

Procedural Modeling

Last Time?

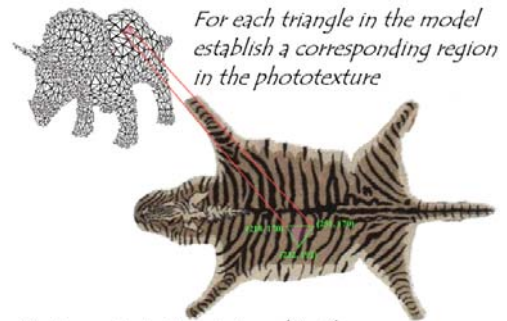
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Today

- Texture Mapping
- Common Texture Coordinate Mappings
- Solid Texture
- Procedural Textures
- Perlin Noise
- Procedural Modeling
- L-Systems

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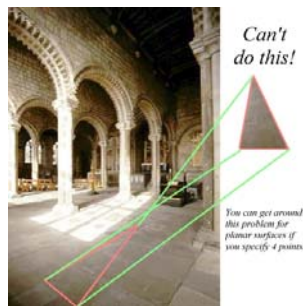
Texture Mapping



During rasterization interpolate the coordinate indices into the texture map

Texture Mapping Difficulties

- Tedious to specify texture coordinates
- Acquiring textures is surprisingly difficult
 - Photographs have projective distortions
 - Variations in reflectance and illumination
 - Tiling problems



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Common Texture Coordinate Mappings

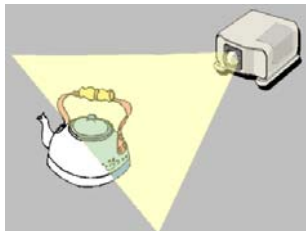
- Orthogonal
- Cylindrical
- Spherical
- Perspective Projection
- Texture Chart



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Projective Textures

- Use the texture like a slide projector
- No need to specify texture coordinates explicitly



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Projective Texture Example

- Modeling from photographs
- Using input photos as textures

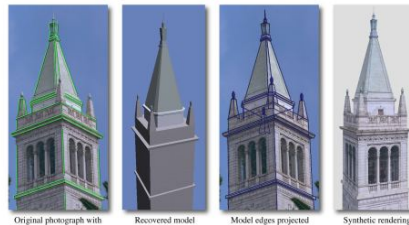
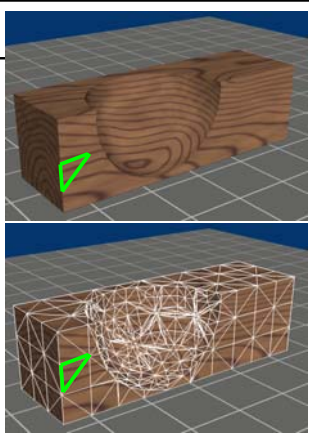


Figure from Debevec, Taylor & Malik
<http://www.debevec.org/Research>

Texture Chart

- Pack triangles into a single image



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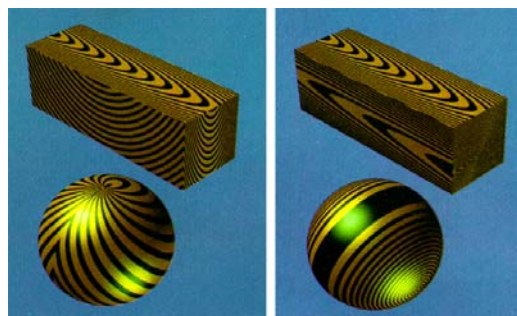
Questions?

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Texture Map vs. Solid Texture



"Solid Texturing of Complex Surfaces",
Peachey, SIGGRAPH 1985

Procedural Textures

$$f(x,y,z) \rightarrow \text{color}$$

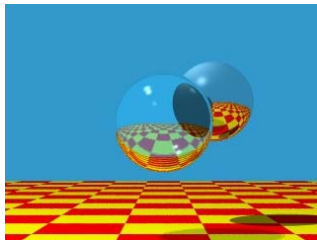
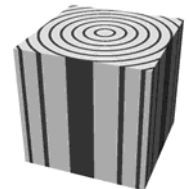
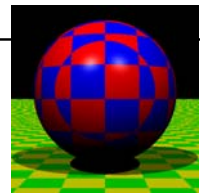


