Goals

• Fundamentals of 3D shape modeling:
  • Curve and Mesh-based representations.
  • Geometry processing: curvature, segmentation, symmetry, deformation...

• Interaction techniques for shape modeling:
  • pen-based, multi-touch, full-body, AR/VR.

• Fabrication.

• Evaluation:
  • Design and Modeling Assignment 25%.
  • Technical Paper presentation 25%.
  • Project (2-3 people working together) 50% (mid-term evaluation 10%, report 10%).
What is this course about?

Creative visual communication

The transformation of a creative vision into a physical reality, that is easy to digitally refine and reuse.
Humans have an audio IN and OUT, a video IN but no explicit video OUT!
video IN: Projection & Perception
video IN: Projection & Perception
video IN: Projection & 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.


Human visual perception combines:
- Visual rules.
- Visual memory.
video IN: visual rules

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

...may lead to implausible reconstructions
Video IN: visual memory

How much can we actually see in this image? How much do we infer?
video OUT: Sketching & Sculpting

Most children between the ages of about 9-11 have a passion for realistic drawing. …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!
Sketching

Ideation doodle

Concept sketch

Production drawing

Construction plan
Sculpting
Issues in interaction for modeling

2D

- stroke filtering
- stroke processing
- stroke appearance
- stroke dynamics
- seamless UI Control
- navigation
- 2D curve modeling
- stroke perception

- fairing, clothoids...
- recognition, regularization...
- NPR, stylization...
- pressure, tilt, direction, temporal order...
- widgets, gestures, crossing, multi-stroke...
- paper manipulation, onion skinning...
- what are desirable curves?
- How do we perceive them?

3D

- 3D scanning/printing
- 3D navigation
- 3D curve and surface modeling
- immersive input and displays
- fabrication

- occlusion and feasibility...
- camera tools, single/multi-view...
- what are desirable surfaces?
- can we draw in 3D?
- can we build as we create?
3D geometric representations

- Point.
- Point-cloud.
- Poly-line.
- Polygon mesh: Quads, Triangles...
- Parametric curve/surface: Hermite, Bezier, B-Spline, NURBS...
- Subdivision curve/surface: Chaikin’s curve, Catmull-Clark...
- Voxels.
- Implicit functions, level-sets, blobby models.
- Texture maps.
3D modeling: form + function

What do these objects do?
3D modeling: good design

- Affordance.
- Visibility.
- Conceptual Model.
- Mapping.
- Feedback.
3D modeling: good design

“Darn these hooves! I hit the wrong switch again! Who designs these instrument panels, raccoons?”