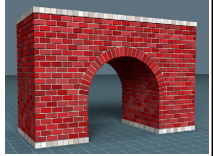
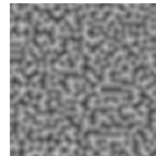
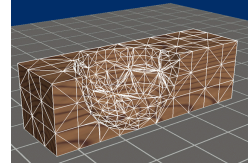


Non-Photorealistic Rendering (NPR)

Last Time?

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



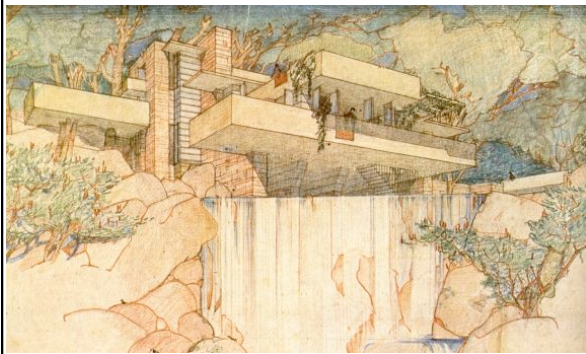
Today: Non Photorealistic Rendering

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

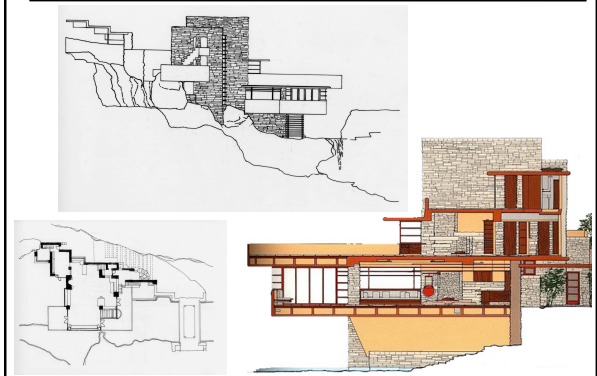
Frank Lloyd Wright's *Fallingwater*

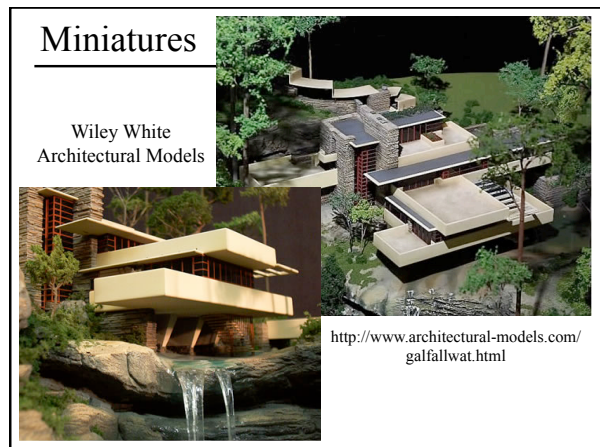
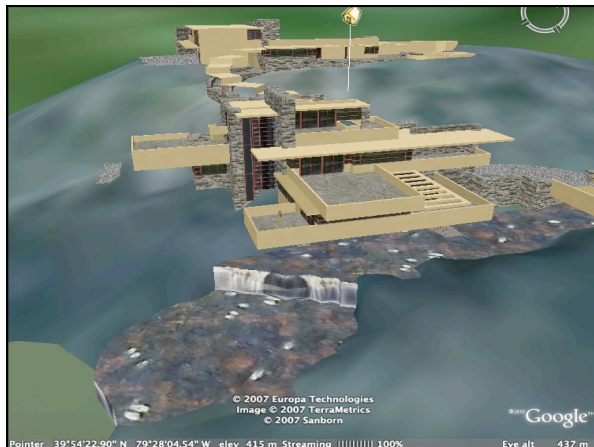
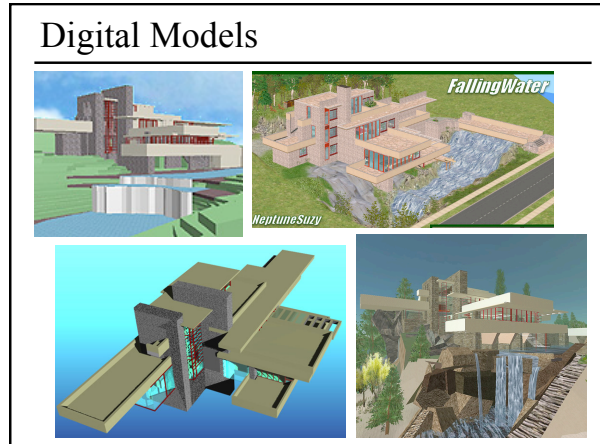
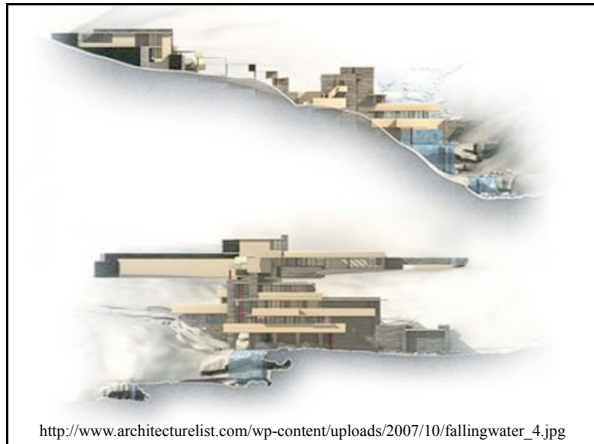


