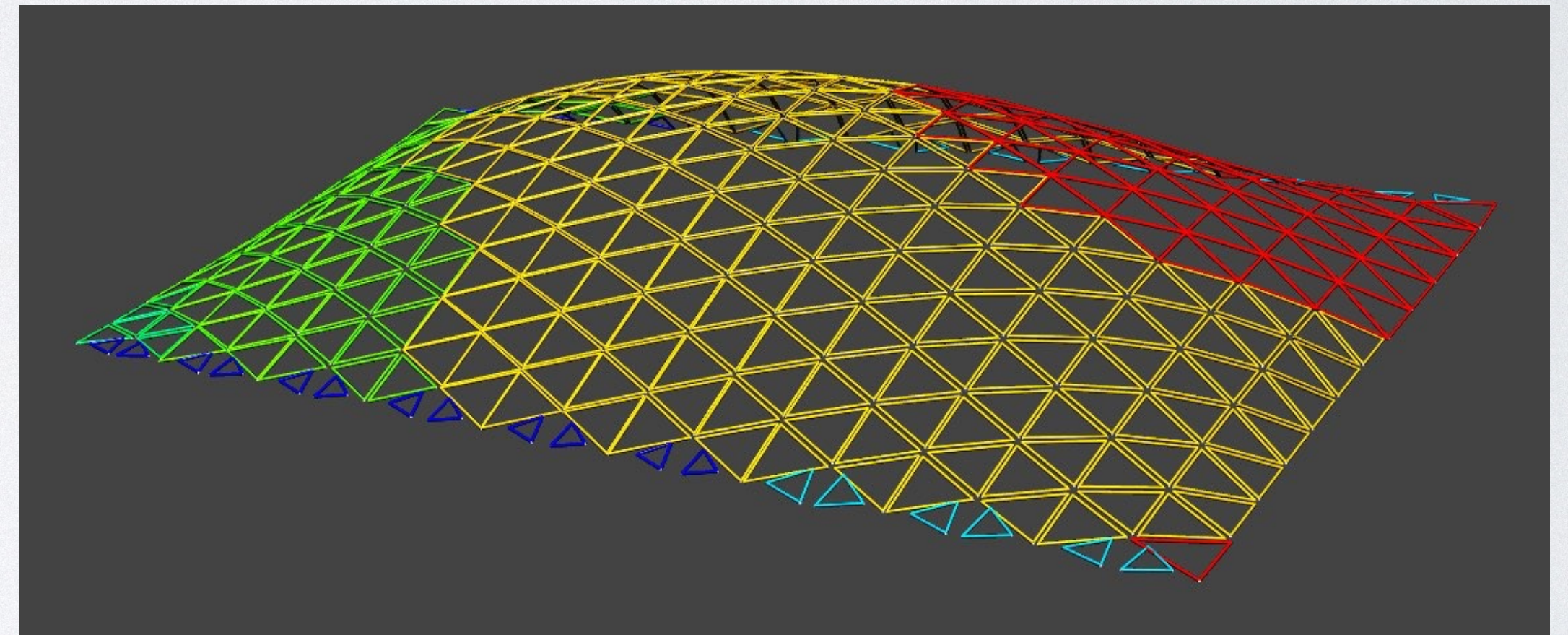
