

# 3D Interaction

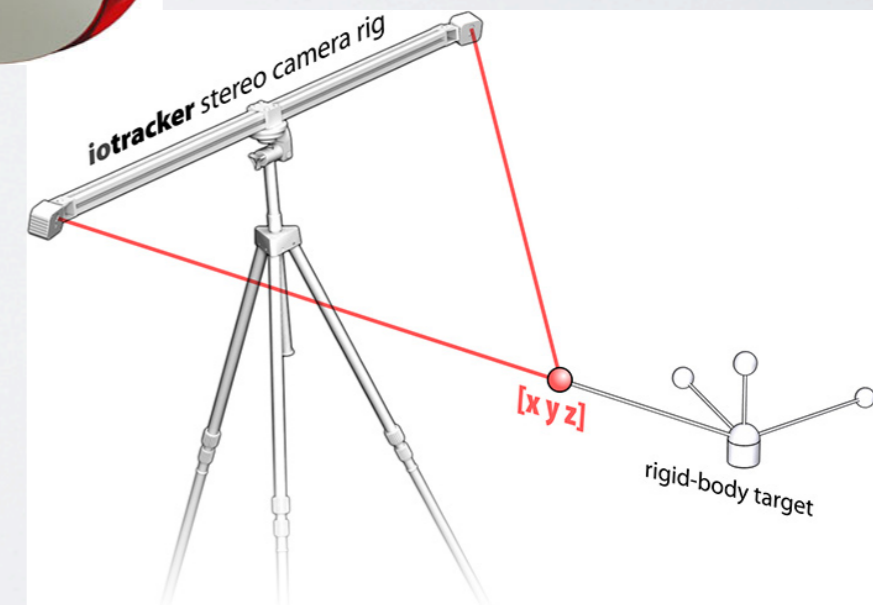
ISIS3D Tutorial @ ITS 2013, St Andrews

Wolfgang Stuerzlinger

# On-Surface Interaction

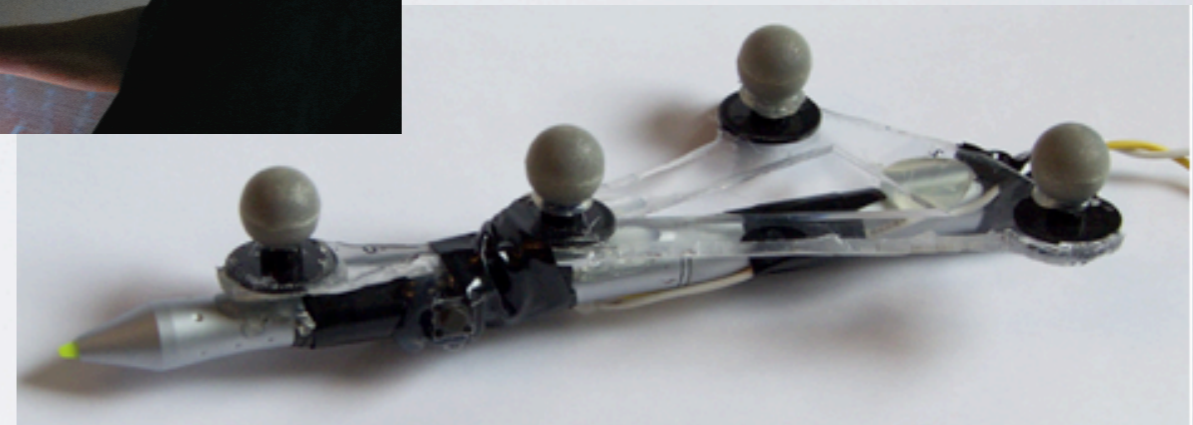


- Touch
- Stylus/pen
- Mouse
  - HCI: pen  $\approx$  mouse  $\approx$  touch
- 3D tracker



# Off-Surface Interaction

- 3D tracker
- Finger/body tracking
- Kinect
- Leap Motion
- Issue: how to “click”



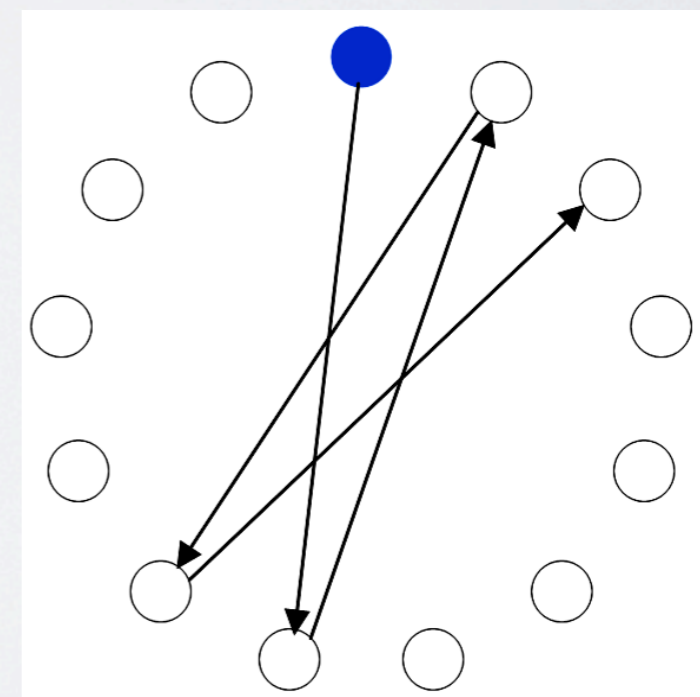
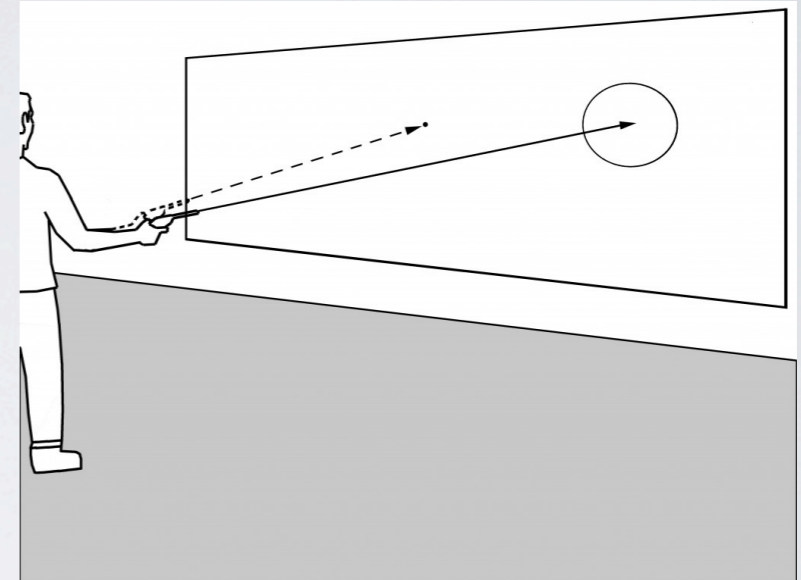
# Basic 3D UI Operations

