

Geometry Images

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Irregular meshes

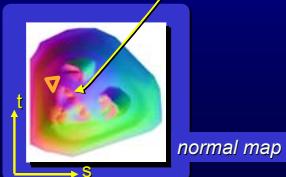


Vertex 1 $x_1 y_1 z_1$	Face 2 1 3
Vertex 2 $x_2 y_2 z_2$	Face 4 2 3
...	...

Texture mapping



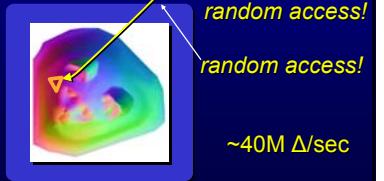
Vertex 1 $x_1 y_1 z_1 s_1 t_1$	Face 2 1 3
Vertex 2 $x_2 y_2 z_2 s_2 t_2$	Face 4 2 3
...	...



Complicated rendering process



Vertex 1 $x_1 y_1 z_1 s_1 t_1$	Face 2 1 3
Vertex 2 $x_2 y_2 z_2 s_2 t_2$	Face 4 2 3
...	...



$\sim 40M \Delta/\text{sec}$

Semi-regular representations



[Eck et al 1995]
[Lee et al 1998]
[Khodakovsky 2000]
[Guskov et al 2000]
...



