
What is NPR?

Amy Gooch

Define Photorealistic Rendering

Photo:

- Comes from the Greek *phos*, meaning light or produced by light

Define Photorealistic Rendering

Realistic:

- Dictionary definition:
 - *fidelity in art and literature to nature or to real life and to accurate representation without idealization*

Rendering:

- Convert a representation of a virtual scene into an image for viewing

Understand Photorealistic Rendering

- Light, material properties, reflections & refraction
- Radiosity, ray tracing, & image-based rendering

Example: Art of Jan Vermeer



Example: Photorealistic Rendering



From *Lightscape*

Define Non-Photorealistic Rendering

Descriptors:

- expressive
- artistic
- painterly
- interpretative

Approach

Photorealistic rendering:

- Simulation, usually physically based

Non-photorealistic rendering:

- Stylization, driven by human perception
- Brings together art and science
- Concentrates less on the process and more on the results

Characteristic

Photorealistic rendering:

- Objective

Non-photorealistic rendering:

- Subjective

Influences

Photorealistic rendering:

- Simulation of physical processes

Non-photorealistic rendering:

- Artistic processes
- Perceptual-based

Level of detail

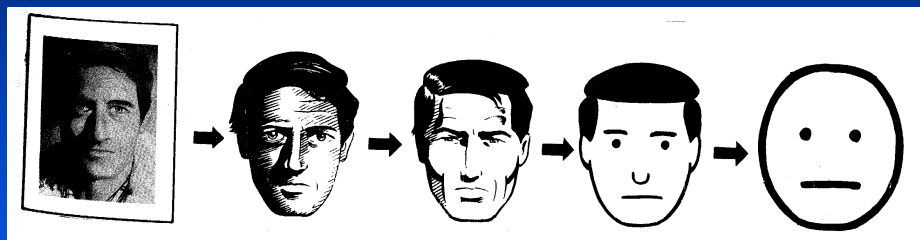
Photorealistic rendering:

- High level of detail, hard to neglect detail

Non-photorealistic rendering:

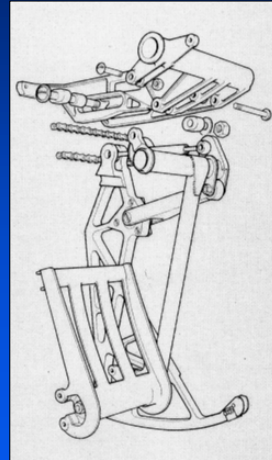
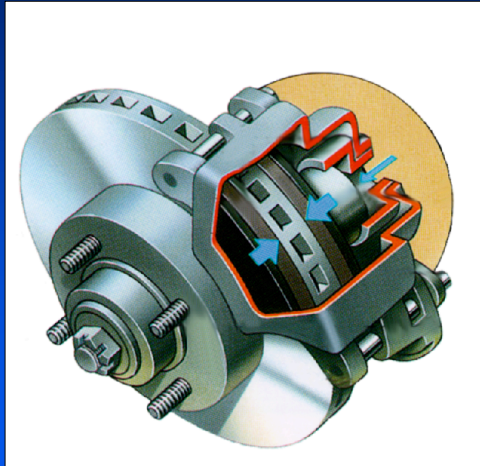
- Runs the range
- Adapt level of detail across the image to focus the viewers attention

Level of Abstraction



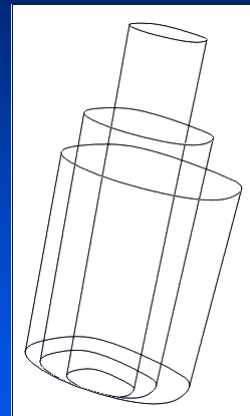
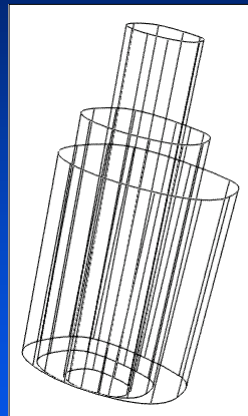
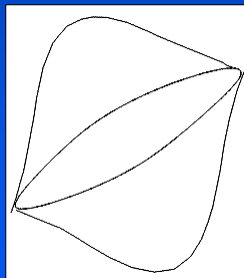
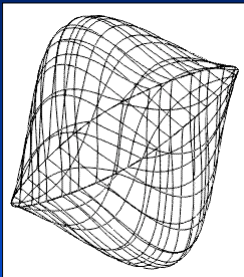
From *Understanding Comics*, by Scott McCloud, 1993

