

CSE 165: 3D User Interaction

Lecture #16: 3D UI Design

Instructor:
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Announcements

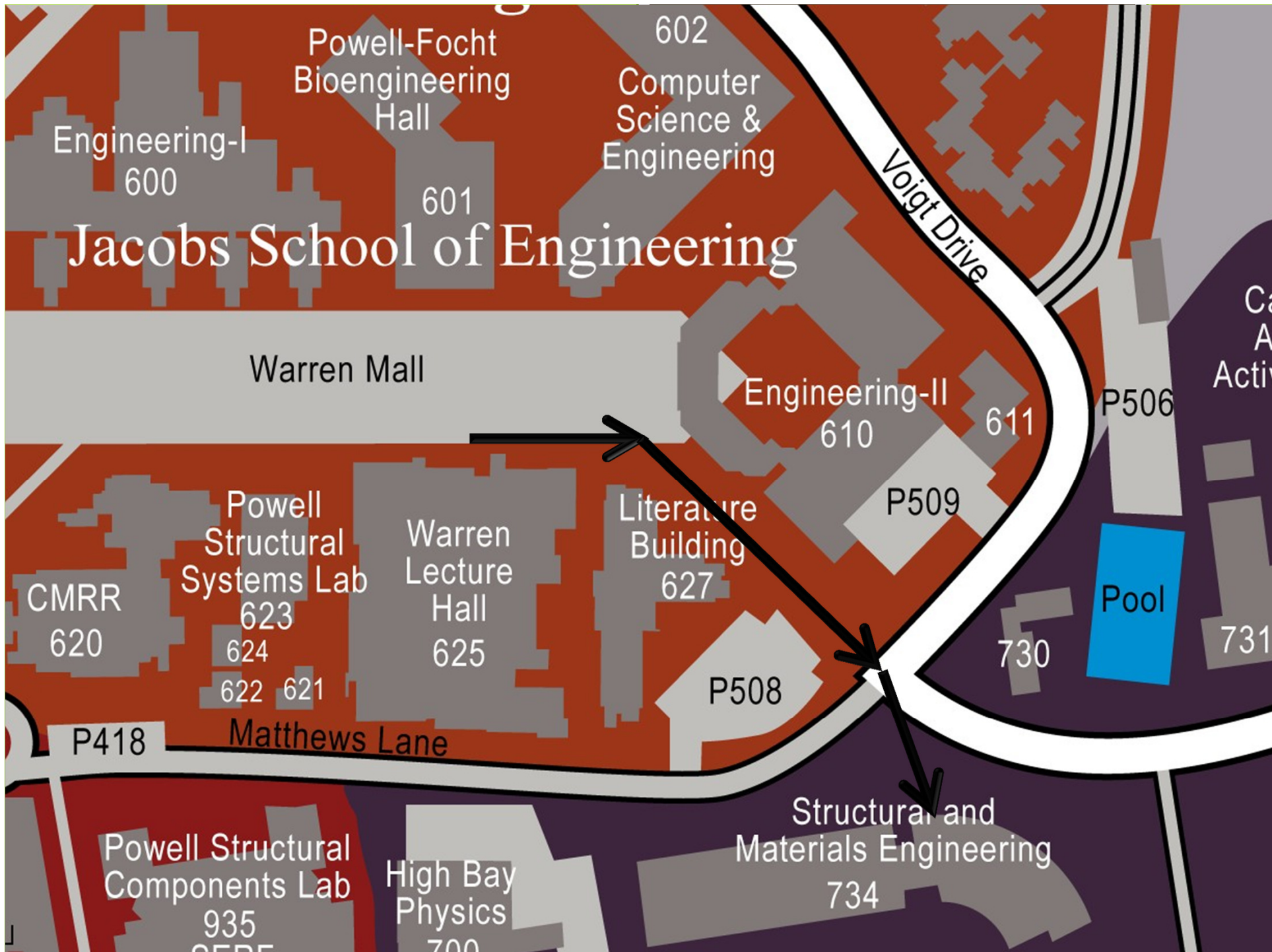
- Homework Assignment #5
 - Due Thursday March 19th at 3pm
 - First blog due Wed March 11th
 - Second blog due Wed March 18th

CAPE

- Submit CAPE forms on-line in **weeks 9+10**
- Responses to all surveys are completely **anonymous**.
- Only a **summary** of results is provided to the CS department and the instructor.
- This summary is provided **AFTER final grades** have been posted.
- A minimum number of **three** evaluations must be submitted by students for summaries to be made available.

