Lecture 16:
Illustration, Animation, & Interaction for Visualization

Erik Johansson, Cut & Fold
http://erikjohanssonphoto.com/worktoo/cut-fold/
Today

- Marching Cubes Worksheet
- **Homework 7: Volume Visualization using Paraview**
- Examples of Animation & Interaction for Visualization
- Readings for Today
  - “Designing Effective Step-by-step Assembly Instructions” Agrawala et al., SIGGRAPH 2003
  - “Interactive Cutaway Illustrations of Complex 3D Models”
- Brief Introduction to Graphics Topic: Non-Photorealistic Rendering
- Readings for Friday
Homework 7: Volume Visualization Using Paraview

- The last non-final project assignment
- Download and experiment with Paraview
  - Based on VTK: The Visualization Toolkit from Kitware, an open-source software company in Clifton Park, NY (with lots of RPI alums!)
- Start with the Paraview Tutorial & sample datasets
- Experiment with settings, take screenshots
- Try your hand at creating your own input dataset
  - generated input is probably easiest
  - or construct a real-world dataset!
- Write a short review of the tool

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Stop motion cutaway animation of a physical object!

Animation can be important to explain how familiar items work!
Visual Response to Interaction

- Hide/Unhide elements
  - Increase/Decrease level of detail
  - Change camera/magnification
  - Add text labels
- Highlight element(s)
  - Change color
  - Change transparency
- Motion
  - Showing time simulation
  - User can rearrange for clarity/exploration

Animations Explaining Mechanical Parts

http://imgur.com/gallery/FvCTr
Animation to Explain an Algorithm

http://tholman.com/bezier-curve-simulation/

Justin Legakis
http://legakis.net/justin/gallery_burr.html
Quite Interesting for “Just” a Slider

How Birth Year Influences Political Views

http://www.nytimes.com/interactive/2014/07/08/upshot/how-the-year-you-were-born-influences-your-politics.html?partner=rss&emc=rss&_r=2&abt=0002&abg=1
Motion for Attention/Continuity

A Really Small Slice of Americans Get to Decide Who Will Rule the Senate

Put another way: The number of people who’ll decide this election will likely be smaller than the population of Florida.


https://i.imgur.com/Gzsq5HS.jpg
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- “Designing Effective Step-by-step Assembly Instructions”
  Agrawala, Phan, Heiser, Haymaker, Klingner, Hanrahan, & Tversky, SIGGRAPH 2003

- Inspired by robotics planning research
- Need to solve planning & presentation simultaneously for best result
Design Principles for Illustrations

- hierarchy/grouping of parts
- hierarchy of operations
- step by step instructions vs. single diagram
- only 1 significant piece at a time
- structural vs. action diagrams
- present as much information as possible
  - don't repeat, don't be tedious
- orientation, natural & preferred views
  - maximize # of important features visible
  - minimize accidental alignments
- visibility
  - occlusion ok when symmetry is clear
  - earlier parts visible for context

Input/Output/Automated/User-Driven

- Input:
  - geometry, orientation, grouping, ordering constraints
- Automatic:
  - location translational blocking, visibility
  - at each step, “planner” chooses to attach a part or reorient diagram
  - optimization for visibility
  - direction (maximally separate, interference free) & separation distance
  - diagrammatic elements, guidelines (based on bounding box or contact)
- Semi-automated user-driven/interactive editing
  - add grouping
  - add constraints
- Not automatic (yet):
  - structure
  - zoom in/use insets to show small details, e.g., subassemblies
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- “Interactive Cutaway Illustrations of Complex 3D Models”, Li, Ritter, Agrawala, Curless, & Salesin, SIGGRAPH 2007
“Interactive Cutaway Illustrations of Complex 3D Models”

- Authoring interface to prepare model for interactive cutaway visualization
- Improve on naive cutting plane/cross section or simple transparency
- Provide more context for complex interactions between components
- Respect for structure/shape/position of internal components
- Consideration of impact of occlusion / occlusion graph
- Standards/Conventions for volume cuts
- Inset cuts to emphasize layering
- Use of shading/shadows to emphasize important parts
- Automatic Label Layout
- Example application to both CAD and anatomical models

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Frank Lloyd Wright’s *Fallingwater*

Photorealism is NOT required to effectively explain an idea. Non-photorealism can even be an advantage!
Types of Edges in Line Drawings

- Silhouettes/Contours: where normal is perpendicular to the view direction
- Suggestive Contour: inflection points of the surface normal
- Ridges & Valleys: extremum of curvature
- Apparent Ridges: based on view dependent curvature

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

Real-Time Hatching
Praun, Hoppe, Webb & Finkelstein
SIGGRAPH 2001
Painterly rendering with curved brush strokes of multiple sizes
Hertzmann SIGGRAPH 1998

A non-photorealistic lighting model for automatic technical illustration
Gooch, Gooch, Shirley, & Cohen SIGGRAPH 1998
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Reading for Friday **pick one**

- "Interactive Visualization on Large and Small Displays: The Interrelation of Display Size, Information Space, and Scale", Jakobsen and Hornbaek, IEEE Visualization 2013
Reading for Friday *pick one*

- “Immersive Collaborative Analysis of Network Connectivity: CAVE-style or Head-Mounted Display?”, Cordeil, Dwyer, Klein, Laha, Marriott, Thomas, IEEE InfoVis 20

![Diagram of virtual environment setup with Oculus Rift, Leap motion, and view frustum](image1)

Reading for Friday *pick one*


![Images of virtual environment setup and movements](image2)