Sketch & sculpt: perception, interaction & modeling

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Humans have an audio IN and OUT, a video IN but no explicit video OUT!
video IN: Perception

- **Visual field:** one eye looking straight at the horizon, with a narrow cone of vision, while standing still.

- **Visual world:** two eyes looking all around with peripheral vision, while moving dynamically.

Most children between the ages of about 9-11 have a passion for realistic drawing. They become sharply critical of their childhood drawings and begin to draw certain favorite subjects over and over again ... Anything short of perfect realism may be regarded as failure.

...many adolescents say, “This is terrible! I have no talent for art. I’m not doing it anymore.”


...regardless, we all mould, gesture and doodle!
Design sketches: Ideation
3D Design Drawing

Concept Sketches

Production Drawings

Construction Plans
Sculpting
Sculpting Workflows

3D

- Primitive creation and coarse manipulation.
- Primitive composition.
- 3D navigation.
- Volume control.

2D

- Sketching on surfaces: chiseling, brush based refinement.
- Surface parameterization and transport for cut and paste.
Physical sculpting challenges

- No digital affordances (undo, history, variability).
- Occlusion problems in 3D scanning.
- Raw 3D scan to usable digital model is non-trivial.
- 3D printing is slow, limited.
- Iteration cycle is long and expensive.
Devices

- Online/interactive
- Immersion
Digital sketching & sculpting challenges

- 2D input (mouse, pen tablet) to define 3D.

- 3D input (phantom, mocap) have poorer fidelity, haptics and ergonomics compared to 2D input.

- Inferring 3D shape from 2D input is inherently ambiguous.

- 3D shape is viewed on a 2D display (volumetric and stereo displays have poorer fidelity).
Challenge

2D to 3D: “Depth” component is ambiguous
Human perception †

Combination of

• Visual rules
• Visual memory

Visual rules

... 

- Interpret straight/coincedent/collinear lines as straight/coincedent/collinear lines in 3D.
- Proximity: nearby in sketch -> nearby in 3D.
- Smoothness: Interpret a smooth stroke as smooth in 3D.

...
Visual rules

- May lead to implausible reconstructions

Figure: http://www.at-brisol.co.uk/Optical/ImpossibleTriangle_main.htm
Pictures: http://im-possible.info/english/articles/real/real3.html
Visual memory

• Allows for more rich reconstruction
  • How much can we actually see in this image? How much do we infer?
Perception flowchart

Visual memory → Found? → Reconstruct from visual rules

Reconstruct from memory
Issues in Digital Sketching

2D

- Stroke filtering. (clothoids, multi-stroke... what are we filtering?)
- Stroke Processing. (sketch widgets, gestures...)
- Strokes and multi-touch. (gestures, symmetric drawing...)
- Stroke appearance (NPR, neatening...)
- Stroke dynamics (pressure, tilt, direction, temporal order...)
- Seamless UI Control (sketch widgets, crossing menus, gestures...)
- Navigation (paper manip., onion skinning...)
- 2D curve creation: (What are desirable curves, how do we perceive them in relation to our design knowledge?).
- Stroke Perception (what spatio-temporal information do they convey?)

3D (Additional dimension for 3D design, animation or 2D design explorations)

- 3D Navigation. (camera tools, single/multi-view, view bookmarks...).
- 3D curve creation: (2D stroke to 3D curves perception & inference).
- Animation (motion trails, evolving shape fronts...)
- Alternate Designs (co-locating them in space...)