Visualization and Nonphotorealistic Rendering

Adrien Treuille
Carnegie Mellon University
• Visualization
• Non-photorealistic Rendering
• Cutaway Illustration
• Contour Drawing
• Good photographs.
• Map Drawing
- Goal: Use computer graphics to understand data.
- For virtual every data type there is a corresponding visualization.
- The importance of graphics!

http://medvis.vrns.at/fileadmin/hvri/images/heads.jpg
Numerical Data
Graphs

http://www.wandora.org/wandora/wiki/images/frree_graph_example.gif
Graphs

http://www.designinginteractions.com/chapters/7
Flow Visualization

http://www.faculty.arizona.edu/jlinden/publications/ParkYuhitosikeylos/LineartHuman06.jpg
3D Volume Data

http://medvis.vrvis.at/fileadmin/ivr/images/headlarge.jpg
Figure 2.4: An example of a visualization of a single respiratory phase of a 4DCT visualization showing lung, bone, and skin.
Volume Rendering

- Visualize large dataset for scientific / medical application.
- Generally do not start with a 3D model.

INPUT

CT Scan - White means higher radiodensity.

OUTPUT
Large Datasets

**INPUT**

CT Scan - White means higher radiodensity.

**OUTPUT**

- **CT or MRI:**
  - e.g. $512 \times 512 \times 200 \approx 50\text{MB}$
- **Visible Human:**
  - $512 \times 512 \times 1734 \approx 433\text{MB}$
Two Options

- Surface Rendering
- Volume Rendering
Surface Rendering

• Threshold volume data.

• Then run our favorite algorithm....

• Hint: rhymes with “starching dudes”
Volume Rendering

- Some data better visualized as a volume, not a surface.
- **Idea:** Use voxels and transparency.
Outline

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Basic Idea

- Which best conveys “reality?”

Photograph.

Painting.
A Rough Sea at a Jetty, 1650.
Jacob van Ruysdael.

Computer Graphics
Duncan Brinsmead

source: Jos Stam. *Photography changes what we think “reality” looks like.*
Reality

A Rough Sea at a Jetty, 1650. - Jacob van Ruysdael.

- This instance in time never happened!
- Perhaps a better match of “subjective reality.”
- Better illustration of “what was going on.”
- Perhaps we can do better graphics...
- By doing non-photorealistic graphics!
NPR Pipeline

- NPR Research often follows this pipeline...

1. Study Existing Rendering or Illustration Technique
2. Extract General Aesthetic Rules
3. “Algorithmicize” These Rules
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Goal
Box Cut

Object-aligned box cut
Window Cut

Window cut
Wedge Cut
Wedge Cut

Wedge cut
Transverse Tube Cut

Transverse tube cut

primary axis
Cut Taxonomy

(a) Object-aligned box cut

(b) Transverse tube cut

(c) Wedge tube cut

(d) Freeform window cut

(e) Four-sided window cut

Parameter space

Model space
Results

Interactive Cutaway Illustrations of Complex 3D Models

Wilmot Li¹  Lincoln Ritter¹
Maneesh Agrawala²  Brian Curless¹  David Salesin¹,³

¹University of Washington  ²University of California, Berkeley  ³Adobe Systems

(Source: Li et al. InteractiveCutawayIllustrationsofComplex3DModels)
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Contours

\[ n(p) \cdot v(p) = 0 \]
Suggestive Contours

\[ \min n(p) \cdot v(p) \]
More Examples

(a) Drawing likelihood  (b) User composite  (c) Suggestive contours

(d) Extracted lines  (e) Sample drawing  (f) Canny edges
Depth Edge Camera
Depth Discontinuities

Internal and external
Shape boundaries, Occluding contour, Silhouettes
Our Method

Canny Intensity Edge Detection
Shadows
Clutter
Many Colors

Highlight Shape Edges
Mark moving parts
Basic colors
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Reality
MapBlast / LineDrive

[Rendering effective route maps: ..., Agrawala and Stolte]
Figure 2: The LineDrive system. (a) Given a route as a sequence of roads, LineDrive designs a route map by processing the route through five consecutive stages. (b) The resulting LineDrive map. (c) The same map rendered without applying the generalization techniques performed by LineDrive. The constant scale factor and retention of detailed road shape make it difficult to identify many of the roads.
MapBlast / LineDrive
Practice Problem

Of all of the NPR examples you saw in class today, which did you think was most effective for what it was trying to do and why?