- Selection, Movement, Rotation, Navigation
- Input
  - 2D
  - 3D
  - More DOF



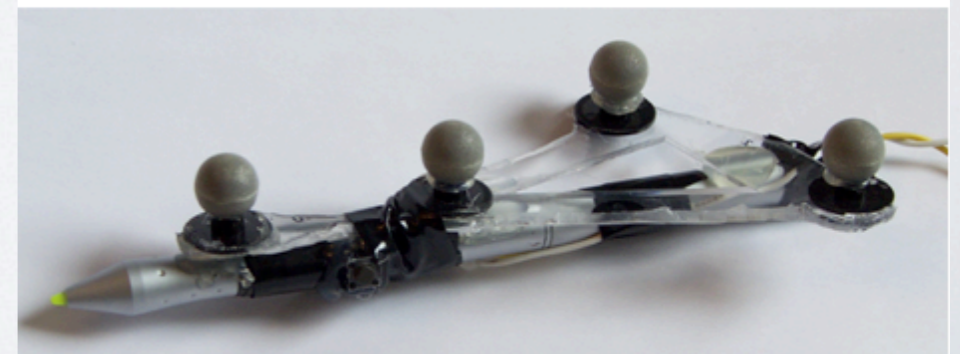
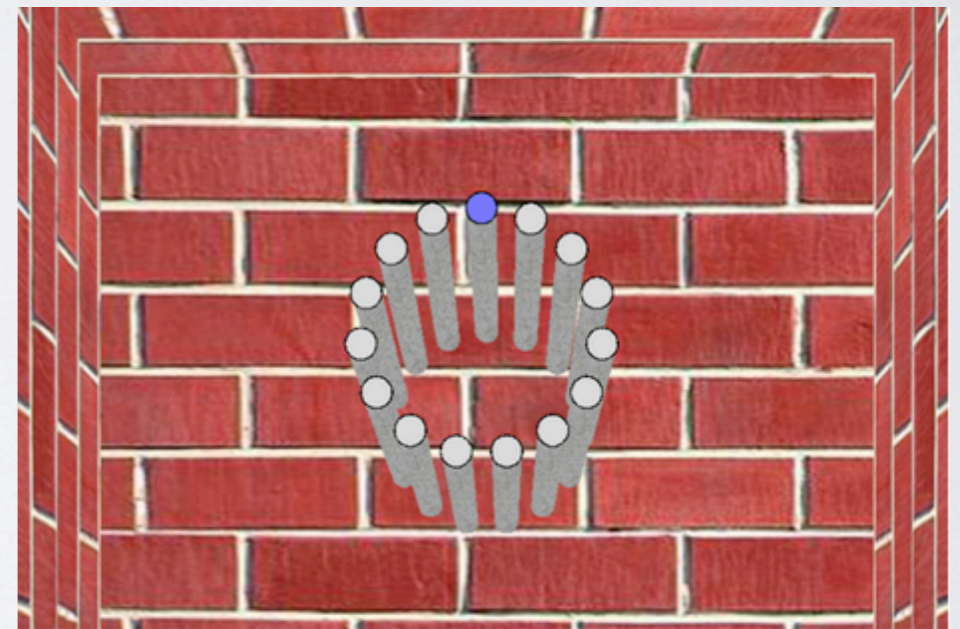
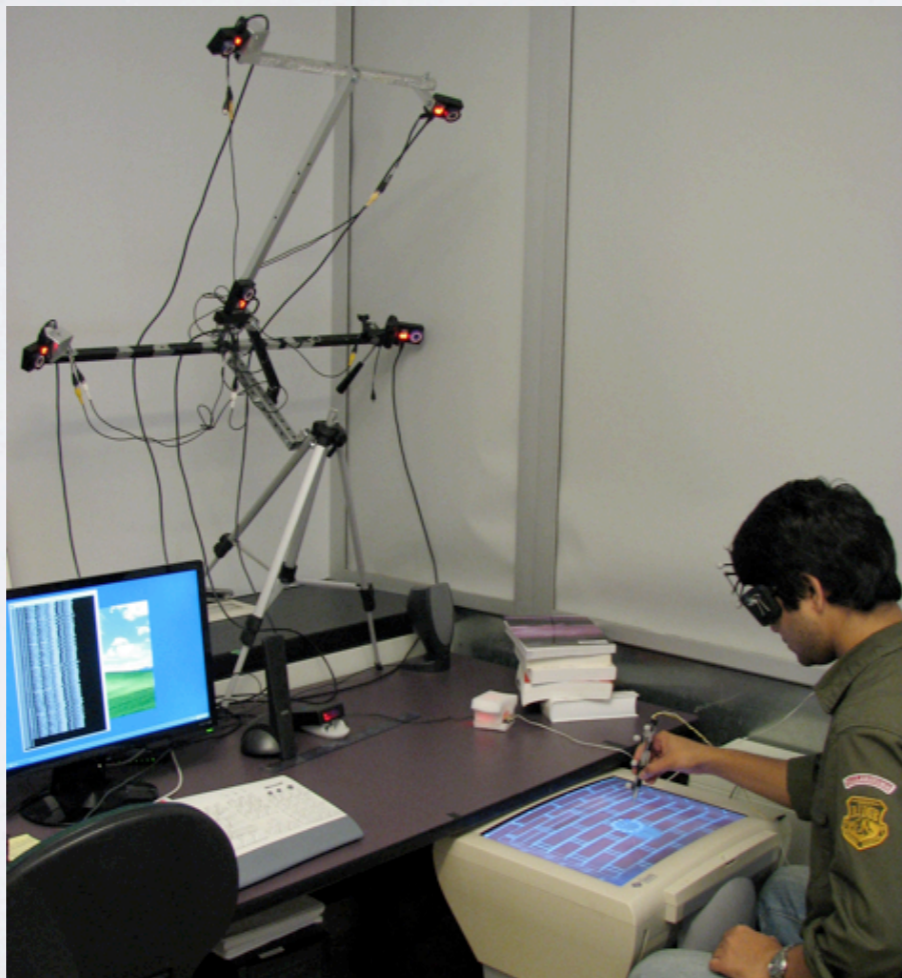
# 3D Selection