Illustrators Use of Lines



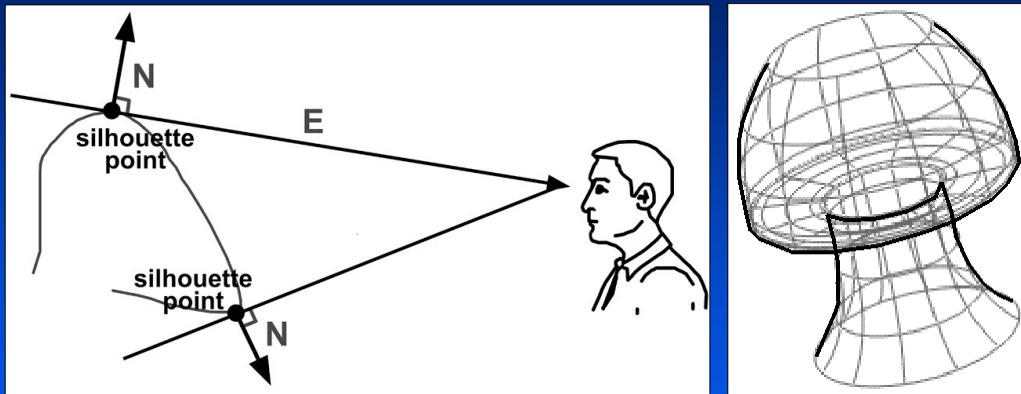
From Technical Illustration by Judy Martin

Wire frame versus Edge Lines



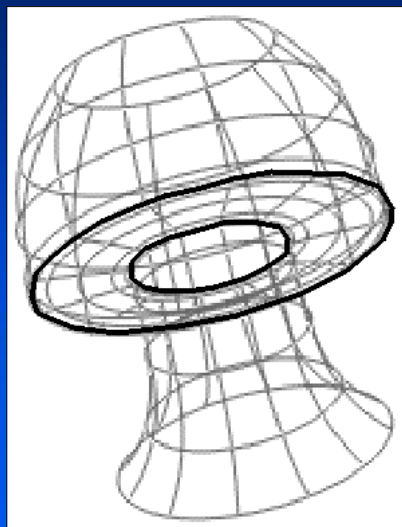
*Are Real Edges Sufficient For Object Recognition?
Sanocki et al.*

Silhouettes

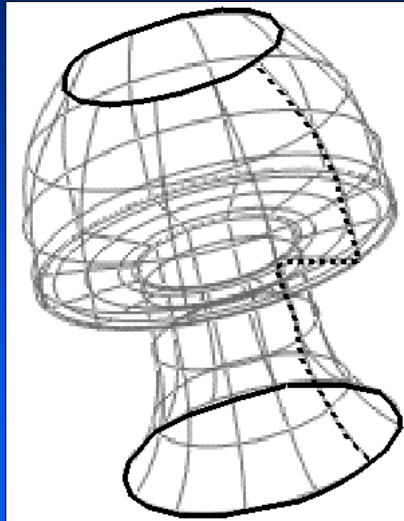


Submitted to *The Journal of Graphics Tools*:
Evaluating Silhouette Algorithms for Polygonal Models, Hartner et al.
A Top-Down Approach to Normal Cone Hierarchies, Hartner et al.
Evaluating Object Space Methods for Silhouette Rendering, Beddes et al.