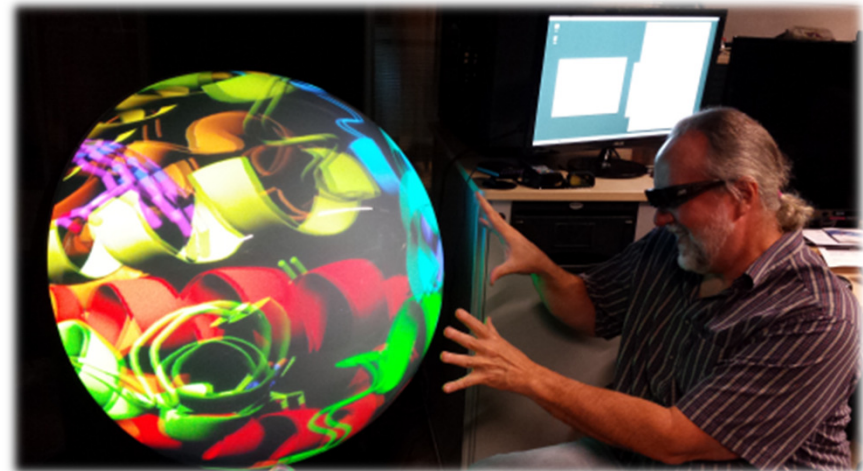
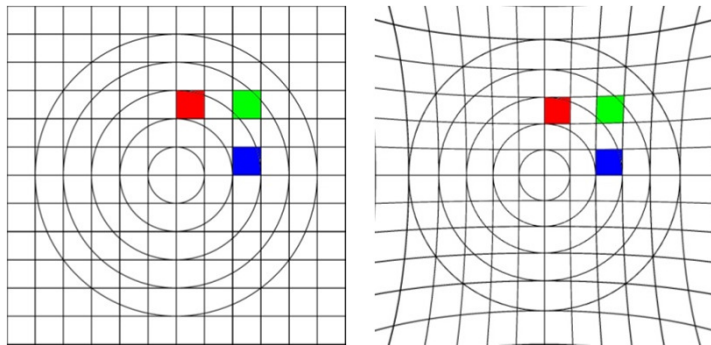
WAVE Lab Tour

- Next Tuesday's lecture (2-3:20pm) is going to be held in the SME building's WAVE lab (room SME 141)
- We'll meet in the classroom, then walk over to the SME building
- If you're late meet us there:
follow the arrows on the map on the next slide; last arrow points to lab door on outside of building (don't go through main entrance)



Independent Research (CSE199)

- JVC Tangible Globe
- Viewer-dependent image warping
- Spring quarter
- Looking for 1-2 people



3D UI Design Strategies

Thus far...

- 3DUI hardware
 - Output
 - Input
- Universal 3DUI tasks
 - Selection
 - Manipulation
 - Navigation
 - System control
 - Symbolic input

But: The combination of techniques and devices alone does not guarantee an enjoyable experience!

3DUI Design

- Microlevel: implementation
 - 3D interaction programming: hard!
 - Testing: difficult and hard to automate
 - Tweaking UI parameters: important but time consuming
- Macrolevel: guidelines
 - Strengths and limitations of human psychology/physiology
 - Common sense
 - Rules of thumb
 - Example: people naturally use 2 hands, so using 2 hands in a 3D UI might improve usability/performance

3DUI Design

- Two main strategies
 - Designing for humans
 - Match design to human strengths
 - Inventing 3D interaction techniques
 - Creative exploration of 3D UIs

Designing for Humans - Feedback

- Feedback is critical to usable 3D interfaces
 - User feedback is any information conveyed to the user to help understand
 - system state
 - result of operation
 - status of task
- Feedback control mechanism
 - Example: turning a knob produces feedback by
 - External sources: the knob
 - Internal sources: user's body
- Want to have appropriate feedback levels
- Ensure compliance (agreement) between different levels/types of feedback

Designing for Humans – Feedback in Multiple Dimensions

- Sensory dimensions
 - Visual, auditory, tactile, olfactory
 - Proprioceptive: relative position of neighboring parts of the body
 - Kinesthetic: bodily motion
- Want to try to give multi-dimensional feedback
 - Can be difficult due to technology (e.g., haptic devices)
 - Sensory feedback substitution
 - Example: visual/audio cues compensate for missing haptic feedback
- System-based feedback
 - Reactive – from sensory dimensions
 - Instrumental – generated by devices
 - Operational – changes in virtual world

Designing for Humans – Compliance

- Main principle in design feedback
- Want different feedback dimensions in sync
 - Maintain spatial and temporal correspondence between multiple feedback dimensions
- Feedback displacement is bad!
 - Example: hand and virtual object move in different directions