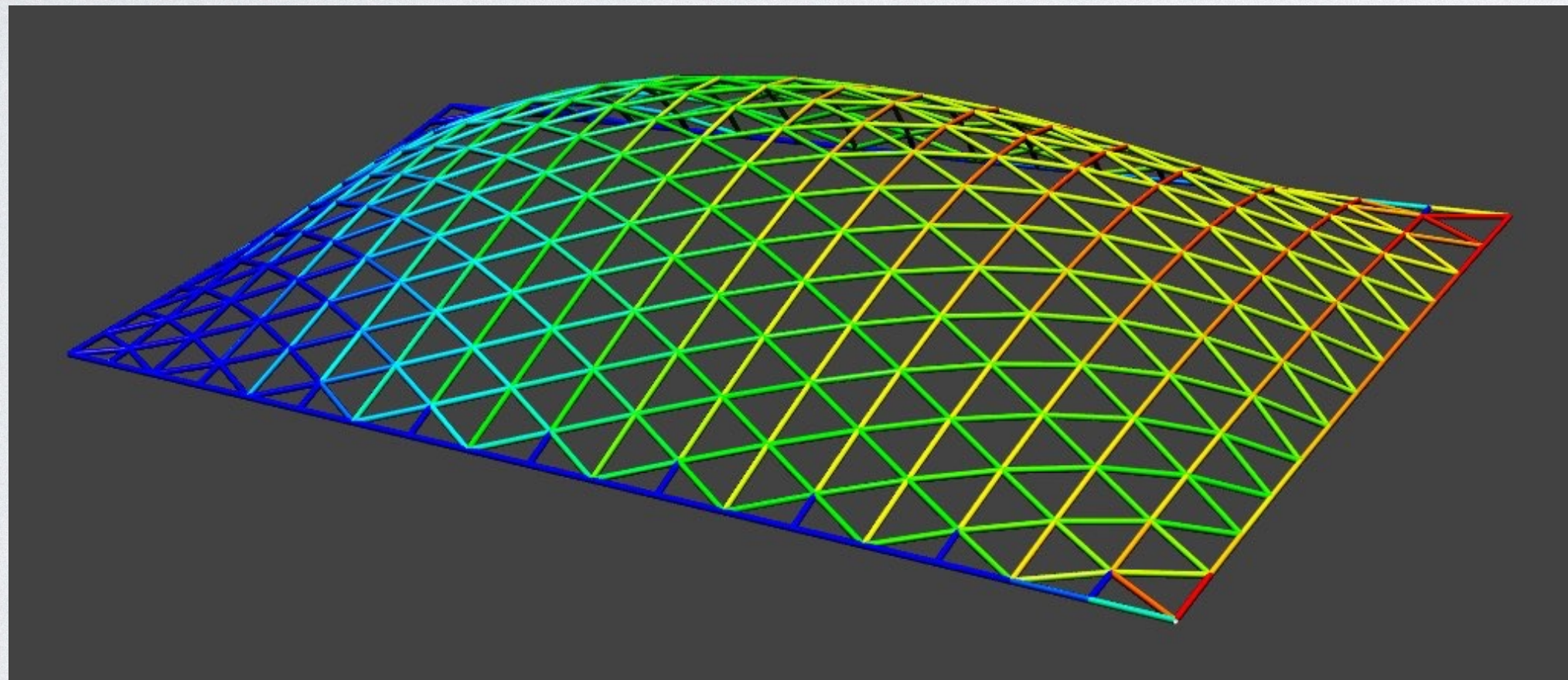
SPRINGS DEMO

