

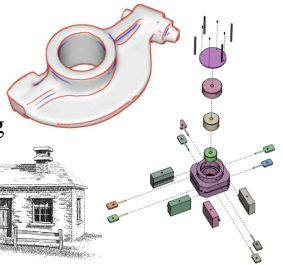
Texture Synthesis

Final Project Status Report:

- Each student should post on LMS by Monday
- Including at least 1 screenshot or other data (project dependent)
- Team Projects:
 - Each member should post and describe their contributions to the project

Last Time?

- Non-Photorealistic Rendering
 - Line Drawing
 - Pen & Ink / Hatching
 - Technical Illustration
 - Painterly Rendering
- Architectural Rendering

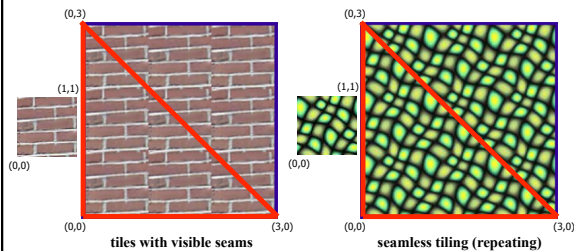


Today

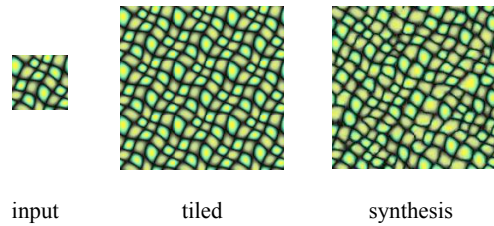
- **Texture Tiling**
- **Texture Synthesis Challenge**
- Markov Model
- Constrained Texture Synthesis
- Image Completion
- Wang Tiles for Texture Synthesis
- Volumetric Texture Synthesis

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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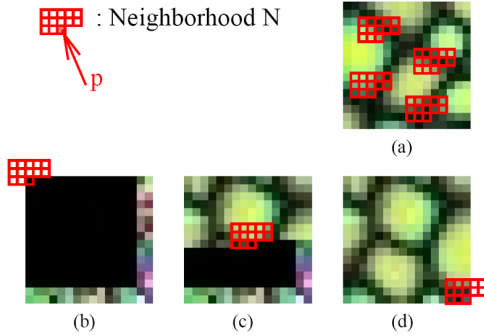
Markov Random Field

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

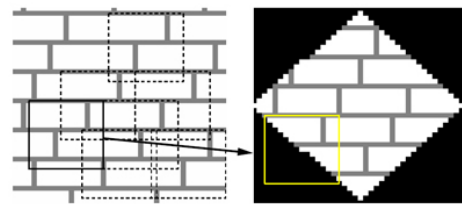
"I spent an interesting evening recently with a grain of salt."

Template

"Fast Texture Synthesis using Tree-structured Vector Quantization", Wei & Levoy, SIGGRAPH 2000.



Alternate Synthesis Order



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

Neighborhood Size

Image from Efros & Leung

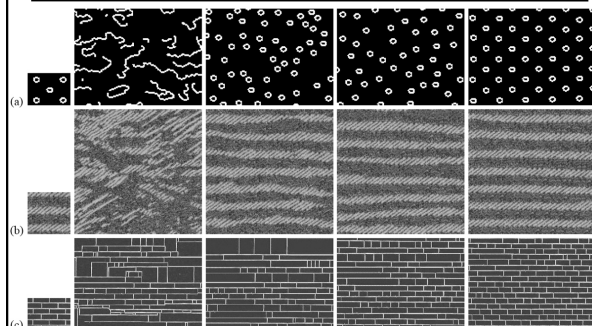
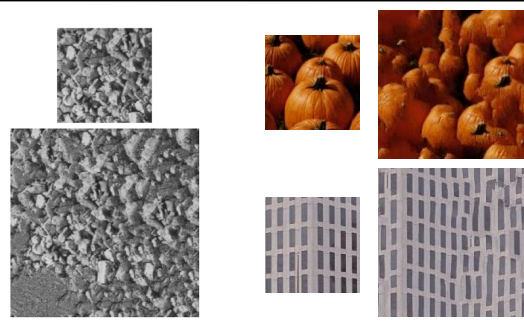


Figure 2. Results: given a sample image (left), the algorithm synthesized four new images with neighborhood windows of width 5, 11, 15, and 23 pixels respectively. Notice how perceptually intuitively the window size corresponds to the degree of randomness in the resulting textures. Input images are: (a) synthetic rings, (b) Brodatz texture D11, (c) brick wall.

