CMSC 491A/691A
Artistic Rendering

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Announcements

• Upcoming paper presentations:
  – Today: John
  – Thurs: JonB; Sean
  – Tues: Josh, JonD

• Upcoming deadlines
  – Alpha, biblio, revised prop: sept 21
  – Media spec: oct 3

• Class in ITE 346 on Sept 26
Conveying Shape

“A basic understanding of how light affects form is another of the essential elements in the production of a scientific illustration. A drawing, no matter how beatifully rendered, will not look convincing if the highlights and shadows are placed unnaturally.”

Elaine Hodges, in Hodges89

Shape Cues: Overall Shape

- Squint to isolate main contour shape

Noelle Congdon, in Wood94, pg 25
Shape Cues: Light and Shadow

Phyllis Wood, in Wood94, pg 22

Shape Cues: Lighting and Shadow

Phyllis Wood, in Wood94, pg 22
**Shape Cues: Rim Shadow**

- Periphery in shadow
- Distant areas darkened
- Simulates beam of light from front
- William Brudon, in Hodges89, pg 86

**Shape Cues: Plateau Lighting**

- Multiple levels of rim shadow
Conveying Depth

“In studying atmospheric perspective we learn that, as an object recedes from the eye, it becomes less clear, dimmer, softer, more hazy. … The part of the specimen that is further away from the eye is drawn with finer lines than is the part closer to the eye. This convention gives a three-dimensional quality to the subject.”

Phyllis Wood, in Wood94
Depth Cues: Atmospheric Perspective

Depth Cues: Line Attributes

Robert Demarest, in Wood94, pg 7

Wood94, pg 32
Depth Cues: Line Attributes

- Stipples recede behind lines.
- Dotted lines recede.
- Heavy spaced lines advance. Thin close lines recede.

Wood94, pg 32

Depth Cues: Halos

- Leave halo behind foreground objects
- Greater space indicates greater distance

Janet McKenzie, in Wood94, pg 45
Depth Cues: Texture Changes

- Breaks in outline
- Line pattern changes

Ralph Idema, in Hodges89, pg 100

Shading and Texturing

- Generating appropriate tone and texture
- Key issues:
  - Matching tone representing shaded surfaces
  - Using strokes appropriate to style
  - Matching desired textures
  - Using tone and texture to clarify shape
Shading and Texturing

- Papers
  - Winkenbach94
  - Meier96
  - Salisbury97
  - Rusinkiewicz06

Computer-Generated Pen-and-Ink Illustration

Georges Winkenbach, David Salesin
SIGGRAPH 94
Basic Approach

• Adapt techniques of traditional pen-and-ink illustration for automatic generation

• Major Topics:
  – strokes
  – tone and texture
  – outlines

NPR Graphics Pipeline

• Unique nature of process
  – strokes create both texture and tone
  – 2D/3D interactions

• Differences from standard pipeline
  – 2D spatial subdivision
  – rendering of tone and texture
  – stroke clipping
  – outlining
Stroke Principles

- Stroke thickness should correspond to level of detail
- Line thickness should vary over stroke length
- Wavy lines indicate schematic parts

- Winkenbach and Salesin ‘94
Stroke Implementation

• Stroke specified with
  – path
  – nib: footprint as function of pressure
  – character function: waviness and pressure
• Strokes clipped to region
• Initial implementation
  – circular nibs
  – randomly perturbed sine wave character funcs

Tone and Texture Principles

• Tones should be created from lines of roughly equal weight and spacing
• Relative tones more important that absolute
• Textures convey material types
• Tone can be implied by “indication”
Texture Implementation

• Stroke texture
  – each stroke has a priority
  – strokes together achieve desired tone
    (computed from simple Phong lighting model)
  – procedural prioritize specification for texture

• Interactive indication specification
  – detail segments generate fields with small
    random perturbation
• Winkenbach and Salesin ’94
Outline Principles

- Quality of outline conveys texture
- Thick outlines suggest shadows
- Halos around outlines improve visibility
- Outlines must be present even when tones are not
- Outlines can be implied by “indication”
Outline Implementation

• Outline types:
  – boundary
  – interior
• Boundary outline as part of texture
• Only draw outlines where necessary
• Accent outlines for shadowing and relief
• Outlines are view dependent
Light Dependence
View Dependence

• Winkenbach and Salesin ‘94

• Winkenbach and Salesin ‘94