Texture Synthesis

Today

- Texture Tiling
- Texture Synthesis Challenge
- Markov Model
- Constrained Texture Synthesis
- Image Completion
- Wang Tiles for Texture Synthesis
- Volumetric Texture Synthesis

Texture Tiling

- Specify a texture coordinate \((u, v)\) at each vertex
- Canonical texture coordinates \((0,0) \rightarrow (1,1)\)

Texture Synthesis Challenge

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Markov Random Field

- English words and sentences can be modeled as a Markov Random Field:

  “I spent an interesting evening recently with a grain of salt.”

Template


Alternate Synthesis Order

“Texture Synthesis by Non-parametric Sampling”, Efros & Leung, ICCV 1999

Neighborhood Size

Image from Efros & Leung

Failure Examples

from Efros & Leung
from Wei & Levoy
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Questions?

Constrained Texture Synthesis

Examples from Efros & Leung
http://graphics.cs.cmu.edu/people/efros/research/EfrosLeung.html

Image Inpainting

"Image Inpainting", Bertalmio, Sapiro, Caselles & Ballester, SIGGRAPH 2000

Image Completion

“Fragment-based image completion”, Drori, Cohen-Or, Yeshurun, SIGGRAPH 2003

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Wang Tiles

Align tiles to match edge color to create non-periodic tilings


Wang Tile Texture Synthesis

- As a precomputation, fill the tiles with texture
- Then create infinite amounts of non-periodic texture!


Questions?
Objective

“Stereological Techniques for Solid Textures”
Jagnow, Dorsey, & Rushmeier, SIGGRAPH 2004

Given a 2D slice through an aggregate material, create a 3D volume with a comparable appearance.

Recovering Sphere Distributions

\[ N_s = \text{Profile density} \]
\[ N_V = \text{Particle density} \]
\[ \overline{H} = \text{Mean caliper particle diameter} \]

The fundamental relationship of stereology:

\[ N_A = \overline{H} N_V \]

Profile Statistics

Segment input image to obtain profile densities \( N_V \).

Bin profiles according to their area, \( \sqrt{A/\hat{A}} \).

Recovering Color

Select mean particle colors from segmented regions in the input image.

Recovering Noise

How can we replicate the noisy appearance of the input?

The noise residual is less structured and responds well to Heeger & Bergen’s method.
Putting It All Together

Input

Synthetic volume without noise

Synthetic volume with noise

Questions?