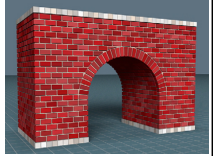
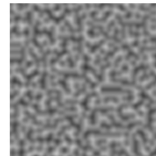
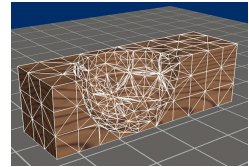


Non-Photorealistic Rendering (NPR)

Last Time?

- Texture Mapping
- Solid Texture
- Procedural Textures
 - Perlin Noise
- Procedural Modeling
 - L-Systems



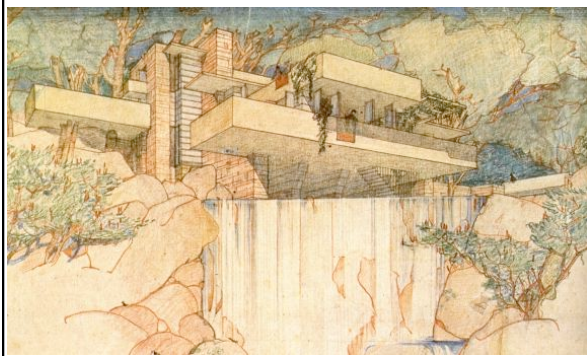
Today: Non Photorealistic Rendering

- **Architectural Rendering**
- Reading for Today
- Line Drawing
- Pen & Ink / Hatching
- Technical Illustration
- Painterly Rendering

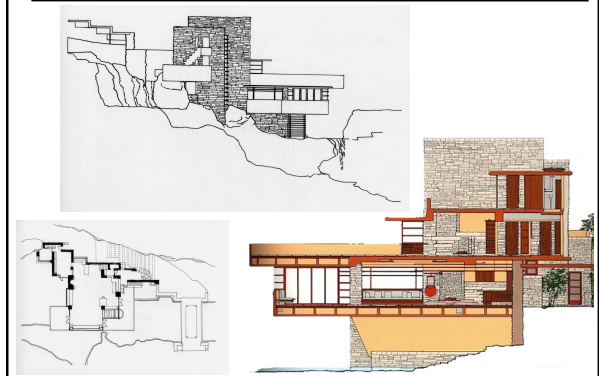
Frank Lloyd Wright's *Fallingwater*



Frank Lloyd Wright's *Fallingwater*



Plan & Section Drawings



Digital Models



Photorealistic Rendering



Non Photorealistic Rendering



Goals for NPR?

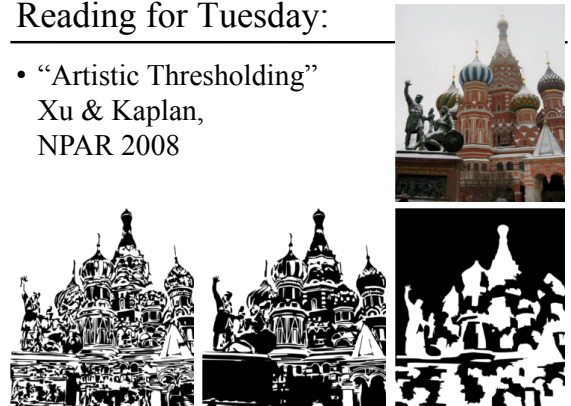
- Exaggerate - or - de-emphasize lighting, texture, contrast, perspective, etc.
- May use limited palette of colors, or precision/resolution
- Allow vagueness about material & geometry
- Varying level of detail – draw attention to particular aspects of imagery
- More detail than a single traditional image can show (cross section, transparency, exploded view, multi-viewpoint rendering, etc.)

Today: Non Photorealistic Rendering

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Reading for Tuesday:

- “Artistic Thresholding”
Xu & Kaplan,
NPAR 2008



Halftoning

http://en.wikipedia.org/wiki/File:Halftoning_introduction.svg <http://en.wikipedia.org/wiki/File:Halftoningcolor.svg>

“Digital Facial Engraving”, Ostromoukhov, SIGGRAPH 1999

Real-time NPR

- (Before programmable pixel shaders)
 - Create 1D texture map of shading tones
 - Local lighting (normal, view, & light directions) turned into texture coordinate
 - Texture lookup is final color
- Concerns about spatial & temporal coherence
 - popping
 - “Shower door” effect

Dynamic Solid Textures for Real-Time Coherent Stylization

Bénard, Bousseau, and Thollot, I3D 2009

<http://artis.imag.fr/Publications/2009/BBT09/DynSolidTextures.mov>

Today: Non Photorealistic Rendering

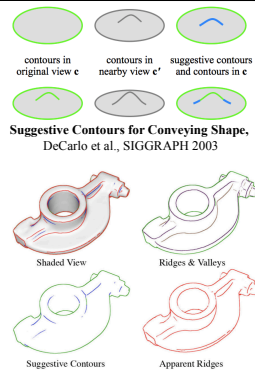
- Architectural Rendering
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Where Do People Draw Lines?