- Either 2D or 3D input
- Visible targets only
  - 2D input sufficient
- Compare 2D and 3D
  - Fitts' law
  - ISO 9241-9, effective throughput



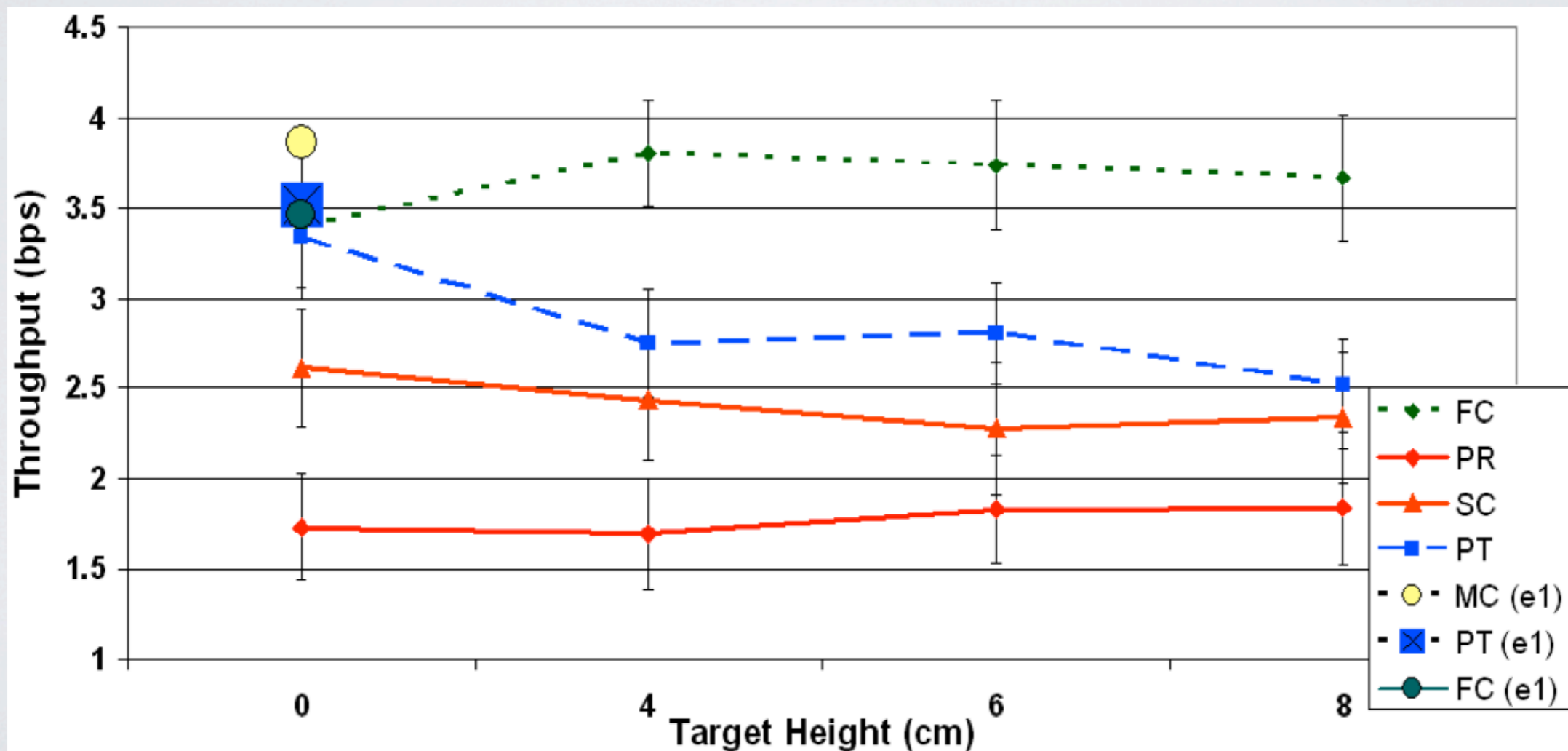
# On vs. Off-Surface Pointing

- Fishtank VR

