Animation

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CS 294-10: Visualization
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Final project

Design new visualization method
- Pose problem, implement creative solution

Deliverables
- Implementation of solution
- 8-12 page paper in format of conference paper submission
- 2 design discussion presentations

Schedule
- Project proposal: 3/29
- Initial problem presentation: 3/31 (Wed)
- Final presentation: In class 5/3 and 5/5
- Final paper: Friday 5/7

Grading
- Groups of up to 3 people, graded individually
- Clearly report responsibilities of each member

Question

The goal of visualization is to convey information

How does animation help convey information?
The secret lives of numbers [Levin 02]

http://www.turbulence.org/Works/nums/applet.html

Cone Trees [Robertson 91]

Volume rendering [Lacroute 95]

Video
**Understanding Motion**

**Motion as a visual cue**

- **Pre-attentive**
  - Stronger than color, shape, ...

- More sensitive to motion at periphery
- Triggers an orientation response
- Motion parallax provide 3D cue (like stereopsis)

**NameVoyager** [Wattenberg 04]

http://www.babynamewizard.com/namevoyager/index.html

**Topics**

- Understanding motion
- Interpreting animation
- Design principles for animation
Segment by common motion (fate)

Tracking multiple targets

How many dots can we simultaneously track?

[4 to 6 - difficulty increases significantly at 6]

Grouped dots count as 1 object

Dots moving together are grouped
Grouping based on biological motion

Motions directly show transitions

Can see change from one state to next
- States are spatial layouts
- Changes are simple transitions (mostly translations)

- Still may be too fast, or too slow
- Too many objects may move at once
Show motion path in static image

Evaluation of Animation Effects to Improve Indirect Manipulation [Thomas 00]

Drag-n-pop [Baudisch 03]

Relevant applications jump to file you are dragging with paths drawn as stretched bands (meant for large screen displays)

What about other transformations (rotation / scale)?

Intuitive physics [Kaiser 92]

What is motion if string cut at nadir of motion?

What is motion if string cut at apex of motion?
Intuitive physics [Kaiser 92]

Airplane animations with 2 conditions, 1) fixed camera and 2) dollying camera

Fixed Camera

Dollying Camera

Interpreting Animation

Constructing narratives

http://anthropomorphism.org/img/Heider_Flash.swf
Attribution of causality [Michotte 46]

Michotte demonstration 1. What do you see? Most observers report that “the red ball hit the blue ball.” The blue ball moved “because the red ball hit it.” Thus, the red ball is perceived to “cause” the blue ball to move, even though the balls are nothing more than color disks on your screen that move according to a programmer.

http://cogweb.ucla.edu/Discourse/Narrative/Heider_45.html

[Reprint from Ware 04]

How does it work?

Four-stroke combustion cycle

Q1: How many times does the piston go up and down per spark-plug firing?
Q2: What side does the fuel come in? What side does it exit?
Q2: How is the timing of the two valves coordinated?

http://auto.howstuffworks.com/engine1.htm
Problems [Tversky 02]

Difficulties in understanding animation
- Difficult to estimate paths and trajectories
- Motion is fleeting and transient
- Cannot simultaneously attend to multiple motions
- Trying to parse motion into events, actions and behaviors
- Misunderstanding and wrongly inferring causality
- Anthropomorphizing physical motion may cause confusion or lead to incorrect conclusions

Solution I: Break into static steps

Two-cylinder Stirling engine
http://www.keveney.com/Vstirling.html

Challenges

Choosing the set of steps
- How to segment process into steps?
- Note: Steps often shown sequentially for clarity, rather than showing everything simultaneously

Tversky suggests
- Coarse level – segment based on objects
- Finer level – segment based on actions
  - Static depictions often do not show finer level segmentation
Design Principles for Animation

Disney’s traditional principles [Lasseter 87]

1. Squash and stretch
2. Anticipation
3. Staging
4. Straight-ahead vs. Post-to-pose
5. Follow through and overlapping action
6. Slow-in and slow-out
7. Arcs
8. Secondary action
9. Timing
10. Exaggeration
11. Solid drawing
12. Appeal

Squash and stretch

Defines rigidity of material

Should maintain constant volume

Smothes fast motion – similar to motion blur

Staging

Clear presentation of one idea at a time

- Highlight important actions
- Lead viewers’ eyes to the action
- Motion in still scene, stillness in busy scene
- Motion clearest at silhouette
Anticipation
Show preparation for an action

Follow-through
Emphasize termination of action

Overlapping action
Start 2nd action before 1st has completed

Slow-in and slow-out
Space in-betweens to provide slow-in and out
Linear interpolation is less pleasing

Luxo Jr’s hop and cord moves at the same time
Principles for conveying information

Congruence:
The structure and content of the external representation should correspond to the desired structure and content of the internal representation.

Apprehension:
The structure and content of the external representation should be readily and accurately perceived and comprehended.

[From Tversky 02]

Principles for animated presentations

Slithy – system for creating animated presentations [Zongker 03]

- Make all movement meaningful (??)
- Avoid cartoony squash and stretch, exaggeration, etc.
- Highlight important things in simple ways
- Avoid instantaneous changes
- Allow users to see transformations from one state to another
- Reinforce hierarchical structure with transitions
- Subtle transition for small change of ideas, less subtle for big changes
- Create a large virtual canvas (??)
- Smoothly expand and compress detail
- Allow users to see transformations from one state to another
- Manage complexity through overlays (??)
- Bring in detail as required (think of detail as being layered in)
- Do one thing at a time
- Reinforce animation with narration (present same idea visually and orally)
- Distinguish dynamics (content) from transitions (connections)

Summary

Animations convey motion, action, story, process

Problems
- Divided attention
- Transient
- Character animation different than explanatory animation

Techniques
- Aid segmentation into events, actions, sequences, story
- Relies on our ability to fill in temporal gaps (closure)
- More research required on principles for creating effective animated visualizations