

Non-photorealistic rendering (NPR)

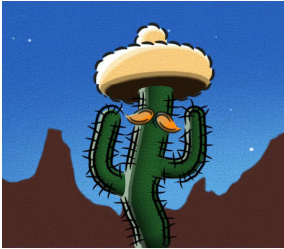
CS559

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.

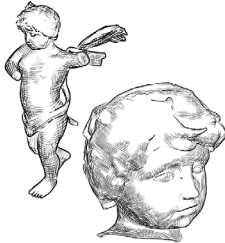
What is NPR exactly?

- ▶ Covers a wide range of styles and techniques



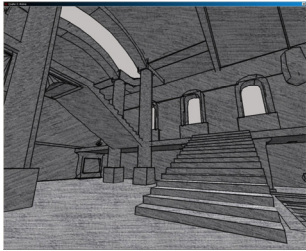
What is NPR exactly?

- ▶ Covers a wide range of styles and techniques



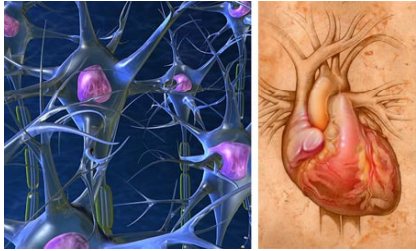
What is NPR exactly?

- ▶ Covers a wide range of styles and techniques



What is NPR exactly?

- ▶ Covers a wide range of styles and techniques



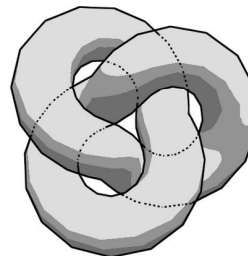
What is NPR exactly?

- ▶ Covers a wide range of styles and techniques



What is NPR exactly?

- ▶ Covers a wide range of styles and techniques



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

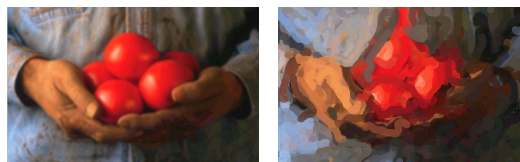
Painterly Rendering

- ▶ Start with a reference image:



Painterly Rendering

- ▶ Produce an image that looks like a painting.



Layer 1

Painterly Rendering

- ▶ Produce an image that looks like a painting.



Layer 2

Painterly Rendering

- ▶ Produce an image that looks like a painting.

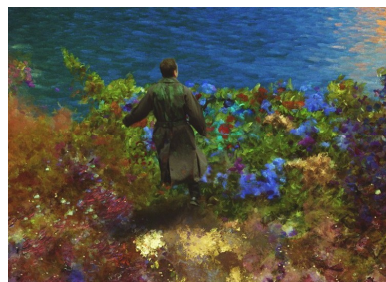


Layer 3

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)

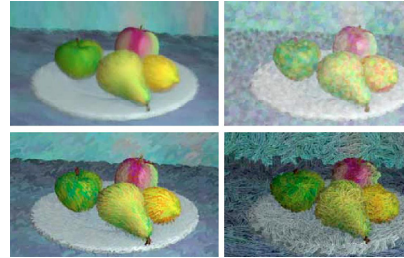
Techniques aren't limited to still images



Waking Life (2001)

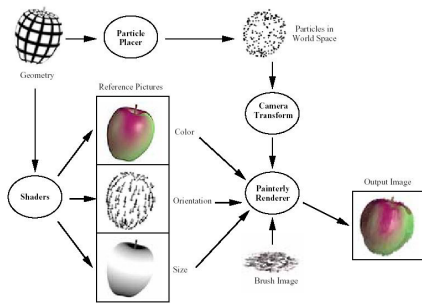
Applying painterly rendering in 3D

▶ These are all generated from the same models



Barbara Meier, "Painterly Rendering for Animation", 1996

Applying painterly rendering in 3D



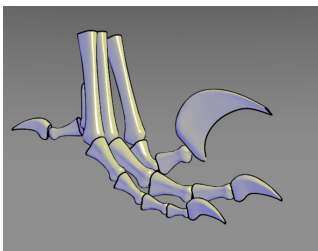
Toon (or cel) Shading

▶ Essentially quantized Gouraud (or Phong) shading



Gooch Shading

▶ Warm color where surface faces light, fading to cool.