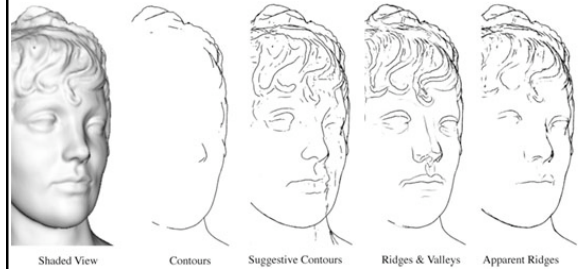
Cole, Golovinskiy, Limpaecher, Stoddart Barros, Finkelstein, Funkhouser, & Rusinkiewicz, SIGGRAPH 2008

Types of Edges in Line Drawings

- Silhouettes/Contours: where normal is perpendicular to the view direction
- Suggestive Contour: inflection points of the surface normal
- Ridges & Valleys: extremum of curvature
- Apparent Ridges: based on view dependent curvature



Types of Edges in Line Drawings



Apparent Ridges for Line Drawings
Judd, Durand & Adelson, SIGGRAPH 2007

Today: Non Photorealistic Rendering

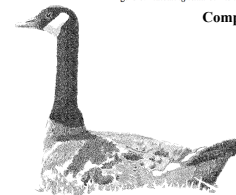
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Pen & Ink Illustration



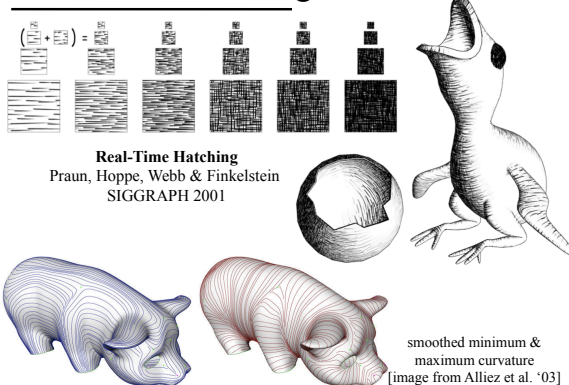
Figure 6. Indicating texture. The left house is drawn using "indication"; the right house is not.

Computer-generated pen-and-ink illustration
Winkenbach & Salesin 1996



Interactive Pen-and-Ink Illustration
Salisbury et al., SIGGRAPH 1994

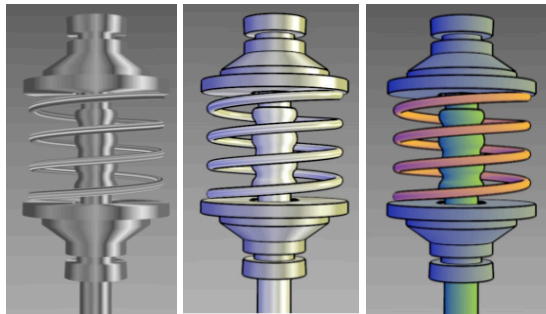
Real-Time Hatching



Today: Non Photorealistic Rendering

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Technical Illustration



A non-photorealistic lighting model for automatic technical illustration
Gooch, Gooch, Shirley, & Cohen SIGGRAPH 1998

Technical Illustration



Rendering Effective Route Maps: Improving Usability Through Generalization
Agrawala & Stolte, SIGGRAPH 2001



Designing Effective Step-By-Step Assembly Instructions
Agrawala et al. SIGGRAPH 2003

Today: Non Photorealistic Rendering

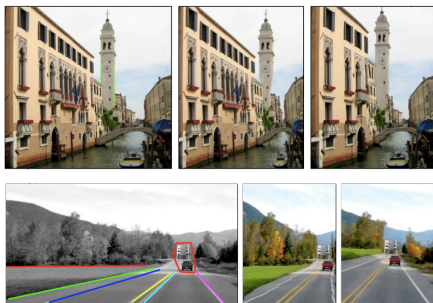
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Painterly Rendering



Painterly rendering with curved brush strokes of multiple sizes
Hertzmann SIGGRAPH 1998

Reading for Friday:



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