Frank Lloyd Wright's *Fallingwater*



Plan & Section Drawings





Non-Photorealistic Miniatures



<http://shop.lego.com/ByTheme/Product.aspx?p=21005&cn=52>

Non-Photorealistic Miniatures



<http://gardenmelodies.blogspot.com/2010/11/falling-water-gingerbread-house.html>

Eating Fallingwater



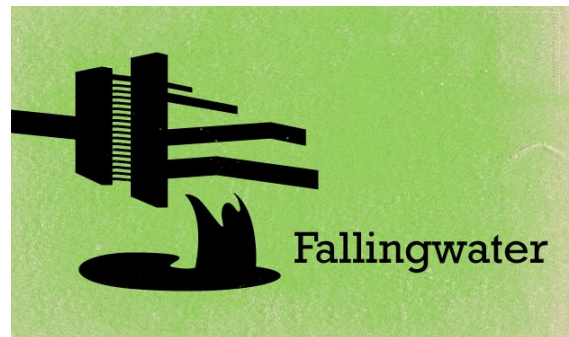
TedWells living : simple

http://twls.libsyn.com/index.php?post_id=35584

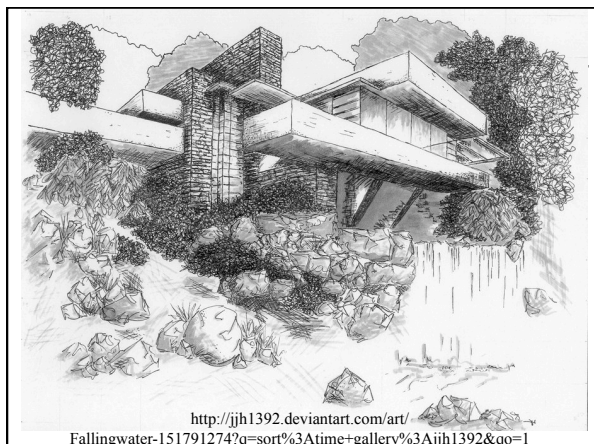


HGA Architects & Planners - Cantilevers: Inspired by Falling Water
http://www.flickr.com/photos/j_bussmann/4549613488/

