Motion:
Animation, Navigation, Zooming

CPSC 533C, Spring 2003

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spatial navigation

real navigation only partially understood

- compared to low-level perception, JNDs

spatial memory / environmental cognition

- city: landmark/path/whole

implicit logic

- evolved to deal with reality
- so we'll learn from synthetic worlds

- but we can't fly in 3D...

how much applies to synthetic environments?

- even perception not always the same!

Proffit line length experiments

vert/horiz line length judgements

- when does vertical height match horiz separation
- systematic vertical overestimation

orig 1999 experiment

- overestimation more with reality than pictures
- perceived physical size of projection on surface
- (not apparent represented size)
- 2x greater viewing large objects than small pictures
  even if identical visual angles

is this about 3D vs 2D, or immersion, or what?

Yang, T. L., Dixon, M. W., & Proffitt, D. R. (1999). Seeing big things: Overestimation of heights is greater for real objects than for objects in pictures. Perception. 28, 445-467.

second Proffit experiment

real life

immersive VR simulation of real life

- same response, lots of overestimation

picture on monitor

- diff response, more correct response
- frames - not it

immersive VR simulation of picture on monitor

- end state identical with VR sim of RL
- but - matched *picture* reponse
- don’t overestimate much if you *think* it’s a projection

Dixon, M. W. & Proffitt, D. R. (2002). Overestimation of heights in virtual reality is influenced more by perceived distal size than by the 2-D versus 3-D dimensionality of the display. Perception 31, 103-112.

synthetic spatial navigation

even perception is tricky

navigation even trickier!

- lessons not as easy to glean
- nonliteral vs literal

action vs. animation

free action		scripted
	<-->	
exploration		exposition

6DOF nav	constrain nav	anim trans	start/stop "VCR"	feature animation

constrained navigation

terrain following

logarithmic motion (PARC paper)

- [video: CHI 91]

constrained zooming

demo: www-ui.is.s.u-tokyo.ac.jp/~takeo/java/autozoom/autozoom.htm

video: Large Space Walking, Hanson, Vis95

animated transitions

guaranteed frame rate for scalability

- or wall-clock time vs. number of frames

desired distance vs size of world

- how to algorithmically define "short"?
- easier in specific than general tools

provides object constancy

- esp important for nonliteral: ZUI, F+C

animation

VCR controls vs feature films

- controls not used in normal viewing

no user control: animation conventions

Principles of Traditional Animation Applied to Computer Animation
John Lasseter, SIGGRAPH 87

- anticipation: foreshadow motion, lead with head/eyes
- slow-in, slow-out
- exaggeration: abstraction choices
- staging: canonical views

cuts/transitions: movie conventions

- moving line on map vs. title stating placename
- (calendar flapping for time passing)

how to show motion?

literal <--> abstract

motion space for time symbols

small multiples: show each time step

- compare: side-by-side easier than temporal
- exception: "blink" between two states

static visual symbols

- comics use arrows, lines
- [Scott McCloud, Understanding Comics, p. 111]