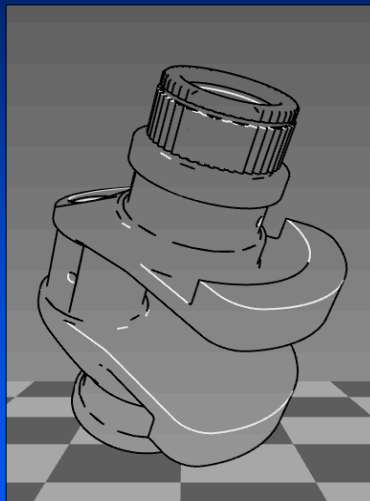
Creases



Surface boundaries

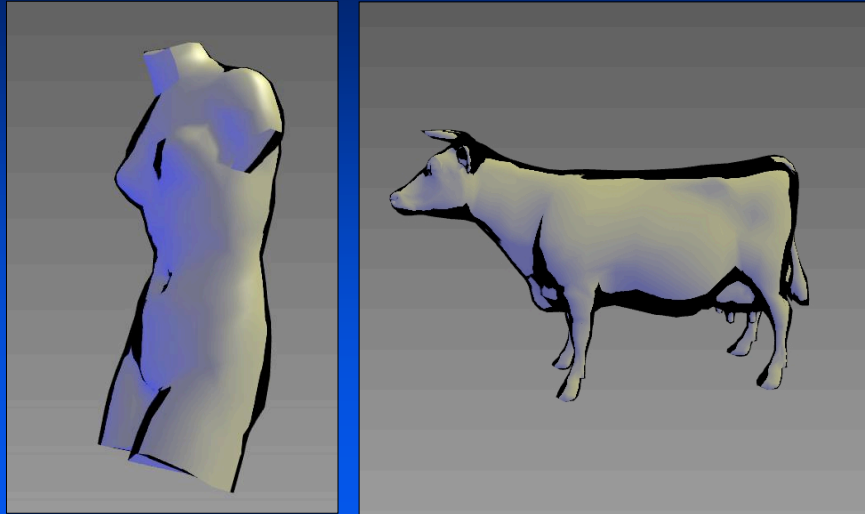


Silhouettes in Black, Creases in White



Gooch et al., *I3D* 1999

Artistic Silhouettes



Gooch et al., *I3D* 1999

Shading Used by Artists

Complementary Shading

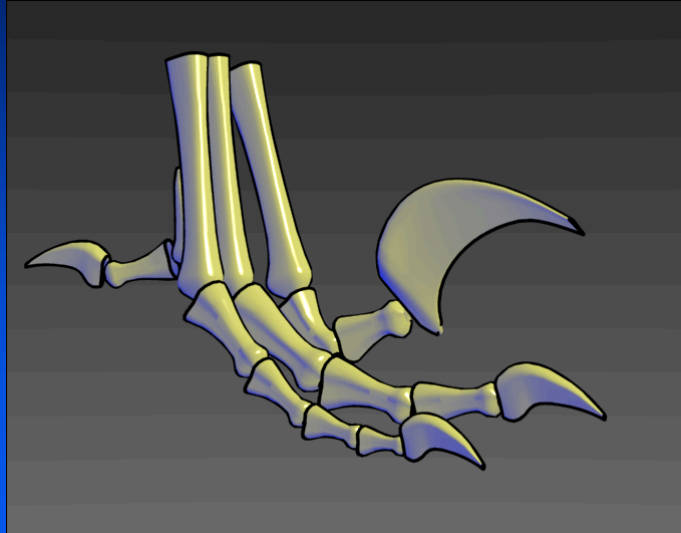


Final image



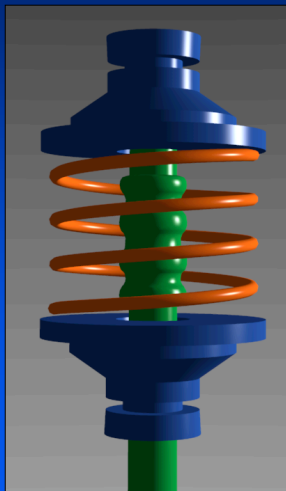
The Book of Color, by Jose Parramon, 1993