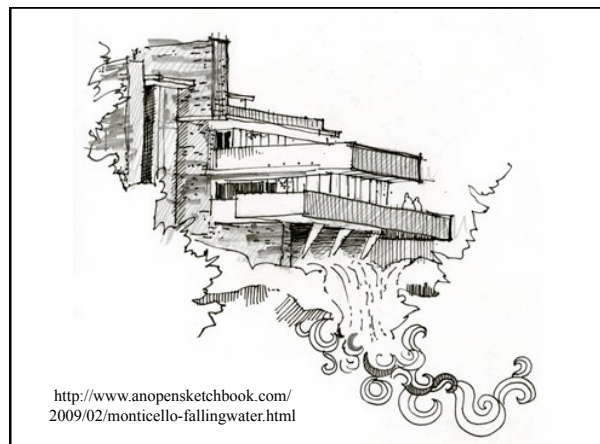
Non-Photorealistic Rendering



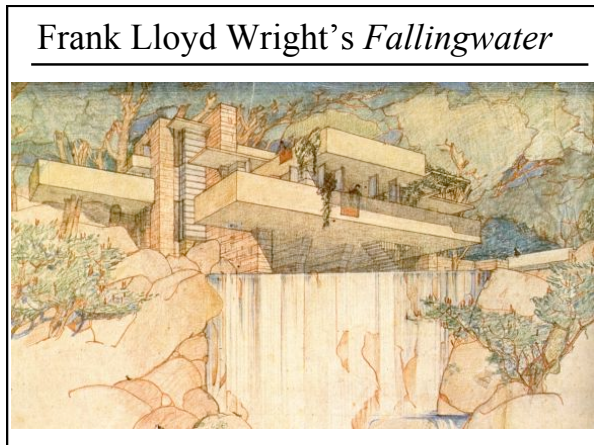
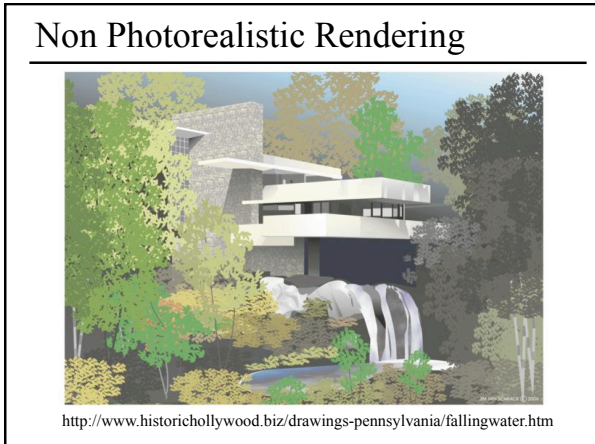
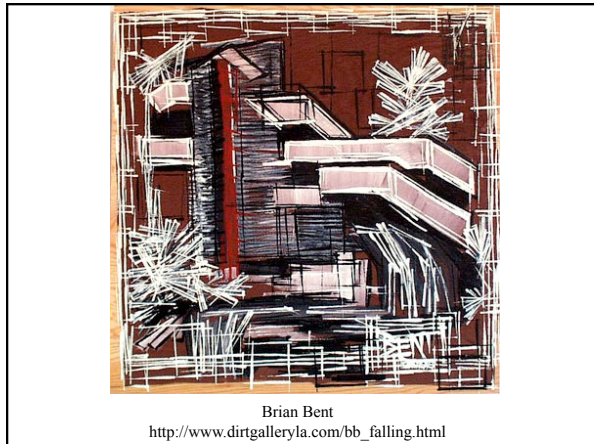
<http://www.studio360.org/2009/may/29/fallingwater/>



<http://jjh1392.deviantart.com/art/Fallingwater-151791274?q=sort%3Atime+gallery%3Ajjh1392&qo=1>

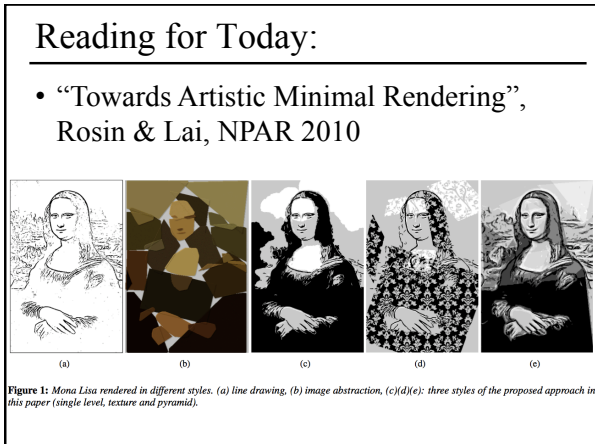


<http://www.anopensketchbook.com/2009/02/monticello-fallingwater.html>

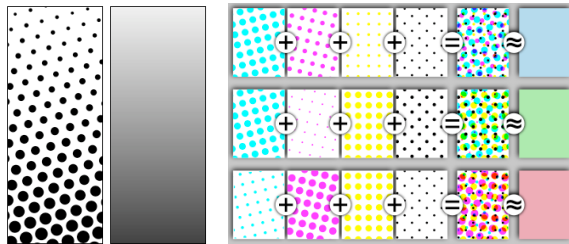


- ### Goals for NPR?
- Exaggerate - or - de-emphasize lighting, texture, contrast, perspective, etc.
 - May use limited palette of colors, or precision/resolution
 - Allow vagueness about material & geometry
 - Varying level of detail – draw attention to particular aspects of imagery
 - More detail than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

- ### Today: Non Photorealistic Rendering
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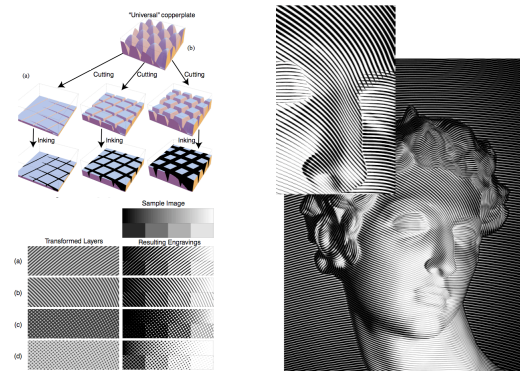
Halftoning