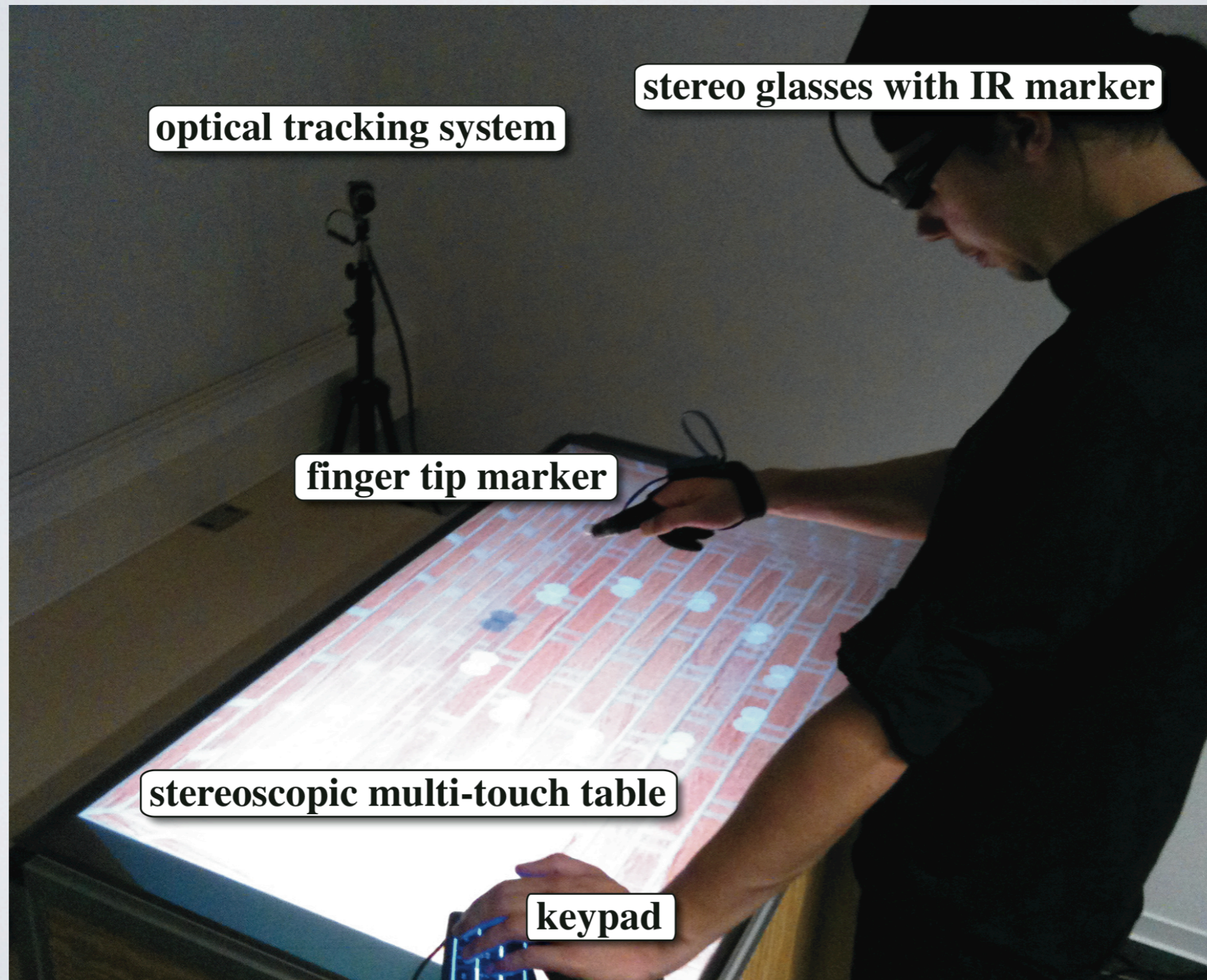


# Results

- PR=Ray, PT=Touch, FC=Mouse at top, SC=Sliding

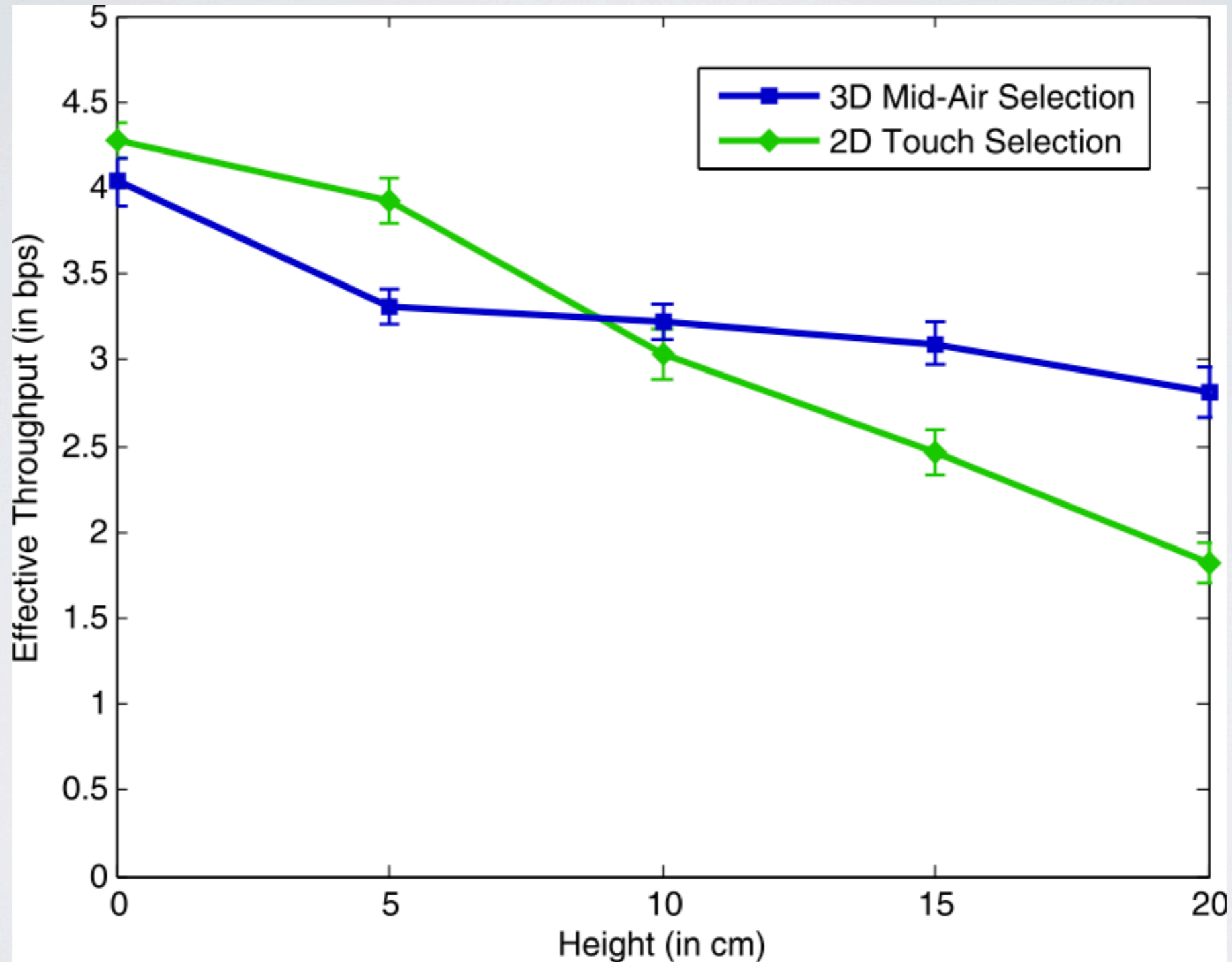


# 2D vs. 3D Touch





# Results



[Bruder, et al. SUI 2013]

# Un-Instrumented In-Air Pointing

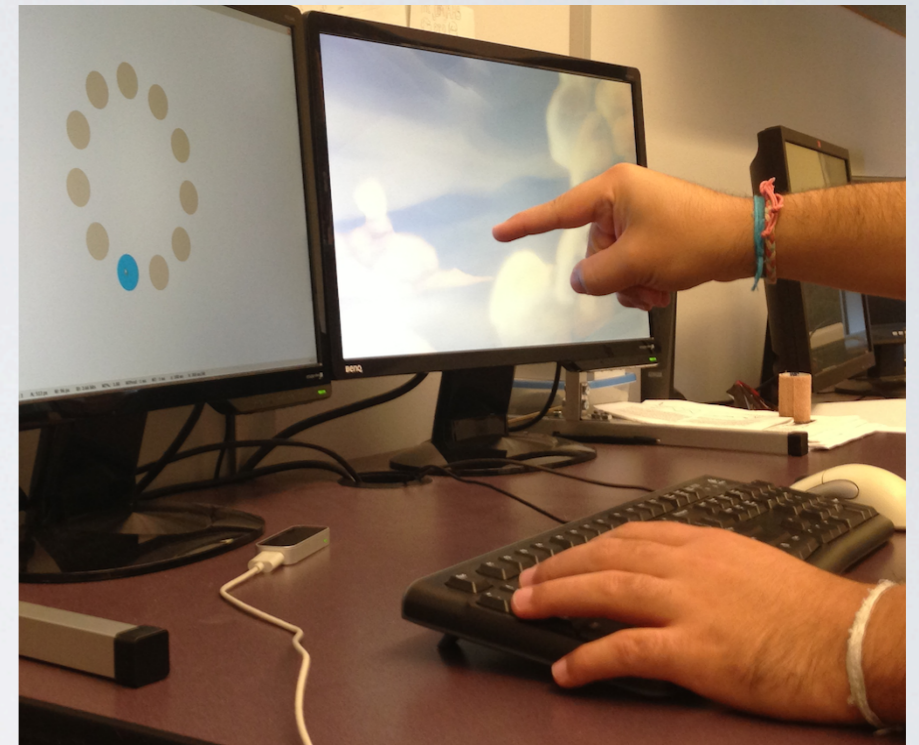
- LeapMotion @ 120Hz

- 2D targets

- Key for selection

- ~2.9 bps for LeapMotion, ~4 bps for mouse (preliminary)

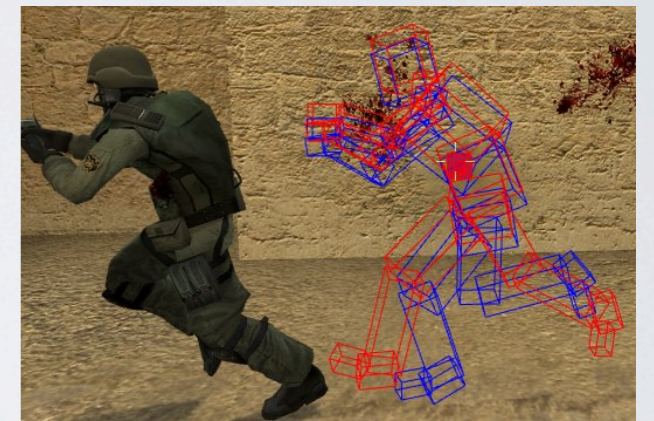
- For hand or finger movements



[Currently submitted]

