Non-photorealistic rendering (NPR)

CS559

Non-Photorealistic Rendering (NPR)
- aka. Stylized rendering, artistic rendering, expressive graphics...
- Covers any area of graphics where the point is to consciously not produce an image that is as photorealistic as possible.

What is NPR exactly?
- Covers a wide range of styles and techniques

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What do these all have in common?
- They're not trying to look like what we see in the world

Why render Non-Photorealistically?
- Emphasize important information
- Convey ambiguity of uncertain information
- Guide focus
- Establish a 'mood'

Why render Non-Photorealistically?
- Convey ambiguity of uncertain information
- specific ↔ universal (one person vs. everyone)
- complex ↔ simple (progressive reduction of detail)
- realistic ↔ iconic (requiring more translation)
- Illustrations interpret physical reality; distill the essential components of the scene
- We seek algorithms that can make explicit some of the intuition that artists rely upon to create an effective visual representation

Types of things we do with NPR:
- In 2D:
  - Use a painterly style
- In 3D:
  - Stylize lights, surface texture
  - Add outlines, halos
- Common theme: start with reference image/model, tweak to achieve goals (whether artistic, or informational)
- Underlying model is usually left unchanged
Painterly Rendering
- Start with a reference image:

Layer 1

Painterly Rendering
- Produce an image that looks like a painting.

Layer 2

Painterly Rendering
- Produce an image that looks like a painting.

Layer 3

Applying painterly rendering in 3D
- What could go wrong when animating strokes?
  - Frame-to-frame coherency is a problem
  - Can’t just sample strokes randomly on each frame
    - They’d skitter around. It’d look terrible.
  - Can’t just attach strokes to the screen
    - Why not?

Techniques aren’t limited to still images

What Dreams May Come (1998)
Techniques aren’t limited to still images

Applying painterly rendering in 3D
- These are all generated from the same models

Barbara Meier, “Painterly Rendering for Animation”, 1996

Toon (or cel) Shading
- Essentially quantized Gouraud (or Phong) shading

Gooch Shading
- Warm color where surface faces light, fading to cool.

George Washington Crossing the Delaware
By Emanuel Gottlieb Leutze

Inconsistent Lighting
Inconsistent Lighting

George Washington Crossing the Delaware
By Emanuel Gottlieb Leutze

Light Collages

- Apply this idea on a input mesh

Lee, et al. "Light Collages: lighting design for effective visualization", 2004

Contour Lines

- Put lines where there are depth discontinuities
- View dependent

Suggestive Contours

- Adds lines in regions with nearby contours


Ridges and Valleys

- Put lines where there are curvature discontinuities
- NOT view dependent
- Often combined with contours
Stippling
- Convey tone using dots
  - Of either varying size
  - Or varying density


Pen-and-ink illustration
- Renders 3D model using hatched textures according to user-specified intent.
  - Uses texture to convey both surface type and tone.


Non-photorealistic Texture
- Tonal Art Maps
- Orient textures along curvature


Halos
- Add a glow around objects
  - Highlights depth-discontinuities