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

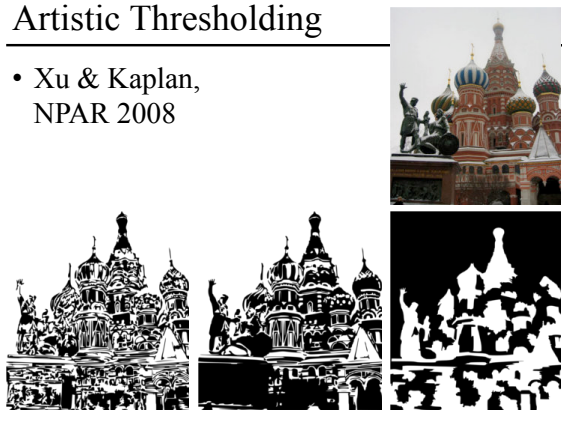
Dynamic Solid Textures for Real-Time Coherent Stylization Bénard, Bousseau, and Thollot, I3D 2009



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

Artistic Thresholding

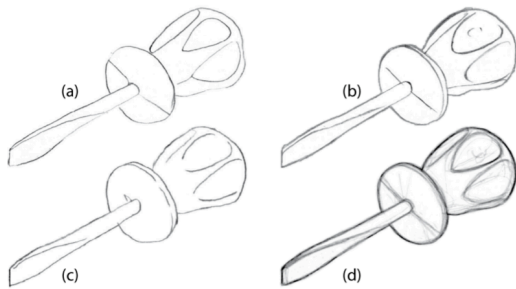
- Xu & Kaplan,
NPAR 2008



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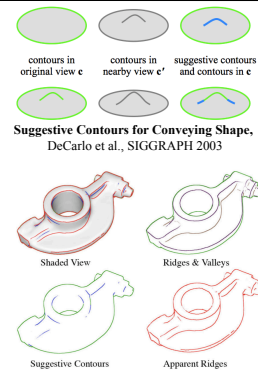
Where Do People Draw Lines?



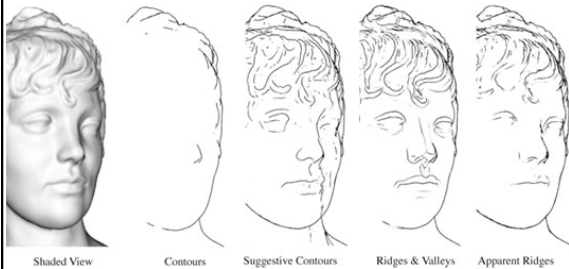
Cole, Golovinskiy, Limpacher, Stoddart Barros, Finkelstein, Funkhouser, & Rusinkiewicz, SIGGRAPH 2008

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

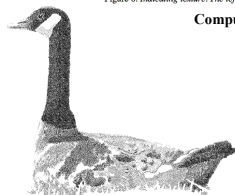
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Pen & Ink Illustration



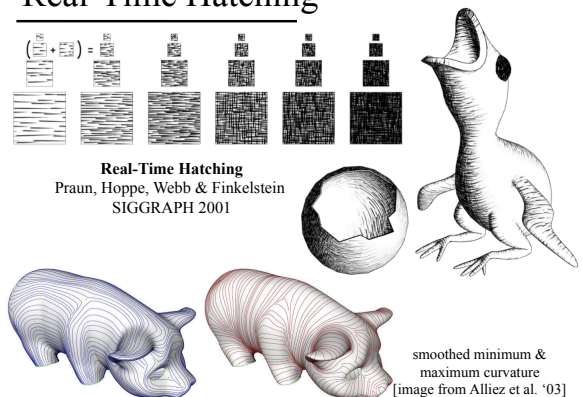
Figure 6. Indicating texture. The left house is drawn using "indication"; the right house is not.

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



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

Real-Time Hatching



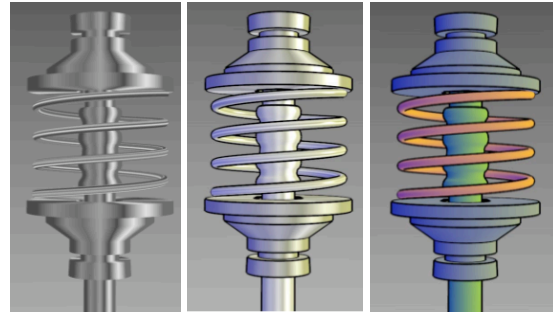
Real-Time Hatching
Praun, Hoppe, Webb & Finkelstein
SIGGRAPH 2001

smoothed minimum & maximum curvature
[image from Alliez et al. '03]

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Technical Illustration

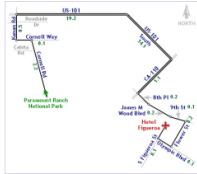


A non-photorealistic lighting model for automatic technical illustration
Gooch, Gooch, Shirley, & Cohen SIGGRAPH 1998

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: "Fragment-based image completion",

Drori, Cohen-Or, Yeshurun, SIGGRAPH 2003