Failure Examples



from Efros & Leung

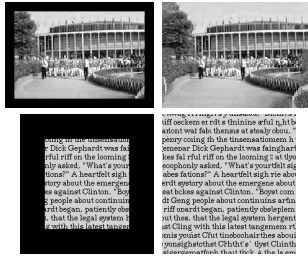
from Wei & Levy

Questions?

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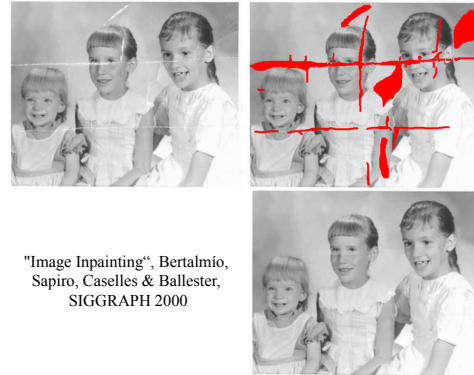
Constrained Texture Synthesis



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

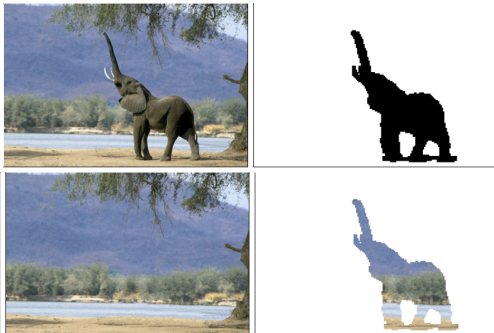
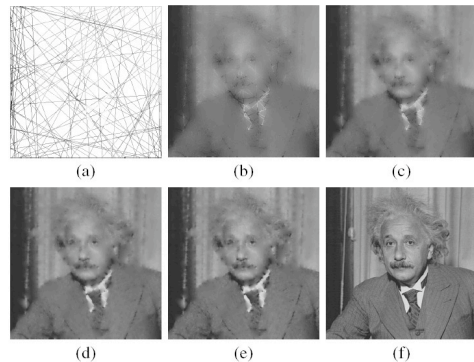
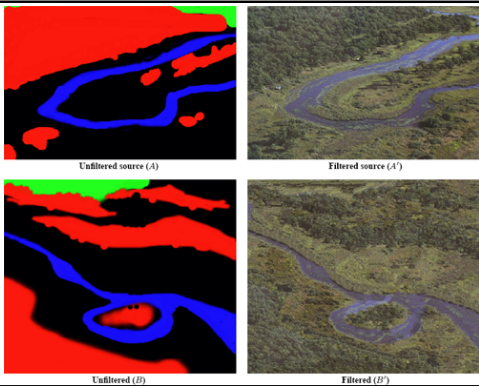


Image Completion

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



"Image Analogies", Hertzmann et al., *SIGGRAPH 2001*



Reading for Today:

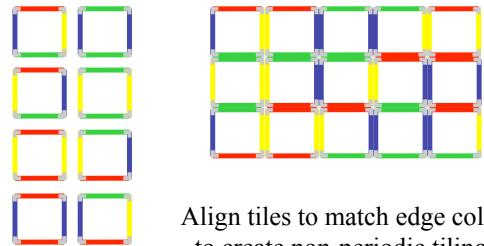


"PatchMatch: A Randomized Correspondence Algorithm for Structural Image Editing", Barnes, Shechtman, Finkelstein, & Goldman, *SIGGRAPH 2009*