# 3D Selection Insights

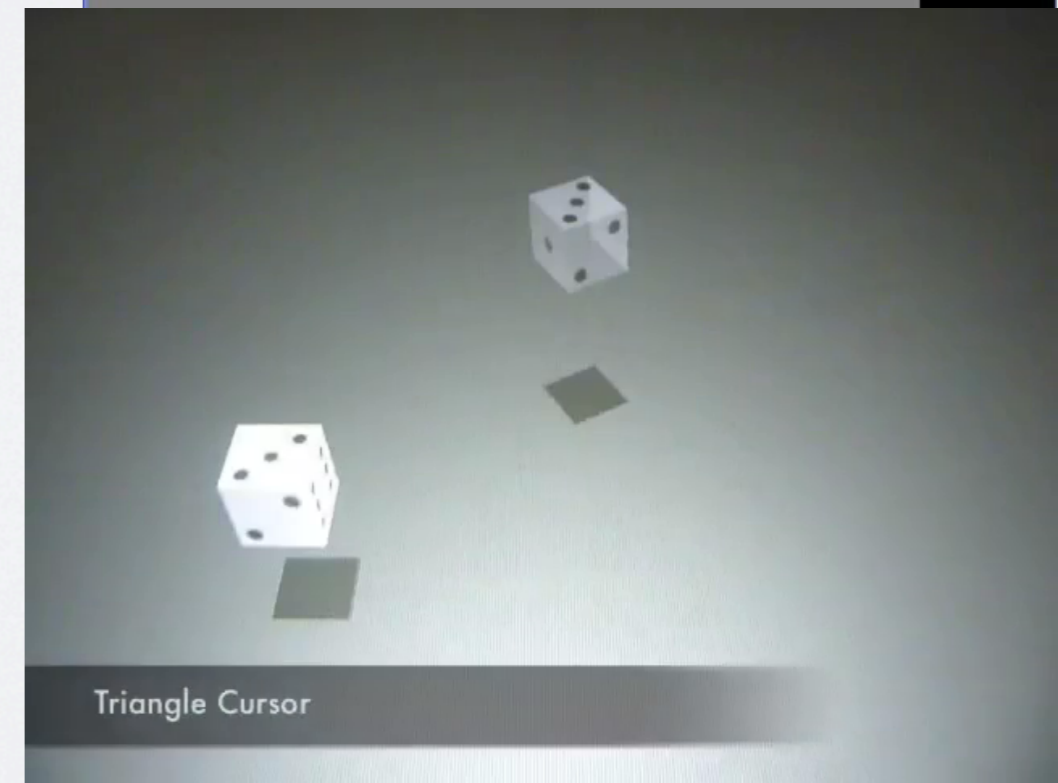
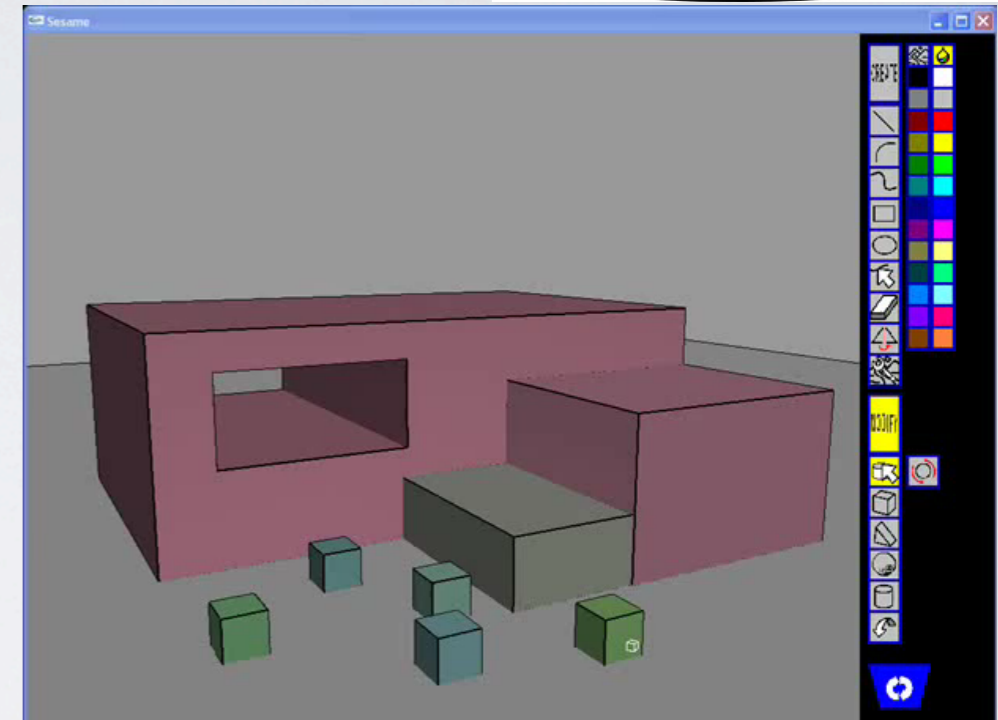
- In-air hitting of small targets difficult
  - Precision much better in 2D
- Latency is bad
- How to select?
  - Click (best), Touch-through, Gesture (unreliable), ...
- Stereo may decrease performance



# 3D Movement



- Fundamental: floating objects or not?
- If no, use 2D input with sliding
  - Dragging  $\approx$  selection
  - Most efficient solution
- If yes, either 3D input or mappings

