Creating and Editing Curves on Subdivision Surfaces

Jörn Loviscach
Hochschule Bremen, Germany

Henning Thöle
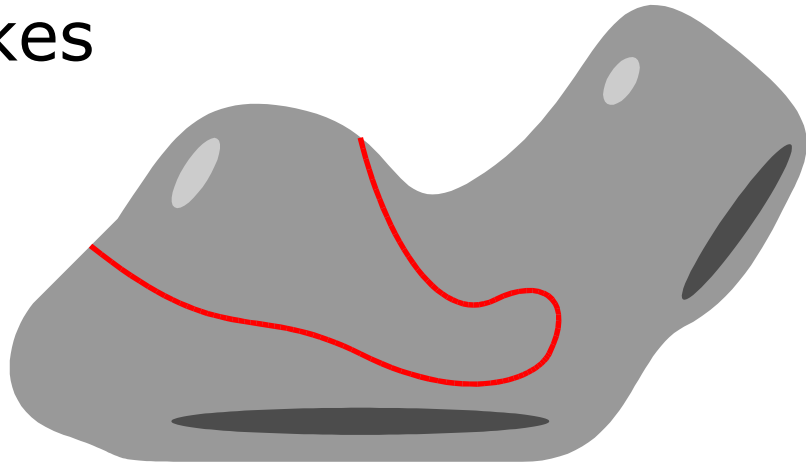Hochschule Bremerhaven, Germany

Outline

- Spline-like Curves on Surfaces
- Related Work
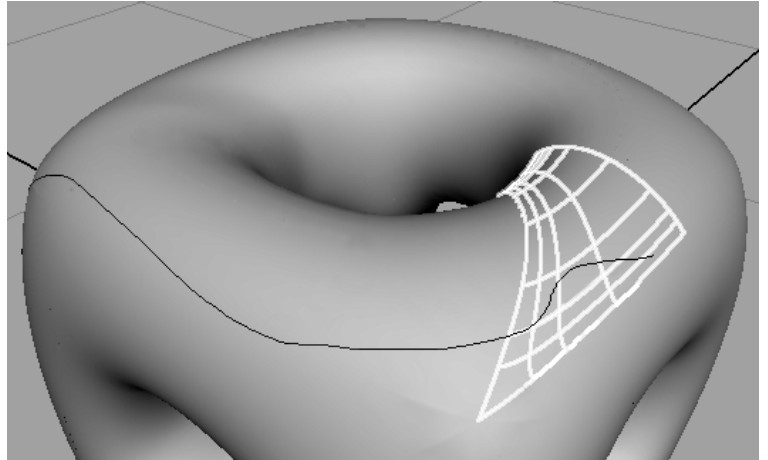- Creating Curves on SDS
- Editing Curves on SDS
- Outlook

Spline-like Curves on Surfaces

- trimming, boolean operations
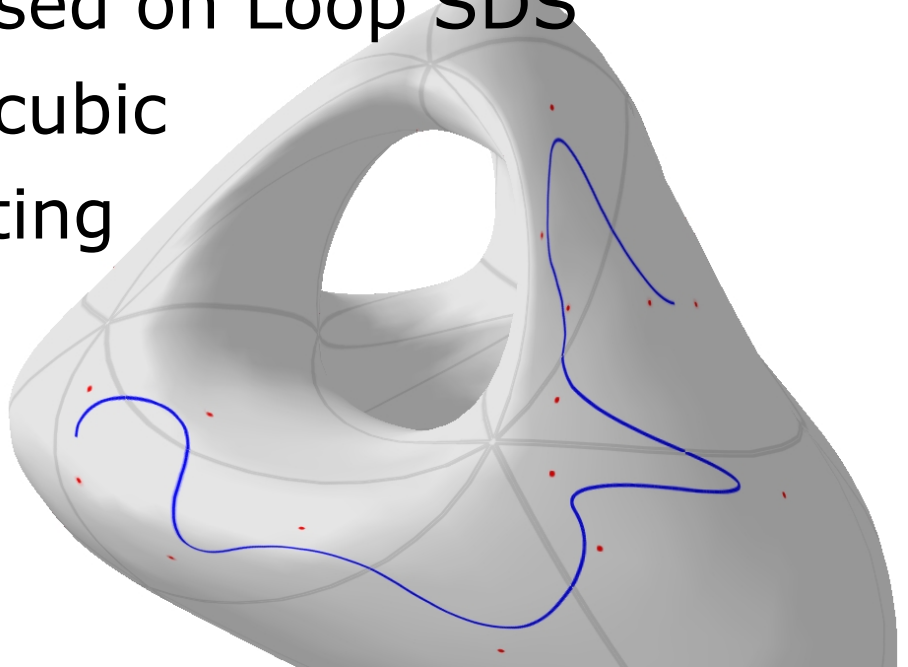- motion paths
- brush strokes