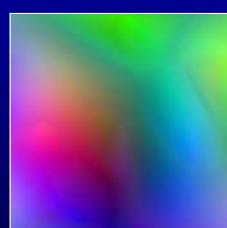
irregular vertex indices



only semi-regular

Geometry Image

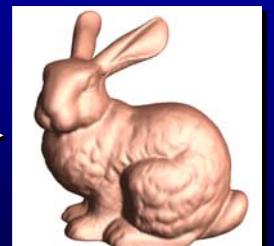
completely regular sampling

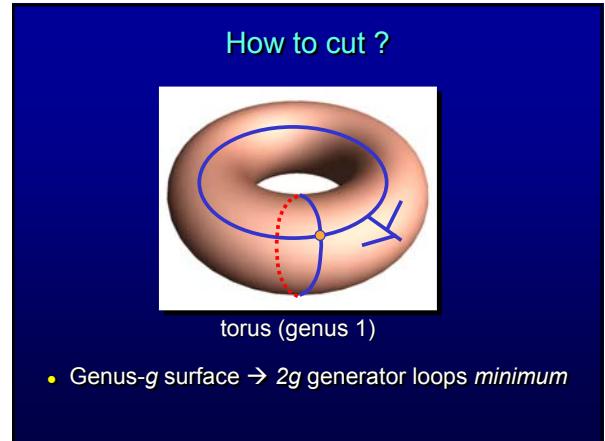
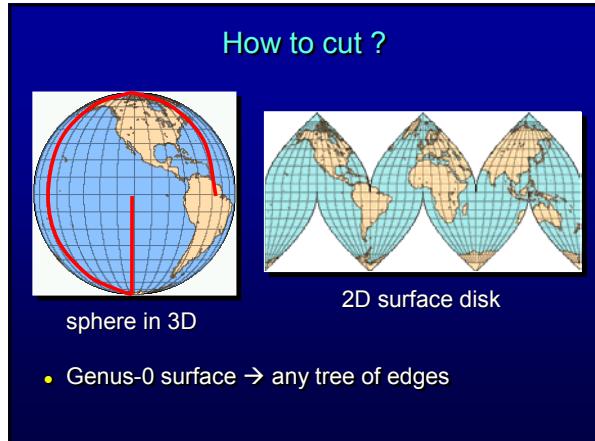
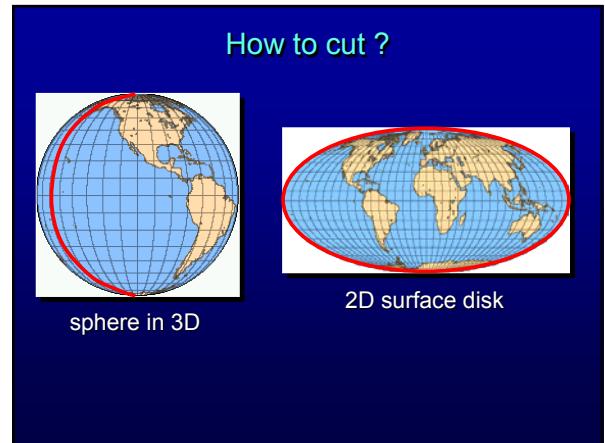
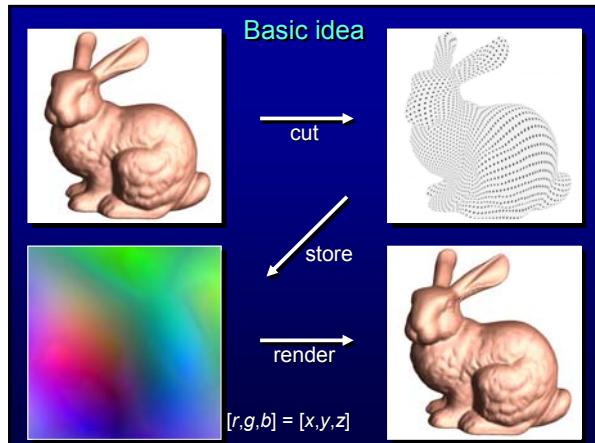
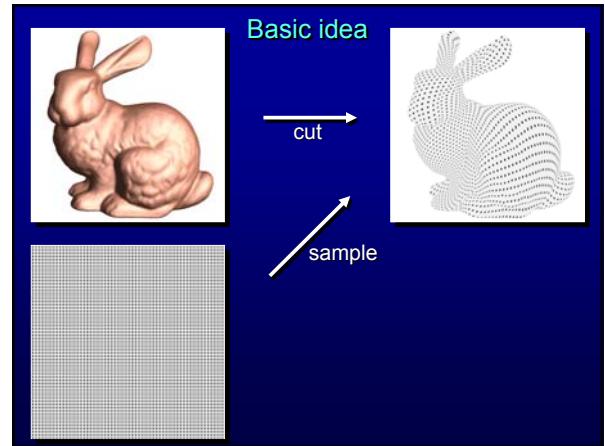
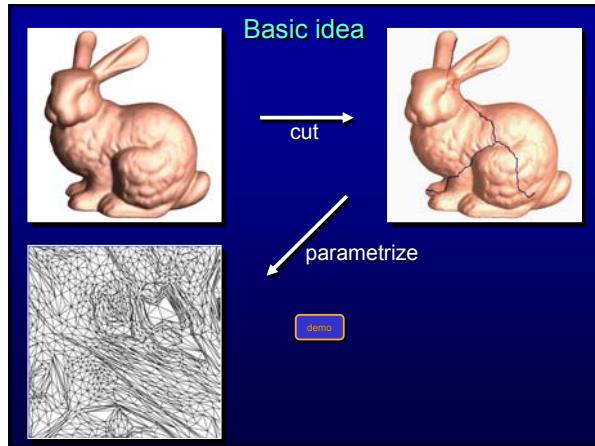


geometry image

257 x 257; 12 bits/channel

3D geometry





Surface cutting algorithm

(1) Find topologically-sufficient cut:

2g loops

[Dey and Schipper 1995]

[Erickson and Har-Peled 2002]

(2) Allow better parametrization:

additional cut paths

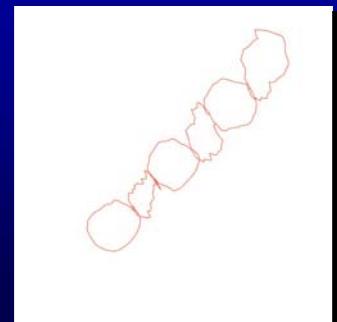
[Sheffer 2002]

Step 1: Find topologically-sufficient cut

(a) retract 2-simplices



(b) retract 1-simplices



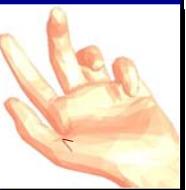
Results of Step 1



genus 6



genus 3



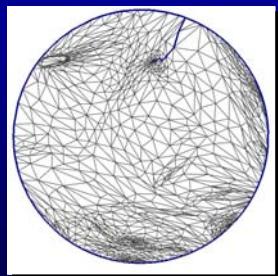
genus 0

Step 2: Augment cut

- Make the cut pass through “extrema”
(note: not local phenomena).
- Approach: parametrize and look for “bad” areas.



