Creating and Editing Curves on Subdivision Surfaces

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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 polyhedron
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