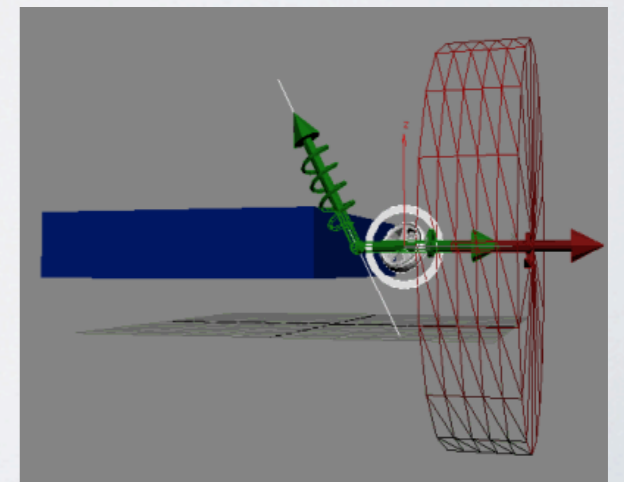


# 3D Rotation



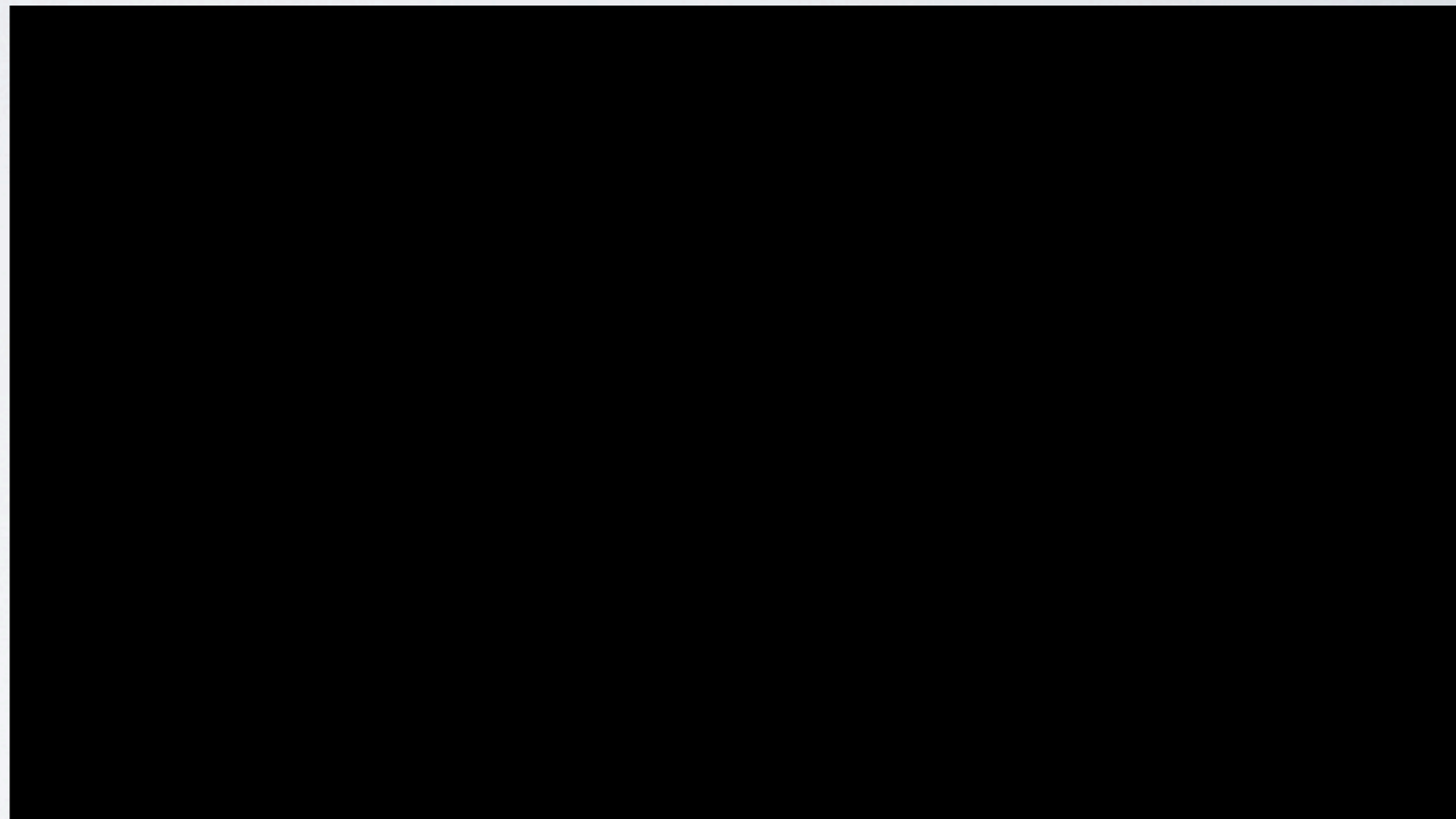
- Free rotations require 3D input
  - Touch with modes (“gestures”)
  - In-air movement

- Constrained rotation needs fewer DOF



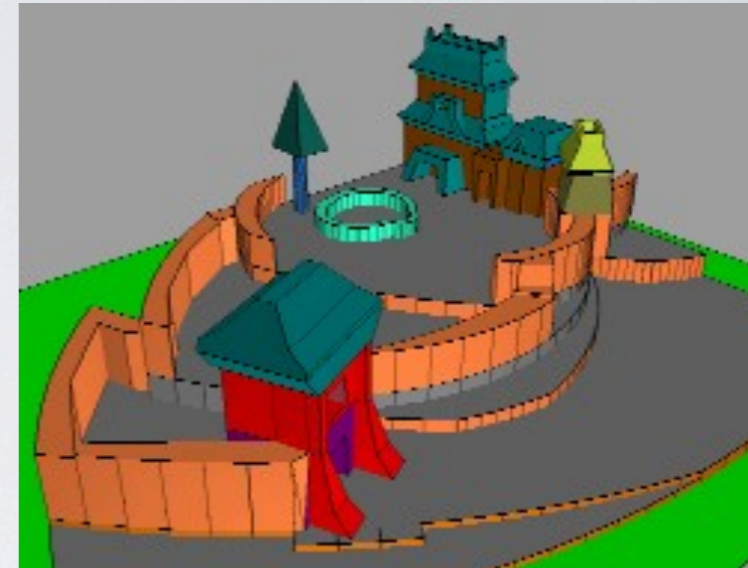
# 3D Navigation

- Travel, look, orbit
  - Need 4 DOF or more
    - Touch modes
    - In air movements
    - Bi-manual