Step 2: Augment cut

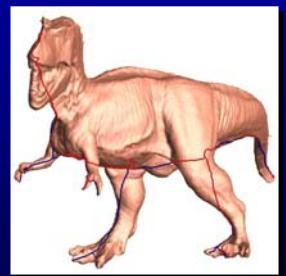


...iterate while parametrization improves

Results of Steps 1 & 2

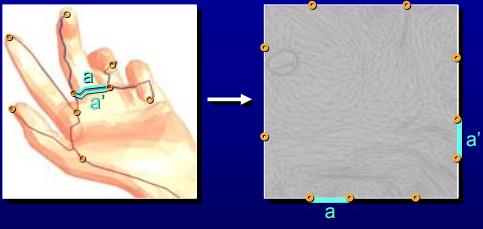


genus 1



genus 0

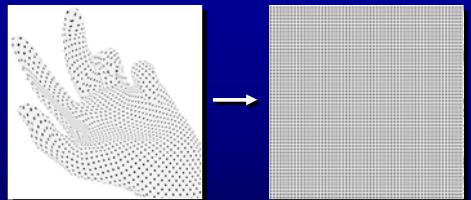
Parametrize boundary



Constraints:

- cut-path mates identical length
 - endpoints at grid points
- } → no cracks

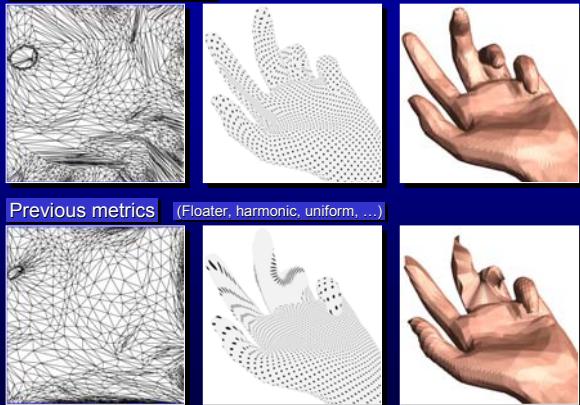
Parametrize interior



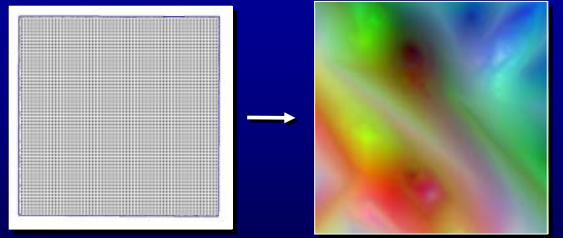
Geometric-stretch metric

- minimizes undersampling [Sander et al 2001]
- optimizes point-sampled approx. [Sander et al 2002]