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Wang Tiles

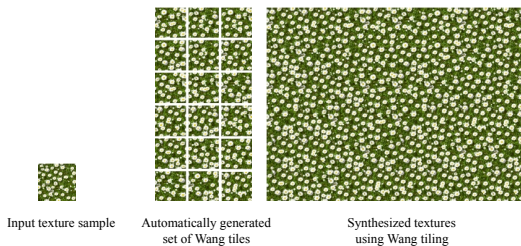


Align tiles to match edge color to create non-periodic tilings

"Wang Tiles for Image and Texture Generation", Cohen, Shade, Hiller, Deussen, *SIGGRAPH 2003*

Wang Tile Texture Synthesis

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



"Wang Tiles for Image and Texture Generation", Cohen, Shade, Hiller, Deussen, *SIGGRAPH 2003*

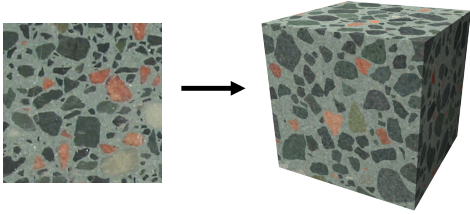
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Objective

"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.



Slide from Rob Jagnow

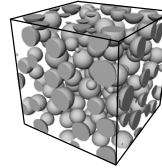
Recovering Sphere Distributions



N_A = Profile density
(number of circles per unit area)

N_V = Particle density
(number of spheres per unit volume)

\bar{H} = Mean caliper particle diameter

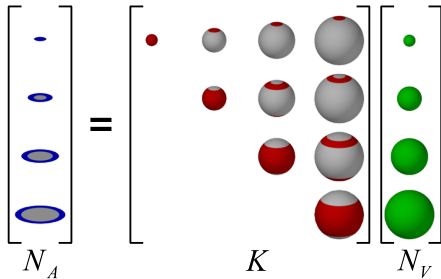


The fundamental relationship
of stereology:

$$N_A = \bar{H}N_V$$

Slide from Rob Jagnow

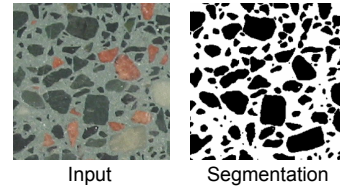
Recovering Sphere Distributions



Slide from Rob Jagnow

Profile Statistics

Segment input image to obtain profile densities N_A .



Input

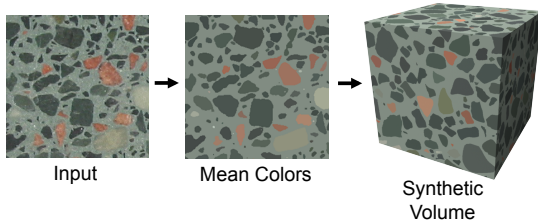
Segmentation

Bin profiles according to their area, $\sqrt{A/A_{\max}}$

Slide from Rob Jagnow

Recovering Color

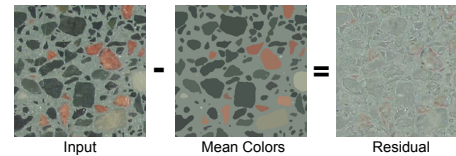
Select mean particle colors from
segmented regions in the input image



Slide from Rob Jagnow

Recovering Noise

How can we replicate the noisy appearance of the input?



Input

Mean Colors

Residual

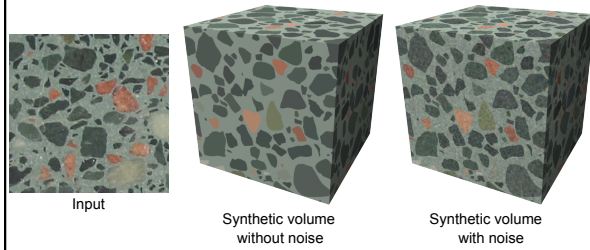
The noise residual is less
structured and responds well to
Heeger & Bergen's method



Synthesized Residual

Slide from Rob Jagnow

Putting It All Together



Slide from Rob Jagnow

Results



Slide from Rob Jagnow

Reading for Tuesday: *pick one*

“Photographing long scenes with multi-viewpoint panoramas”, Agarwala, Agrawala, Cohen, Salesin, & Szeliski, SIGGRAPH 2006



“Environment Matting and Compositing”
Zongker, Werner, Curless, & Salesin, SIGGRAPH 1999