Tone Shading on a Gray Model

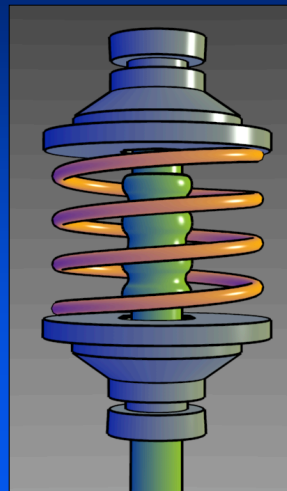


Tone Shading

Phong Shading



Tone Shading



Gooch et al., *ACM Siggraph 1998*

Treasure Planet

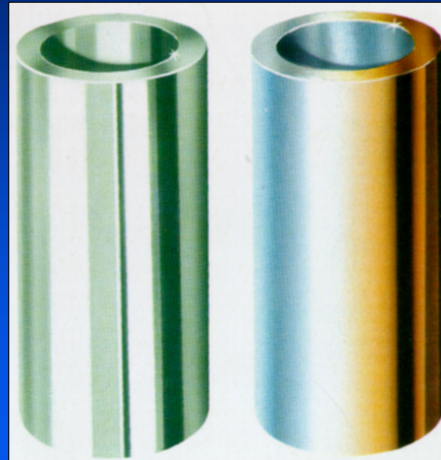


Material Properties

Photograph

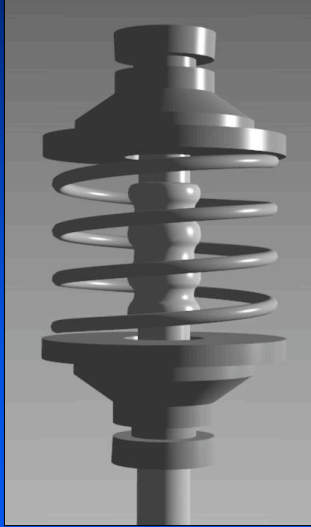


Illustration

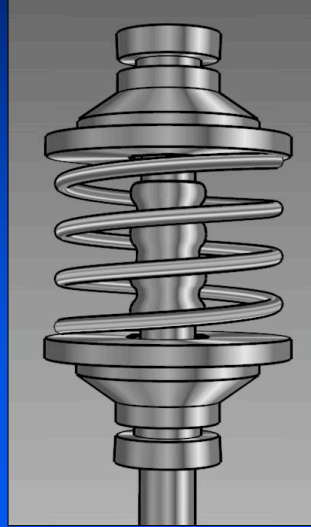


Imitating Material Properties

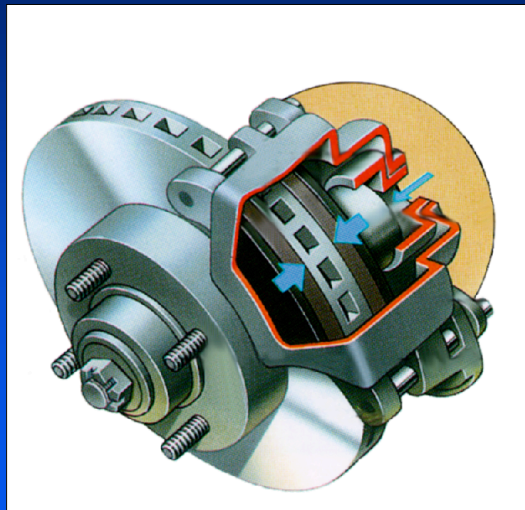
Phong shaded



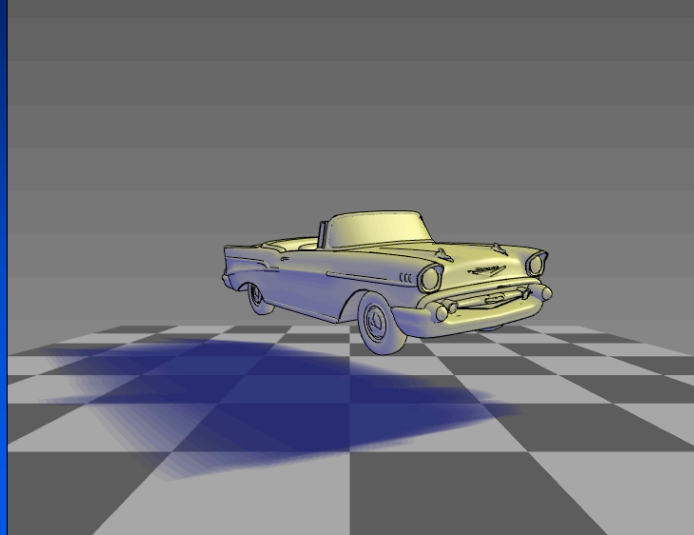
Metal shaded



Illustrators Use of Shadows

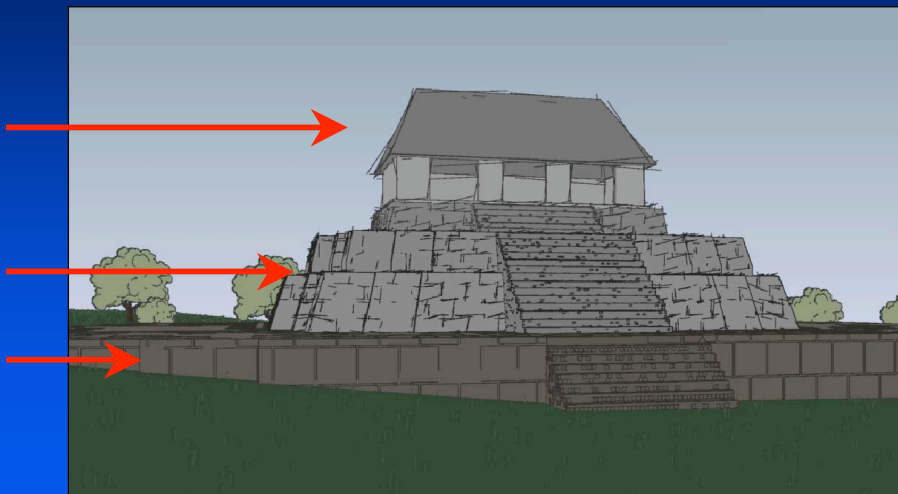


Soft Colored Shadow



Gooch et al., ACM I3D 1999

Mayan Temple Example