Stretch parametrization

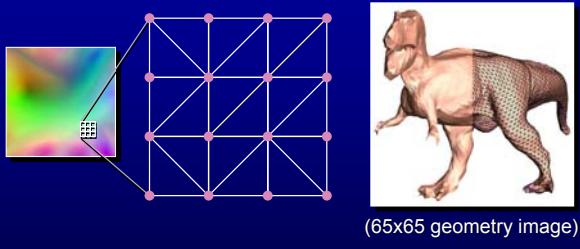


Sample

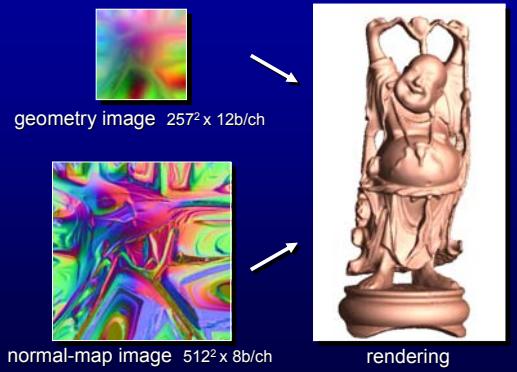


geometry image

Rendering



Rendering with attributes

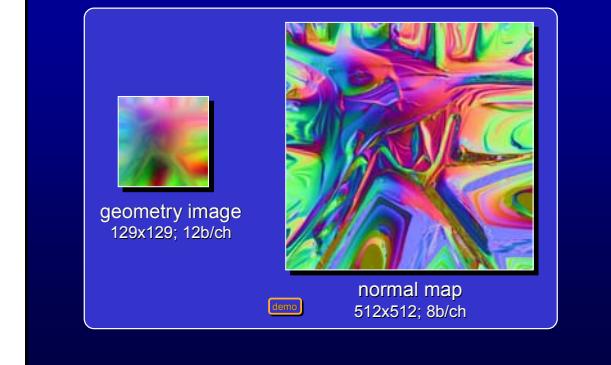


Advantages for hardware rendering

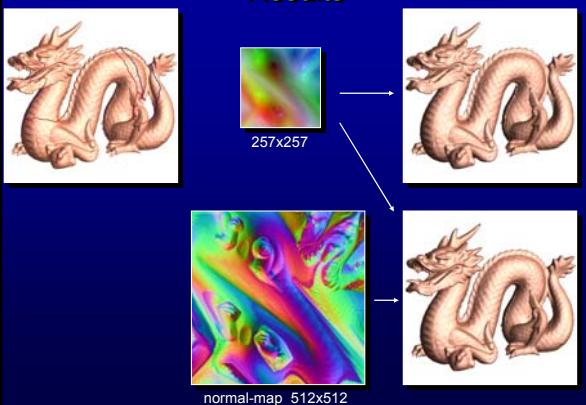


- Regular sampling → no vertex indices.
 - Unified parametrization → no texture coordinates.
- Raster-scan traversal of source data:
geometry & attribute samples in lockstep.
- Summary: compact, regular, no indirection