Designing for Humans – Spatial Compliance

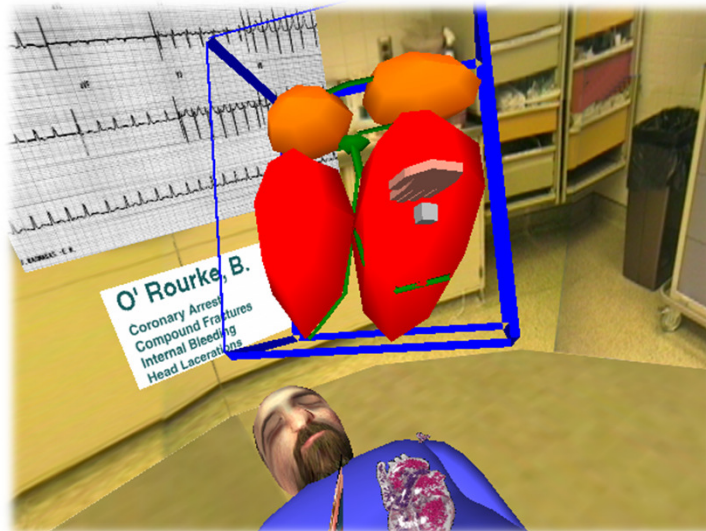
- Directional compliance – virtual object should move in the same direction as manipulated by input device
- Nulling compliance – when user returns device to initial pose, virtual object returns to corresponding initial pose
- Instrumental and operational feedback also require spatial compliance
 - Example: real and virtual hand should be aligned

Designing for Humans – Temporal Compliance

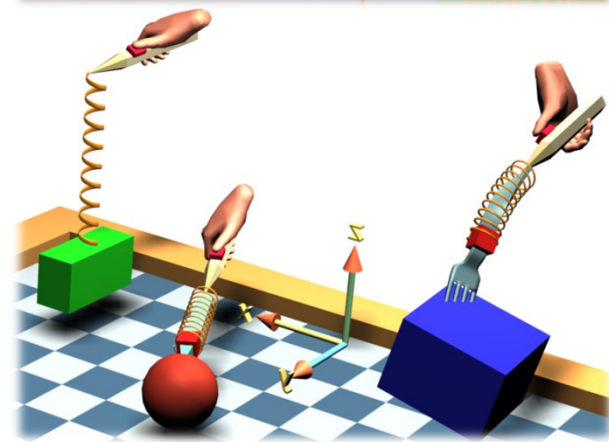
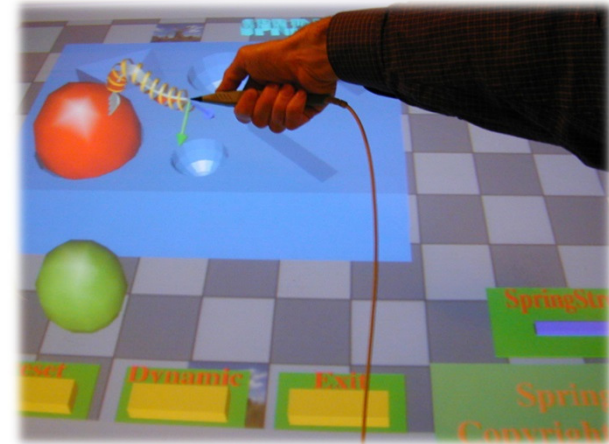
- Latency – typical problem
 - Temporal delay between user input and sensory feedback
 - Incompliance with internal feedback
- Variable latency can be even more problematic
- Solutions?
 - Reduce scene complexity
 - Faster hardware
 - Predictive tracking

Designing for Humans – Feedback Substitution

- Cannot always support all sensory feedback dimensions
- Typical approach is to substitute



Highlighting object about to be selected



*Spring Manipulation Tools,
Michal Koutek, TU Delft*

Designing for Humans – Passive Haptics

- Match shape and appearance of virtual object with physical prop
 - User both sees and feels
- Advantages
 - Inexpensive haptic/tactile feedback
 - Establish perceptual frame of reference
- Disadvantages
 - Scalability
 - Performance improvements have not yet been measured



Designing for Humans – Constraints

- Constraints:
 - Are a relation between variables that must be satisfied
 - Example: a line should stay horizontal
 - Define geometrical coherence of scene
 - Can make interaction simpler and improve accuracy

Designing for Humans – Constraint Types

- Physically realistic constraints
 - Collision detection and avoidance
 - Gravity
 - Application dependent
- DOF reduction
 - Simplify interaction (example: constrain travel to ground)
- Dynamic alignment tools
 - Grids and snapping, guiding surfaces
- Intelligent constraints
 - Deal with semantics
 - Example: lamp can only stand on horizontal surfaces

Designing for Humans – Two Handed Control

- Also known as bimanual input
- Transfer everyday manipulation experiences to 3DUI
- Can increase user performance on certain tasks
- Active topic of research