Non-Photorealistic Rendering (NPR)

Last Time?
- Texture Mapping
- Solid Texture
- Procedural Textures
  - Perlin Noise
- Procedural Modeling
  - L-Systems

Reading for Last Time:
  & “Improving Noise”, SIGGRAPH 2002

Procedural Modeling of Buildings

Today: Non Photorealistic Rendering
- Architectural Rendering
- Reading for Today
- Line Drawing
- Pen & Ink / Hatching
- Technical Illustration
- Artistic Styles and Painterly Rendering

Frank Lloyd Wright’s Fallingwater
Digital Models


Digital Models

From Half Life 2

http://www.turbosquid.com/3d-models/water-house-3d-x/266247
Photorealistic Rendering

http://www.etereastudios.com/docs_html/fallingwater_htm/fall_still_03.htm

Miniatures

Wiley White
Architectural Models

http://www.architectural-models.com/gaifallwat.html

Non-Photorealistic Miniatures

http://shop.lego.com/ByTheme/Product.aspx?p=21005&cc=52
http://www.urbanbydesignonline.com/urbanbydesign/tag/fallingwater

Non-Photorealistic Miniatures

http://www.flickr.com/photos/matijagrguric/sets/72157623778661188/

Non-Photorealistic Miniatures

Adam Reed Tucker http://www.mocpages.com/moc.php/226533
Non-Photorealistic Miniatures


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

Non-Photorealistic Rendering

http://www.fallingwater.org/


Non Photorealistic Rendering

http://www.historichollywood.biz/drawings-pennsylvania/fallingwater.htm

Painting / Painterly Rendering

Painting / Painterly Rendering

http://disney.go.com/create/art/2ps11k6UcU3s000010940000-g-bce863

Painting / Painterly Rendering

http://www.ivonneimagines.com/487/falling-water/

http://kempersmith.com/fallingwater.html

Brian Bent

http://www.dirtgalleryla.com/bb_falling.html


http://www.gibson-design.com/images/Slides/fallingwater-entry-100dpi.jpg
Frank Lloyd Wright’s *Fallingwater*
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.)

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Reading for Today:

- “Artistic Tessellations by Growing Curves”, Li & Mould, Non-Photorealistic Animation and Rendering (NPAR) 2011

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Where Do People Draw Lines?

- 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

- Silhouettes/Contours: where normal is perpendicular to the view direction
- Suggestive Contour: inflection points of the surface normal
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Types of Edges in Line Drawings

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

Halftoning

“Digital Facial Engraving”, Ostromoukhov, SIGGRAPH 1999

Pen & Ink Illustration

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
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
Bérard, Bousseau, and Thollot, I3D 2009

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

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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 & Stalte, SIGGRAPH 2001

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

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Painterly Rendering

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

“Towards Artistic Minimal Rendering”,
Rosin & Lai, NPAR 2010

Artistic Thresholding

• Xu & Kaplan,
NPAR 2008

Reading for Today/Discuss Friday:

• “WYSIWYG NPR: Drawing Strokes Directly on 3D Models”,
Kalnins, Markosian, Meier, Kowalski, Lee, Davidson, Webb, Hughes, & Finkelstein, SIGGRAPH 2002

Reading for Friday:

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