Non-Photorealistic Rendering (NPR)

Last Time?

- Texture Mapping
- Solid Texture
- Procedural Textures
  - Perlin Noise
- Procedural Modeling
  - L-Systems
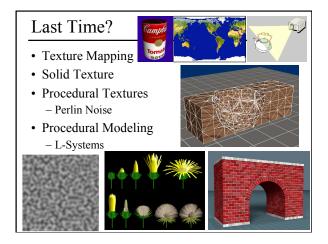
End of Semester

- Quiz on Tuesday 4/14
  - Sample problems are posted on website
- Last lecture on Friday 4/17 – Texture Synthesis
- Final Project Presentations – last 3 classes
  - Attendance mandatory
  - Start at 2pm sharp (please don't be late)
  - No laptops allowed during your classmates' presentations
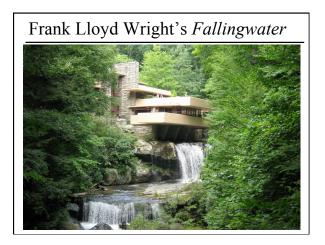 - Ask good questions (participation grade)

Final Presentation Schedule

Tues. April 21	Fri. April 24	Tues. April 28
1. Cody & David	1. Joseph & Atira	1. Yi Xiang
2. Jeff	2. Chris L. & Devin	2. Patrick
3. Josh & Jon Z.	3. Sean	3. Jon C.
4. Chris J. & Jarrett	4. Luke	4. Eric & Andrew
5. Jeremy	5. Abhishek & Taro	5. Justin & Mike "Z"
	6. Allan	6. Greg
		7. Corey

Total time (including setup & questions):
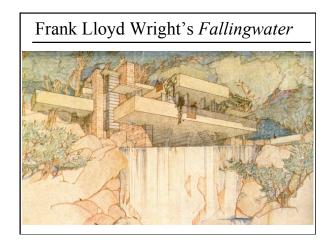14 min (individual), 24 min (team of 2)
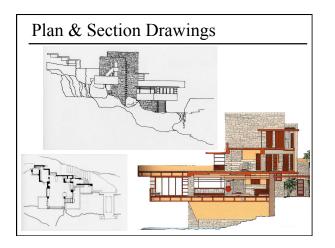
Final Presentation

- Summarize prior work as necessary
  - You don't need to discuss papers we covered in class
- Be technical:
  - What were the challenges?
  - How did you solve them?
- Live demo if possible (depends on project)
  - Use examples (both of success & failure)
- Teams of 2 or 3:
  - All should present & make it clear who did what
- Practice! & time yourself!

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

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

Non Photorealistic Rendering

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

Goals for NPR?

- Exaggerate/de-emphasize lighting, texture, contrast, perspective, etc.
- Limited palette of colors
- Allow vagueness about material & geometry
- Varying level of detail – draw attention to particular aspects of imagery
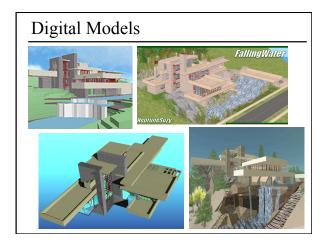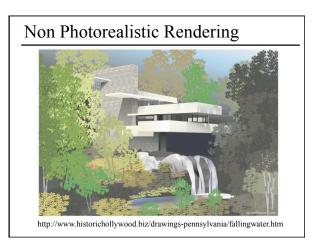- Exploded view

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Reading for Today:

- "Stylized Rendering Techniques For Scalable Real-Time 3D Animation", Lake, Marshall, Harris, and Blackstein, NPAR 2000

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

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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

contours in original view **c**   contours in nearby view **c′**   suggestive contours and contours in **c**

Suggestive Contours for Conveying Shape,
DeCarlo et al., SIGGRAPH 2003

Shaded View   Ridges & Valleys

Suggestive Contours   Apparent Ridges

Types of Edges in Line Drawings

Shaded View   Contours   Suggestive Contours   Ridges & Valleys   Apparent Ridges

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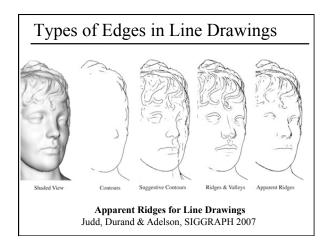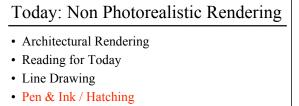Judd, Durand & Adelson, SIGGRAPH 2007

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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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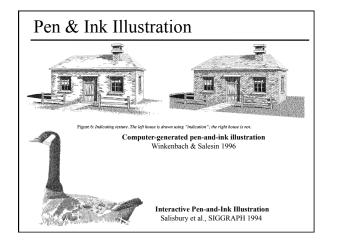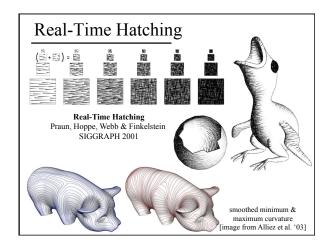- Pen & Ink / Hatching
- Technical Illustration
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Technical Illustration

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
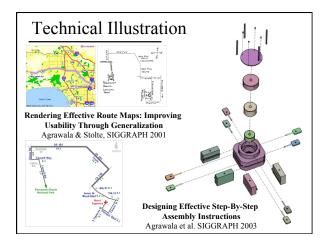Agrawala et al. SIGGRAPH 2003

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Painterly Rendering

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

Reading for Friday 4/17

Unfiltered source (A)   Filtered source (A′)

Unfiltered (B)   Filtered (B′)

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