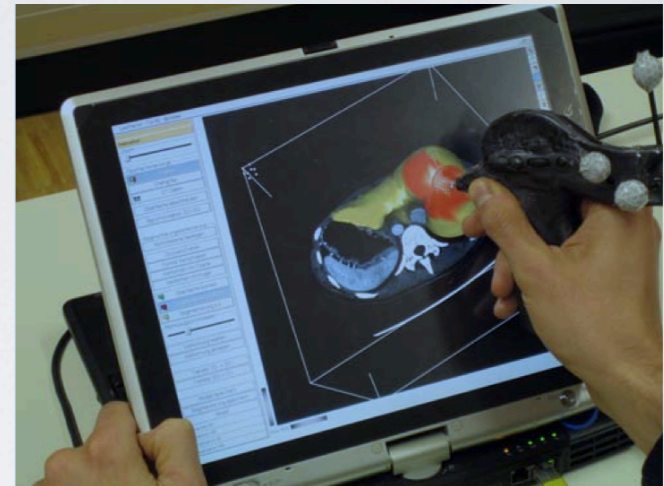
# 3D Editing

- Many operations, including animation
- Touch modes
- In air movements only for some operations
- Bi-manual
- Menus
- Biggest constraint: Precision only on surface



# Combination of 2D & 3D

- With 3D trackers in HMDs
- With pens on tablets
- Touch on table





# Mockup Builder

**Mockup Builder:  
Direct 3D Modeling On and Above the Surface  
in a Continuous Interaction Space**

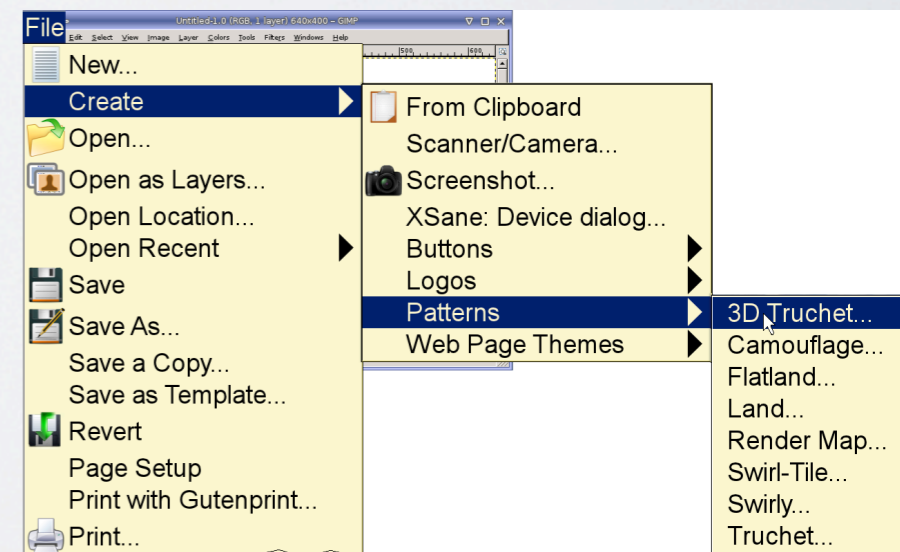
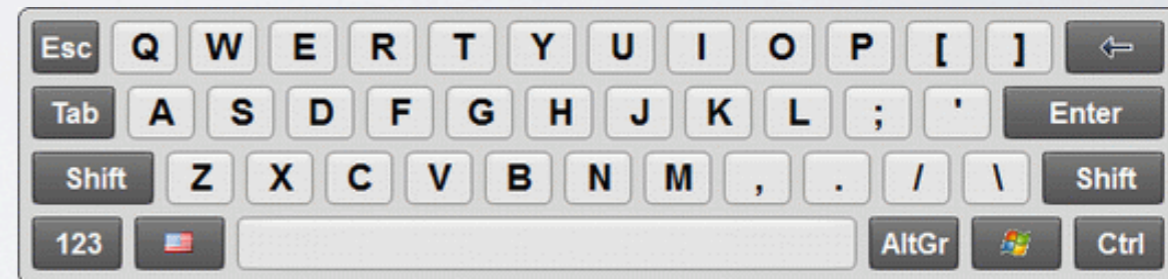
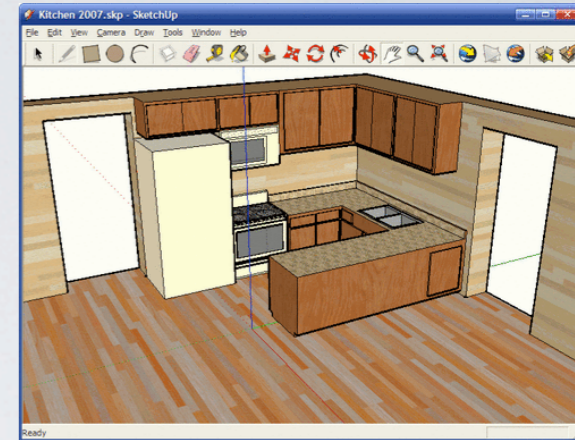
**Bruno R. De Araùjo<sup>1</sup>, Géry Casiez<sup>2</sup> & Joaquim A. Jorge<sup>1</sup>**

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**In proceedings of GI 2012**

# Other 3D UI Components

- Selection of colors, textures, materials, objects, ...
  - Large scale selection, like desktop
- Text entry
  - On-screen keyboard
- System control
  - Menus or commands



# My Thoughts on ISIS 3D UIs

- Performance matters
- Precision matters
- Constraints simplify
- Reliability matters
  
- All improve user satisfaction!