Today Mostly:
Curves on NURBS

- broken according to patches
- continuity problems
- awkward editing

This Work:
Curves on Subdiv. Surfaces

- prototype based on Loop SDS
- quadratic or cubic
- real time editing

Related Work

- Altafini: The De Casteljau algorithm on SE(3). 2000
- Buss/Fillmore: Spherical averages and applications to spherical splines and interpolation. 2001
- Pottmann/Leopoldseder/Hofer: Approximation with active B-spline curves and surfaces. 2002
- Litke/Levin/Schröder: Trimming for subdivision surfaces. 2001
- Biermann/Kristjansson/Zorin: Approximate Boolean operations on free-form solids. 2001
- Stam: Exact evaluation of Catmull-Clark subdivision surfaces at arbitrary parameter values. 1998
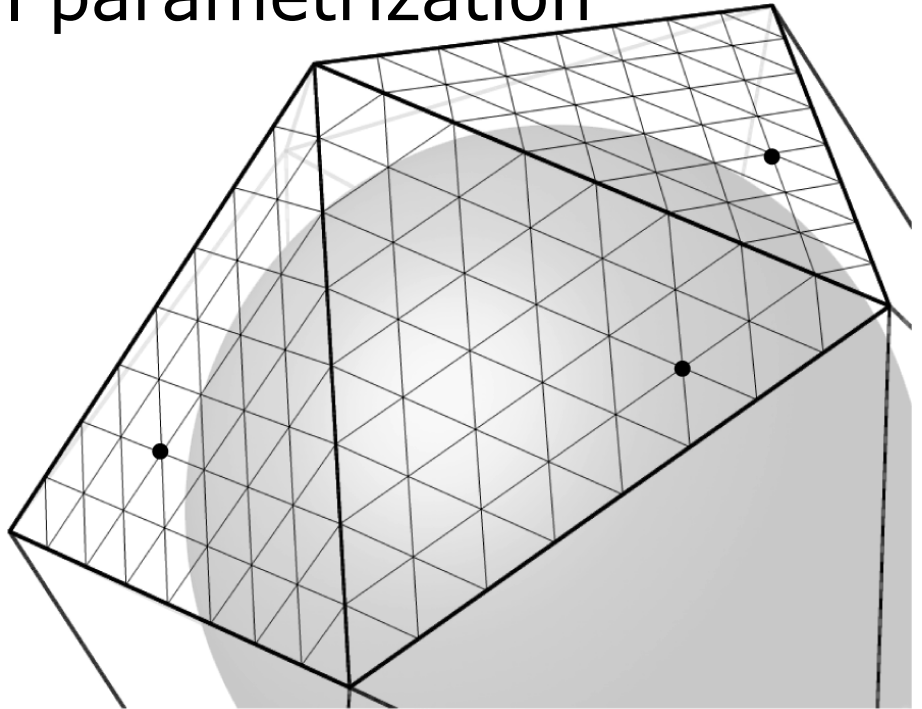
Creating Curves on SDS

Step 1:
mark control vertices on limit surface
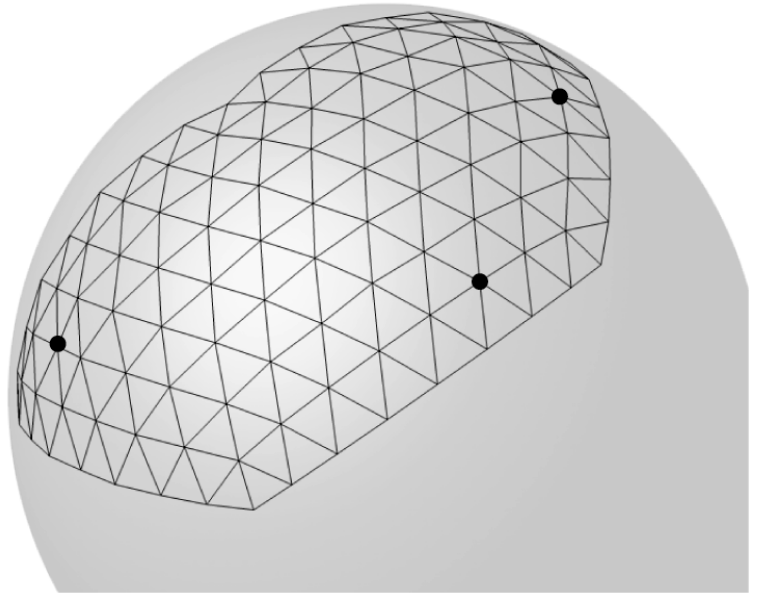
Creating Curves on SDS