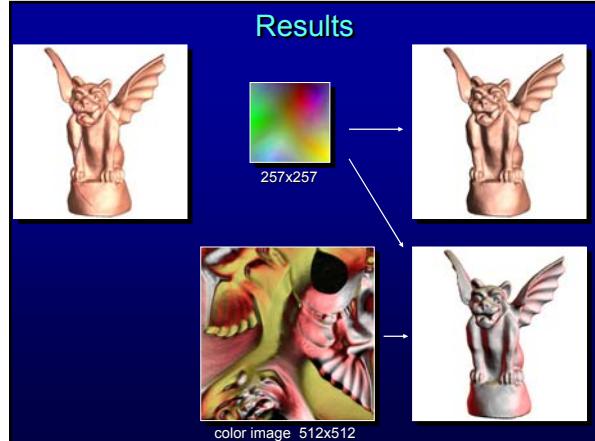
Normal-Mapped Demo



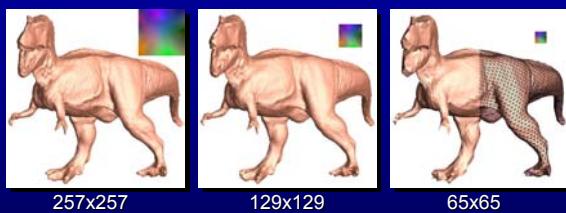
Results



Results

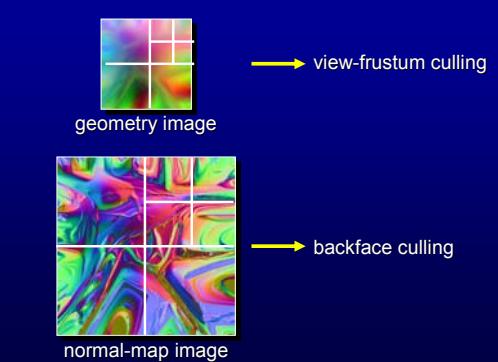


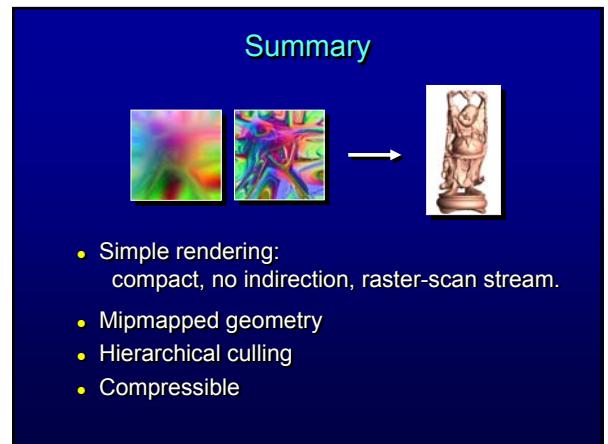
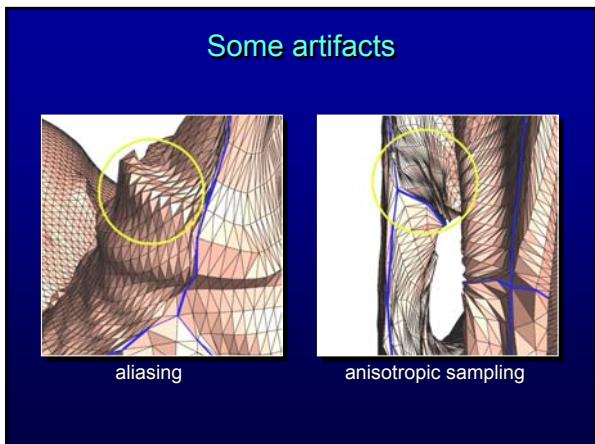
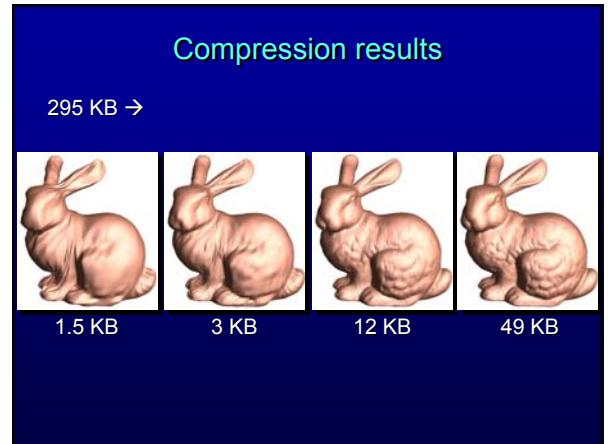
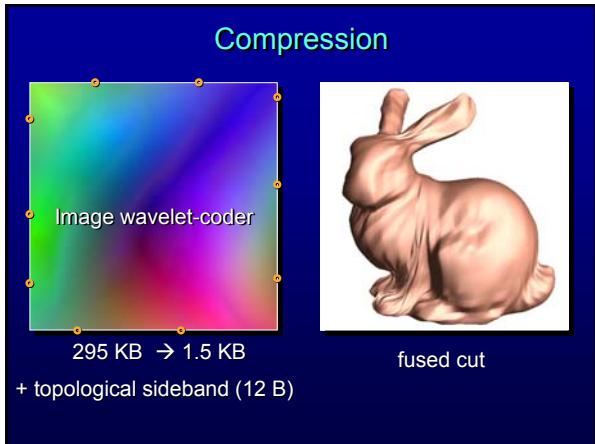
Mip-mapping



boundary constraints
set for size 65x65

Hierarchical culling





- ### Future work
- Better cutting algorithms
 - Feature-sensitive remeshing
 - Tangent-frame compression
 - Bilinear and bicubic rendering
 - Build hardware