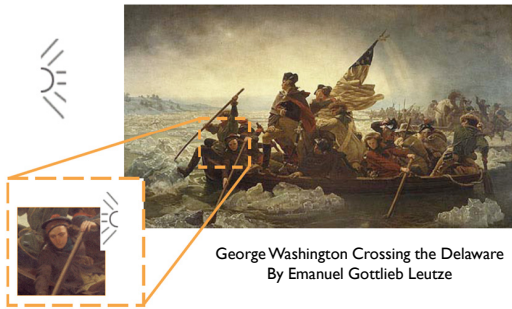
Gooch, et al. "A Non-Photorealistic Lighting Model For Automatic Technical Illustration", 1998

Inconsistent Lighting



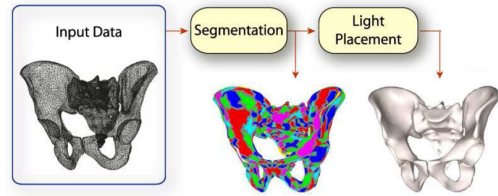
George Washington Crossing the Delaware
By Emanuel Gottlieb Leutze

Inconsistent Lighting



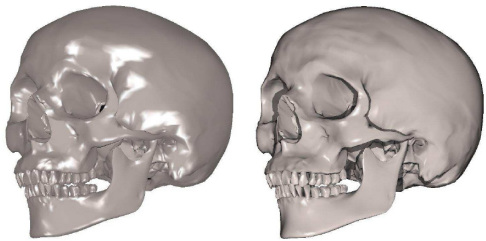
Light Collages

- ▶ Apply this idea on a input mesh



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

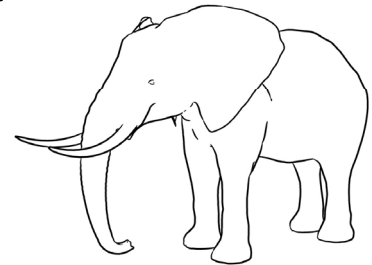
Light Collages



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

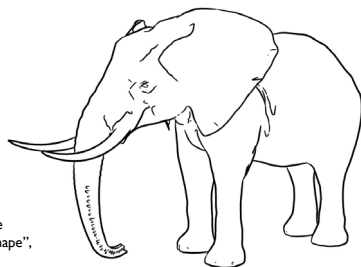
Contour Lines

- ▶ Put lines where there are depth discontinuities
- ▶ View dependent



Suggestive Contours

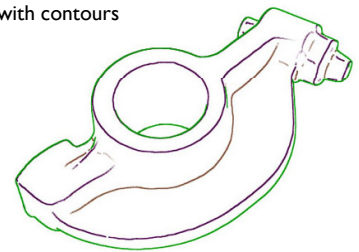
- ▶ Adds lines in regions with nearby contours



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

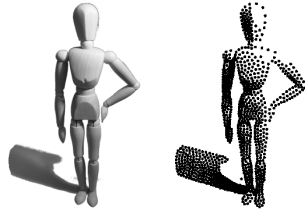
Ridges and Valleys

- ▶ 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



Adrian Secord, "Weighted Voronoi Stippling", 2002.

Pen-and-ink illustration

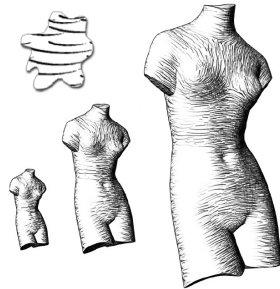
- ▶ Renders 3D model using hatched textures according to user-specified intent.
 - ▶ Uses texture to convey both surface type and tone.



Georges Winkenbach and David H. Salesin, "Computer-Generated Pen-And-Ink Illustration", 1994.

Non-photorealistic Texture

- ▶ Tonal Art Maps
- ▶ Orient textures along curvature



Webb, et al. "Fine Tone Control in Hardware Hatching", 2002.

Non-photorealistic Texture

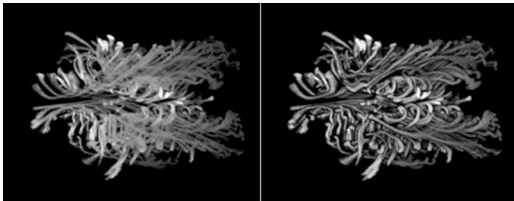
- ▶ Tonal Art Maps
- ▶ Orient textures along curvature



Webb, et al. "Fine Tone Control in Hardware Hatching", 2002.

Halos

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



Halos

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