Step 2:
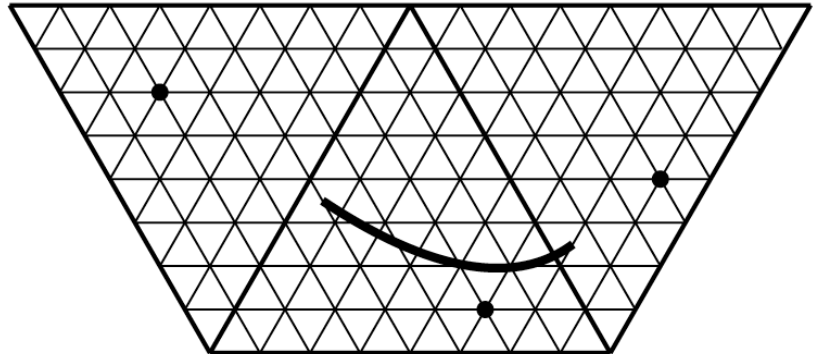map to natural parametrization
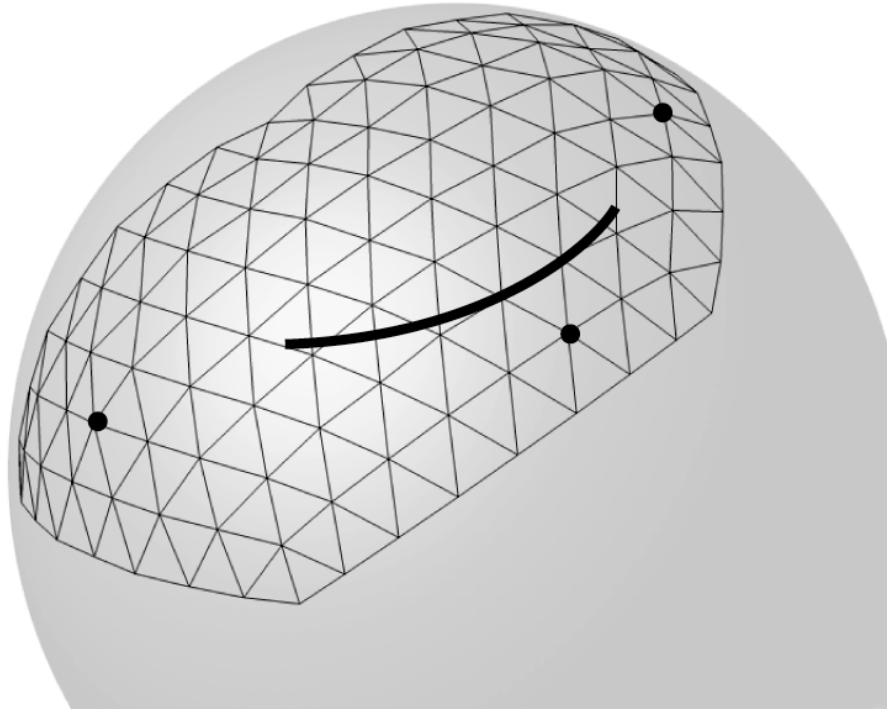
Creating Curves on SDS

Step 3:
map to regular hexagonal grid
(barycentric coordinates)
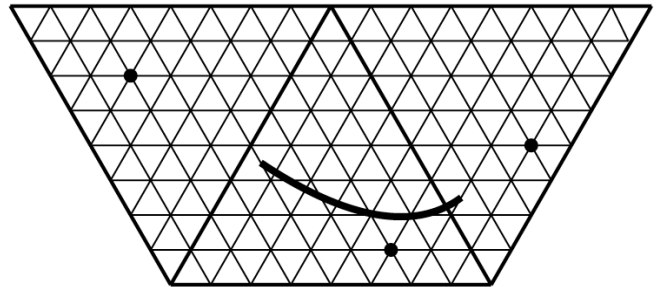and construct spline curve there