$$E_{spring} = \sum_{e_{ij} \in E} (\|v_i - v_j\| - l)^2$$

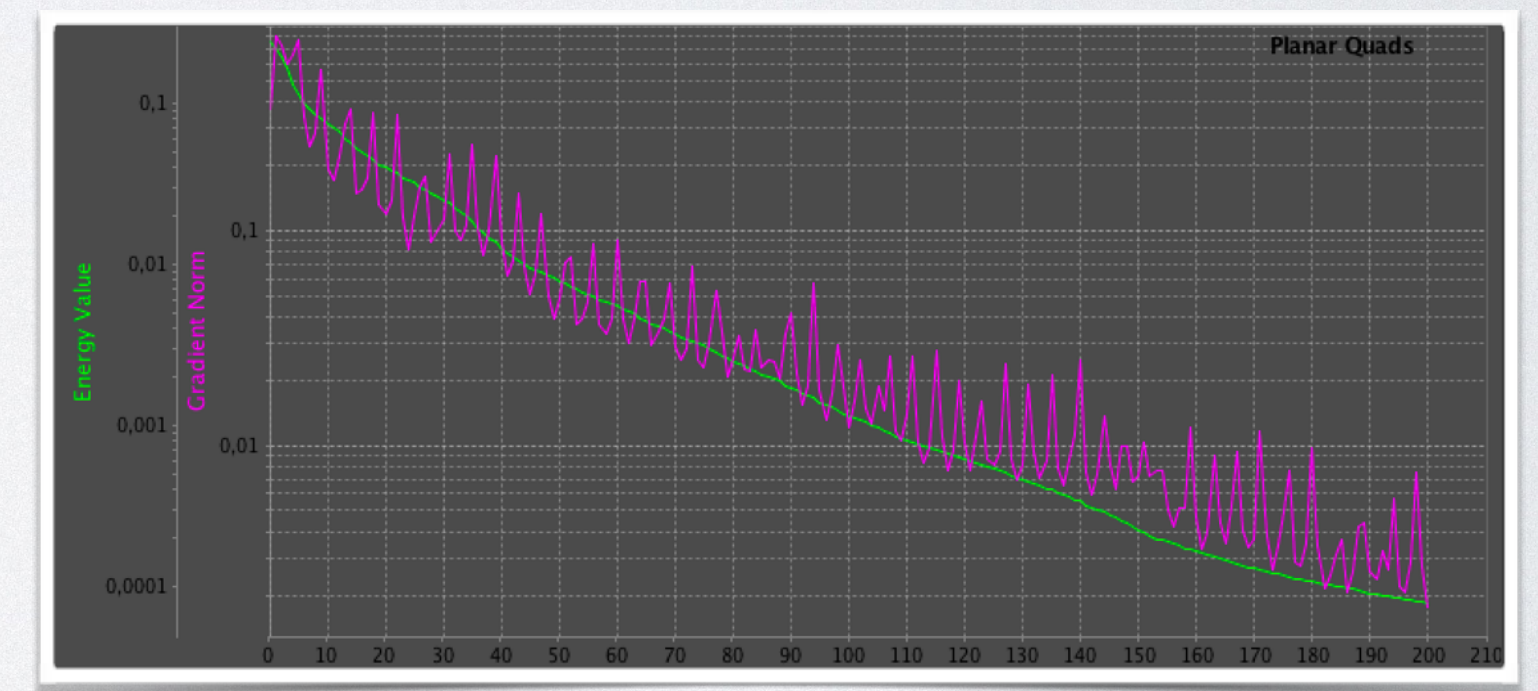
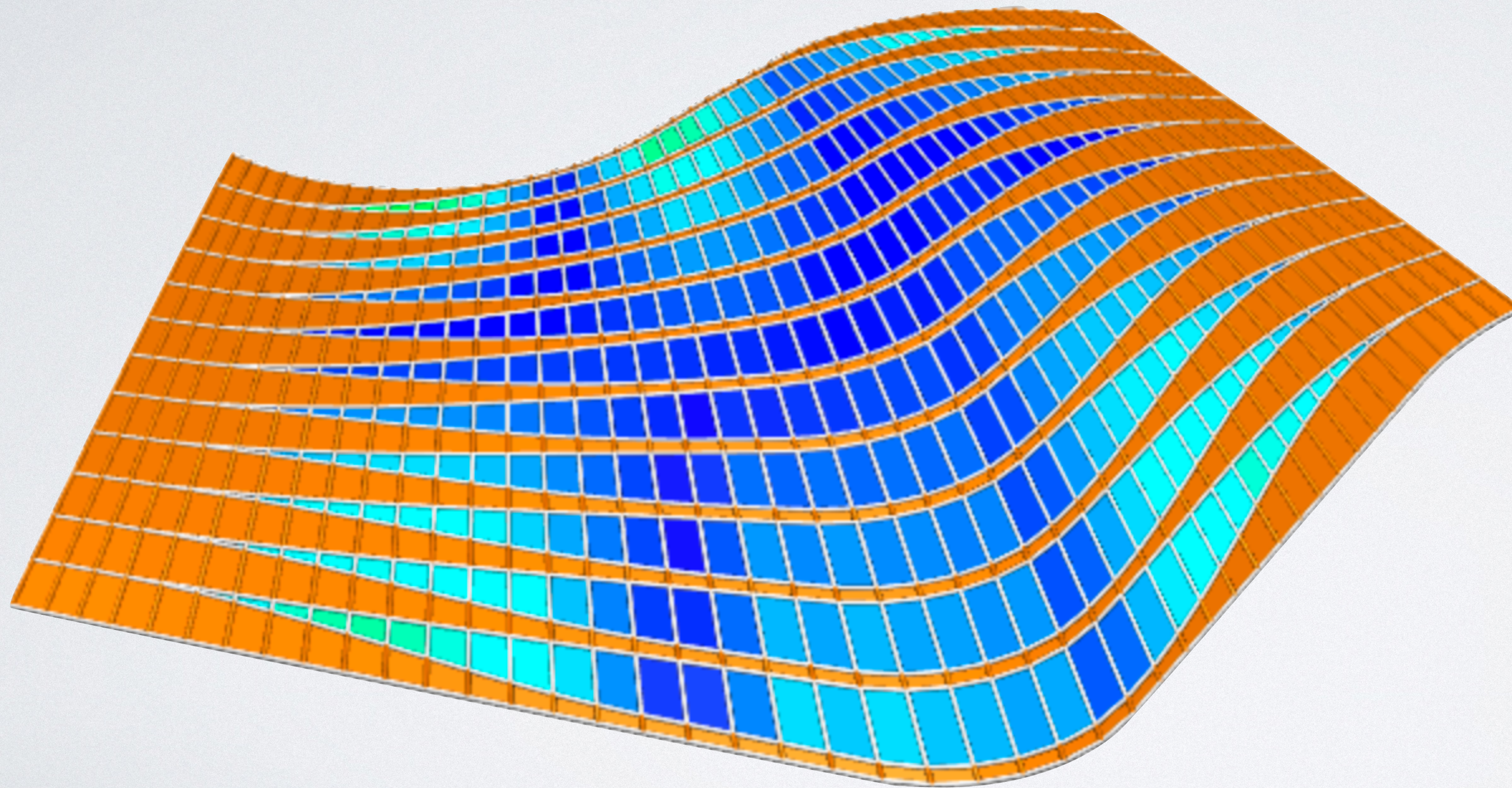