animation vs multiples

show time with time vs. show time with space

carefully segmented keyframes usually wins

- unless transitions too complex to be broken down

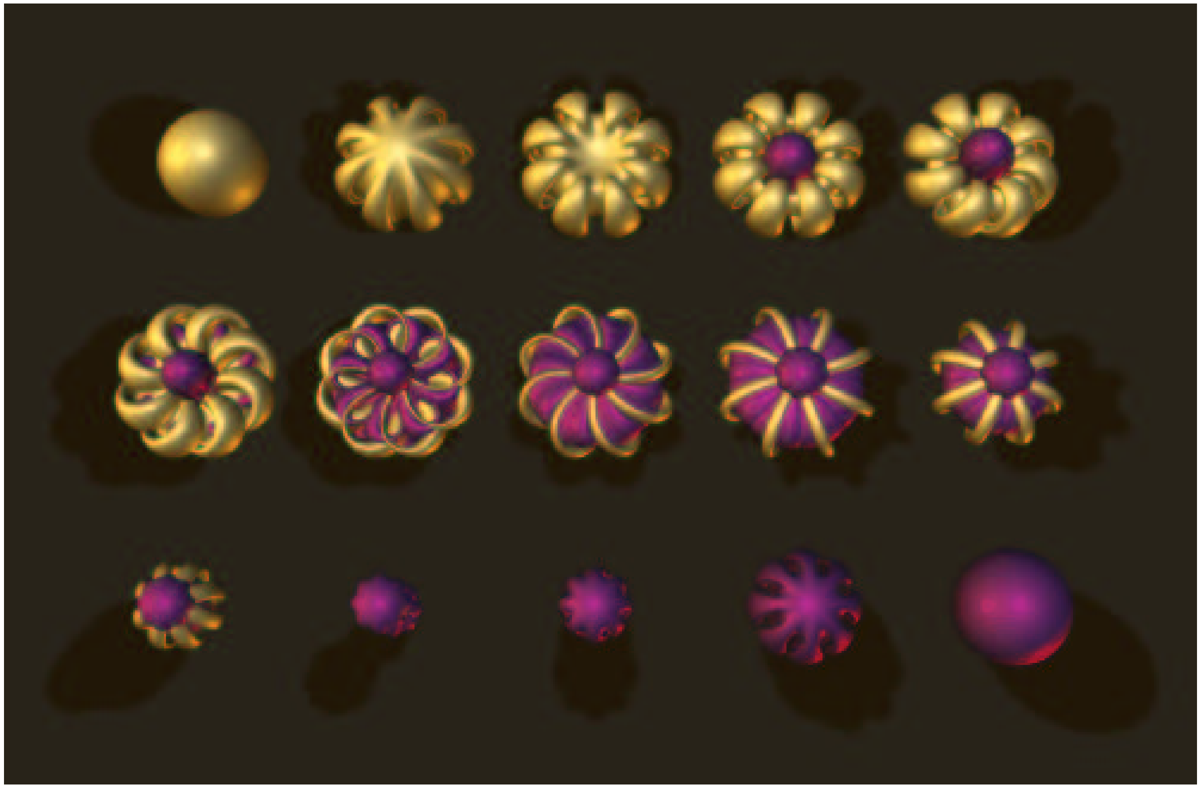
Animation: Does It Facilitate Learning?, SmartGraphics 2000
Julie Bauer Morrison, Barbara Tversky, Mireille Betrancourt

bad news for algorithm animation
good news for us

complex motion: sphere eversion

even careful segmentation not enough

[video: Outside In]



[Silvio Levy, Delle Maxwell, and Tamara Munzner. Outside In (Video, 22 minutes). AK Peters, 1994.]

complex motion: sphere eversion

1. just show entire object motion
2. decompose object into semantic pieces
3. decompose motion into semantic stages

scripted not free

process/morph not rigid motion

multiple views briefly

- powerful but dangerous in animation

animation vs. interactive navigation

- [demo: OI live]
- expository vs exploratory

what to move?

viewpoint vs. object

1 camera, 1 object

- same mathematically
- different UI feeling
  - first-person motion (Quake)
  - move object (Space Invaders)
  - infovis example: H3 vs. Constellation

multiple views, multiple objects

what kind of motion?

rigid

- rotate/pan/zoom
- easy to understand
- object shape static, positions change

morph/change/distort

- object evolves

  beating heart, thunderstorm, walking person

- multiscale/ZUI
  object appearance changes by viewpoint
- focus+context
  carefully chosen distortion

multiscale desert fog

Critical Zones in Desert Fog: Aids to Multiscale Navigation
Susanne Jul, George W. Furnas UIST 98

environment devoid of navigational cues

- not just Pad: 6DOF navigation where object fills view

designer strategies

- explicit world creation - fog not made on purpose
    - games - partial counter example
- island of information surrounded by desert fog

Pad: min/max visibility distances

view-navigation theory

Effective View Navigation, CHI 97
George Furnas

characterizing navigability: viewing graph

- nodes: views
- links: traversible connections

1. short paths between all nodes

- true in ZUIs (e.g. speed-dependent zooming)

2. all views have small number outlinks

- not overwhelmed by choices

critical zones

region where zoom-in brings interesting views

- show with navigation "residue"

unambiguous action choice

- visible critical zone "residue" of stuff beneath
- zoom out if see nothing

extension to VN theory

- 3. all views contain good residue of all nodes
- 4. all links must have small outlink-info
- must build support for these into ZUIs

do not have "minsize", always use a few pixels

- they don’t address clutter/scalability

guaranteed visibility

TreeJuxtaposer

layout/navigation designed so that desert fog impossible

marked objects always visible

efficiency: what if 1M nodes in tree?