Creating Curves on SDS

Step 4:
map back

Creating Curves on SDS

- result is C1 (quadratic spline) or C2 (cubic spline) away from extraordinary vertices

- restriction: every three (cubic: four) consecutive control vertices lie in at most three adjacent triangles of the control poly-hedron
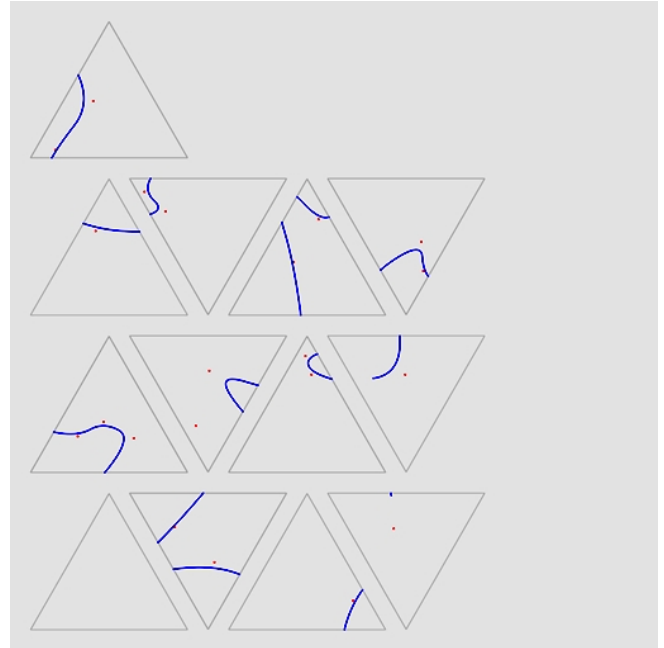
Editing Curves on SDS

- real-time with help
  of graphics hardware

- use textures to map
  via natural parametrization
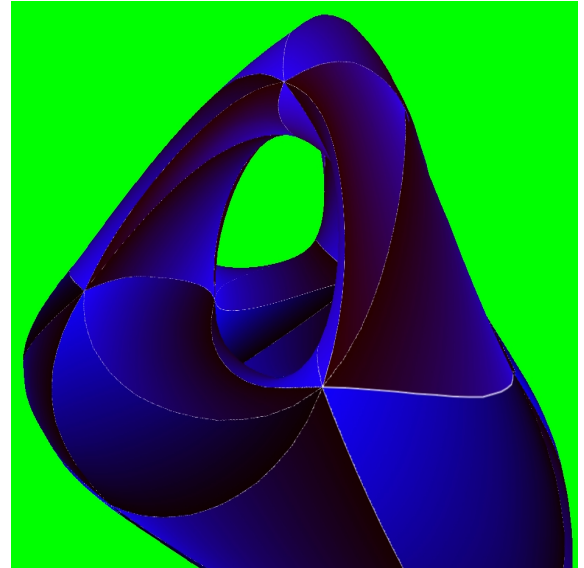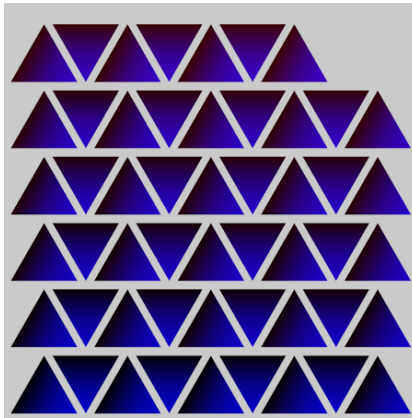 onto a subdivided mesh and back

Editing Curves on SDS

- mapping via texture for rendering the curve and its control vertices

- MIP mapping: points and lines of constant width

- render-to-texture, antialiasing, anisotropic filtering

Editing Curves on SDS

- mapping via texture for selecting and editing the control vertices
- render to back buffer, read

Outlook

- not only control vertices
  in adjacent triangles
  of control polyhedron

- other subdivision schemes
  (Catmull-Clark!)

- approximate intersection curves
  between SDS