QUANTIZED EDGES

$$E_{spring} = \sum_{e_{ij} \in E} (\|v_i - v_j\| - l)^2$$

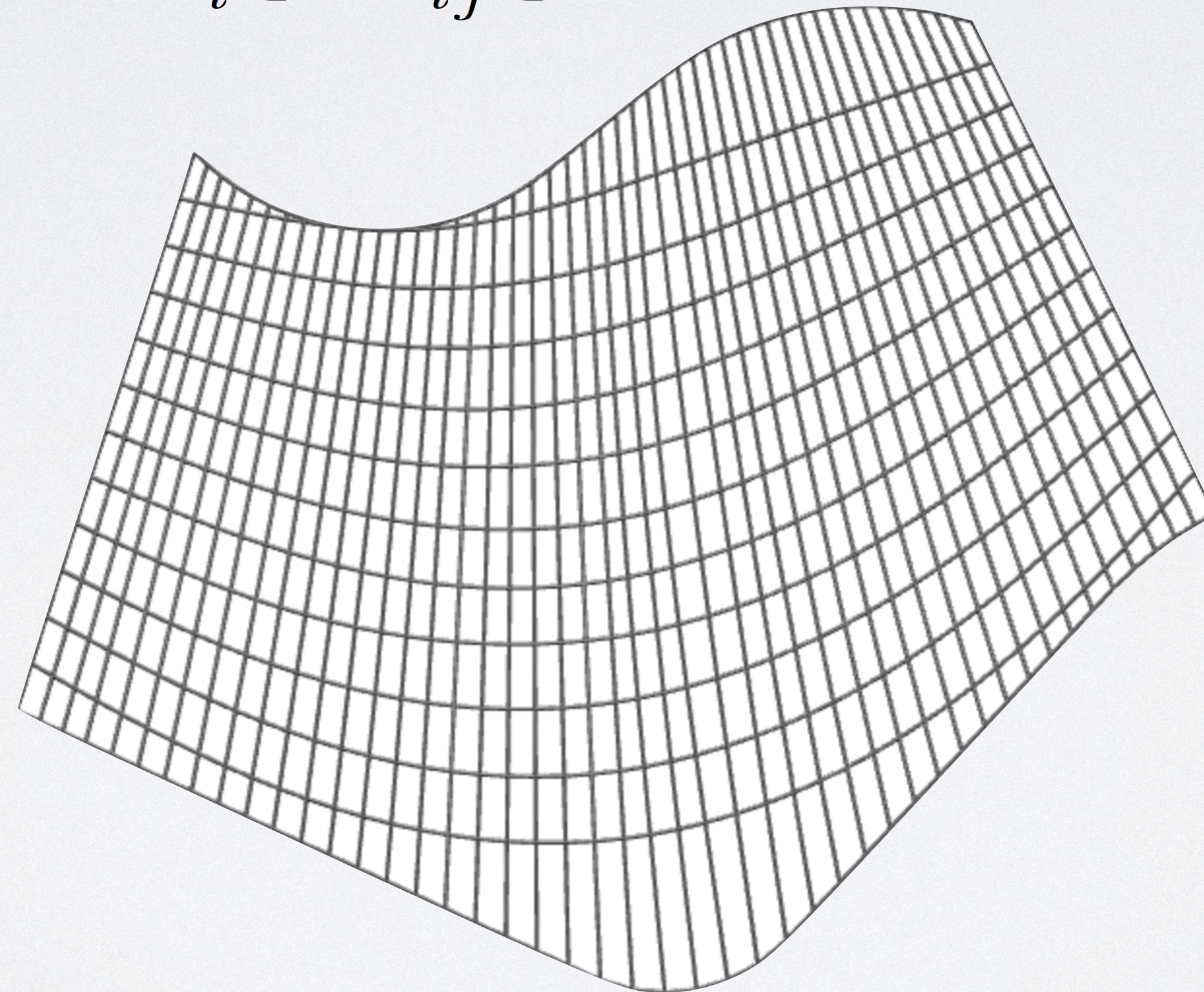


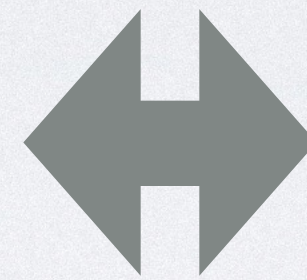
PLANARITY DEMO



FAIRING DEMO

$$E_{ega} = \sum_{v_i \in V} \sum_{e_{ij} \in E} (\pi - \angle(e_{ij}, \tilde{e}_{ij}))^2$$



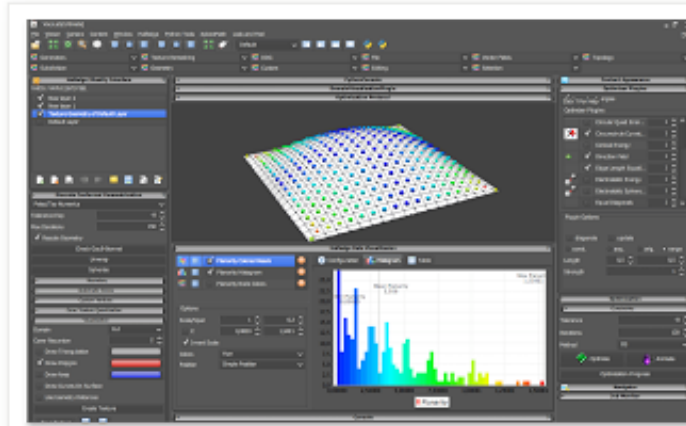


VARYLAB AND GRASSHOPPER

VaryLab Discrete Surface Optimization

Home

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 extensible and modular tool for experiments with discrete surfaces in pure mathematics and applications in industrial geometry.

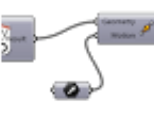


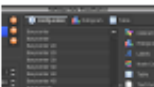
The VaryLab User Interface

Seiten

- Home
- News
- Gallery
- Forum
- Rhino Plug-in
- MyVaryLab

News

 VaryLab Grasshopper Components
We started to implement a set of Grasshopper components to connect the VaryLab main program to the Rhino world. This is different to the pri...

 VaryLab Data Visualization
Data visualization

WWW.VARYLAB.COM