Image by Turner Whitted

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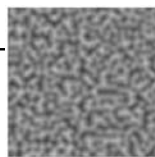
Procedural Textures

- Advantages:
 - easy to implement in ray tracer
 - more compact than texture maps (especially for solid textures)
 - infinite resolution
- Disadvantages
 - non-intuitive
 - difficult to match existing texture



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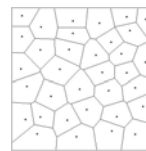
Perlin Noise



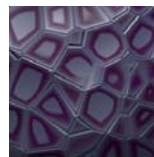
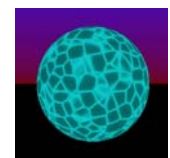
Ken Perlin,
"An Image Synthesizer", SIGGRAPH 1985
"Improving Noise", SIGGRAPH 2002

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Cellular Textures



Voronoi diagram



"A Cellular Texture Basis
Function", Worley,
SIGGRAPH 1996
www.worley.com



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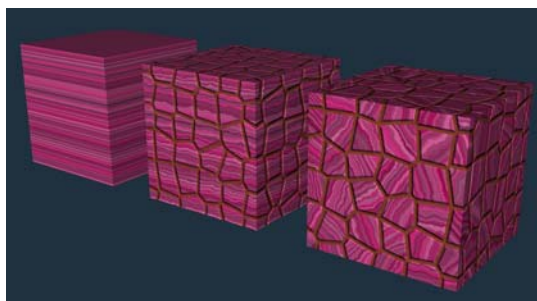


Image by Justin Legakis

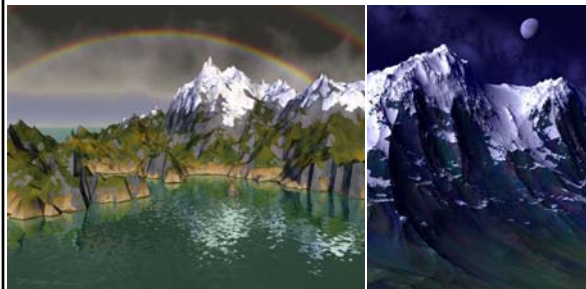
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- **Procedural Modeling**
- **L-Systems**

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Procedural Displacement Mapping



Ken Musgrave
www.kenmusgrave.com

L-Systems

alphabet: {a,b}
initiator: a
production rules:
a $\rightarrow$ b
b $\rightarrow$ ba

generations:
a
b
ba
bab
babba
babbabab
babbababbabba
babbababbabababab



d
n=7, $\delta=20^\circ$
X
X $\rightarrow$ F [+X] F [-X] +X
F $\rightarrow$ FF



e
n=7, $\delta=25.7^\circ$
X
X $\rightarrow$ F [+X] [-X] FX
F $\rightarrow$ FF

Prusinkiewicz & Lindenmayer,
The Algorithmic Beauty of Plants, 1990
<http://algorithmicbotany.org/>

L-Systems



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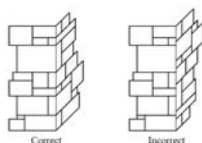
L-Systems for Cities



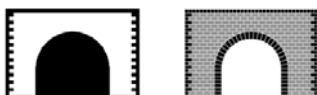
"Procedural Modeling of Cities",
Parish & Müller, SIGGRAPH 2001



Cellular Texturing for Architecture



Correct Incorrect



"Feature-Based Cellular Texturing for
Architectural Models", Legakis, Dorsey,
& Gortler, SIGGRAPH 2001



Questions?

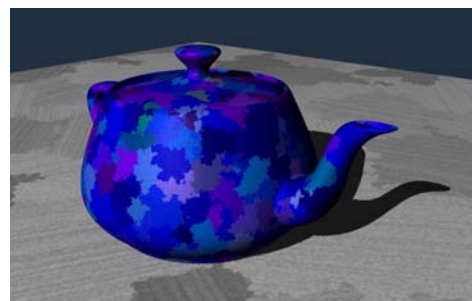


Image by Justin Legakis

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