Potter et al.

Motivation for Computer Scientists

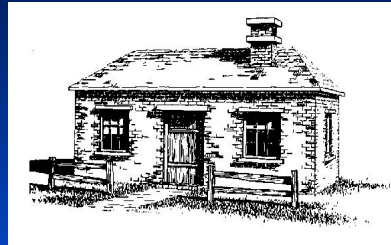
Provide tools for :

- artists
- non-artists

Categorizing NPR

Hard to categorize NPR

- Natural media emulation
 - *pen-an-ink*
 - *watercolor*
 - *oil*



Winkenbach et al. 1994



Hertzmann 1997



Curtis et al. 1997

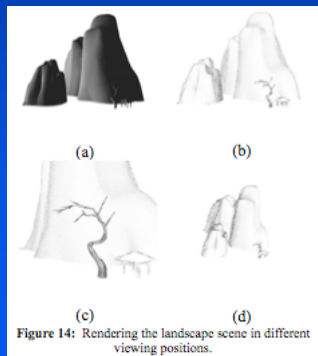
Line and Stipple Drawing



Secord et al. 2002



Deussen et al.



Way et al. 2002



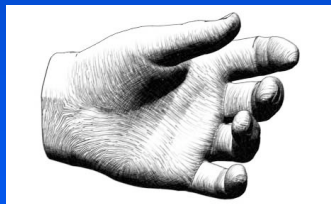
Sousa et al. 2003



Hatching



Webb et al. 2002

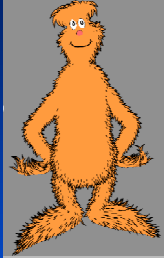
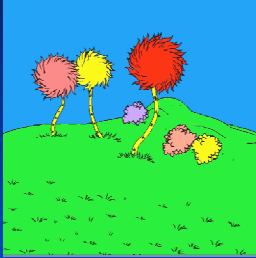


Praun et al. 2001

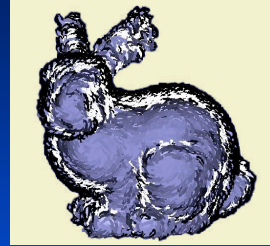


Hertzmann 2000

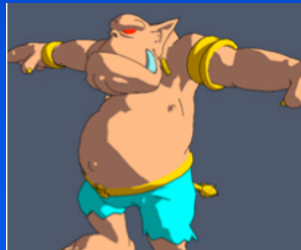
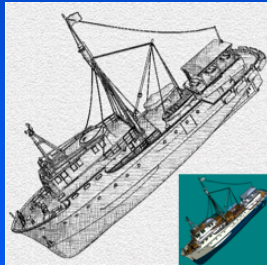
Cartoon Rendering



Markosian et al.



Kaplan et al.



Lake et al.

Simulating materials

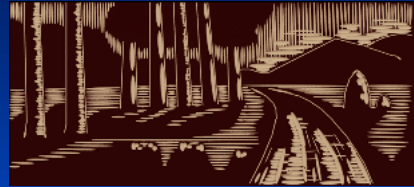


Wax Crayons, Rudolf et al. 2003

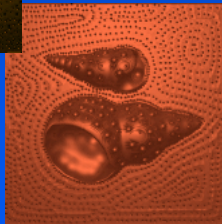


Rudolf et al. 2003

Embossing



Sourin 2001



Categorizing NPR

- Image and video enhancement



Before



After

From www.revisionfx.com

Categorizing NPR

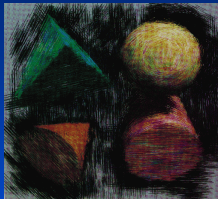
- Image and video enhancement



From www.revisionfx.com

Categorizing NPR

- User interface, like a paint program (2D & 3D)



Haerberli 1990



Cohen 2000



Gooch et al. 2002



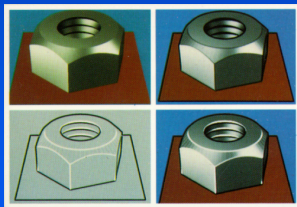
Salisbury et al. 1997

Categorizing NPR

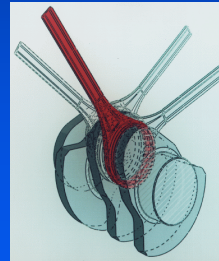
- Process applied to geometric models



Meier 1996



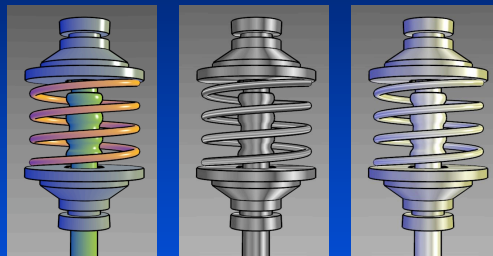
Saito et al. 1990



Dooley et al. 1990

Categorizing NPR

- Process applied to geometric models



Gooch et al. 1998

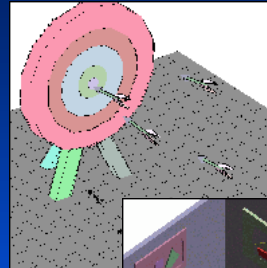


Creating Models



Takeo Igarashi

<http://www-ui.is.s.u-tokyo.ac.jp/~takeo/java/smoothteddy/>



Sketch From Brown U.

What NPR can & can't/shouldn't do

- It is difficult to imitate the decisions of a real artist
- Can we give computer programs inventiveness?
- Can programs be expressive in themselves, or do we depend on the user?

It's not all automatic

You can't just apply NPR to any image or scene & get a work of art

Think about:

- Subject matter
- Scene composition
- Conveying emotion or purpose

Benefits of NPR

- Communication
- Change user focus
- Eliminate unnecessary details
- Create details not seen in the geometric model

