User interface technology

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CS 376

Announcements

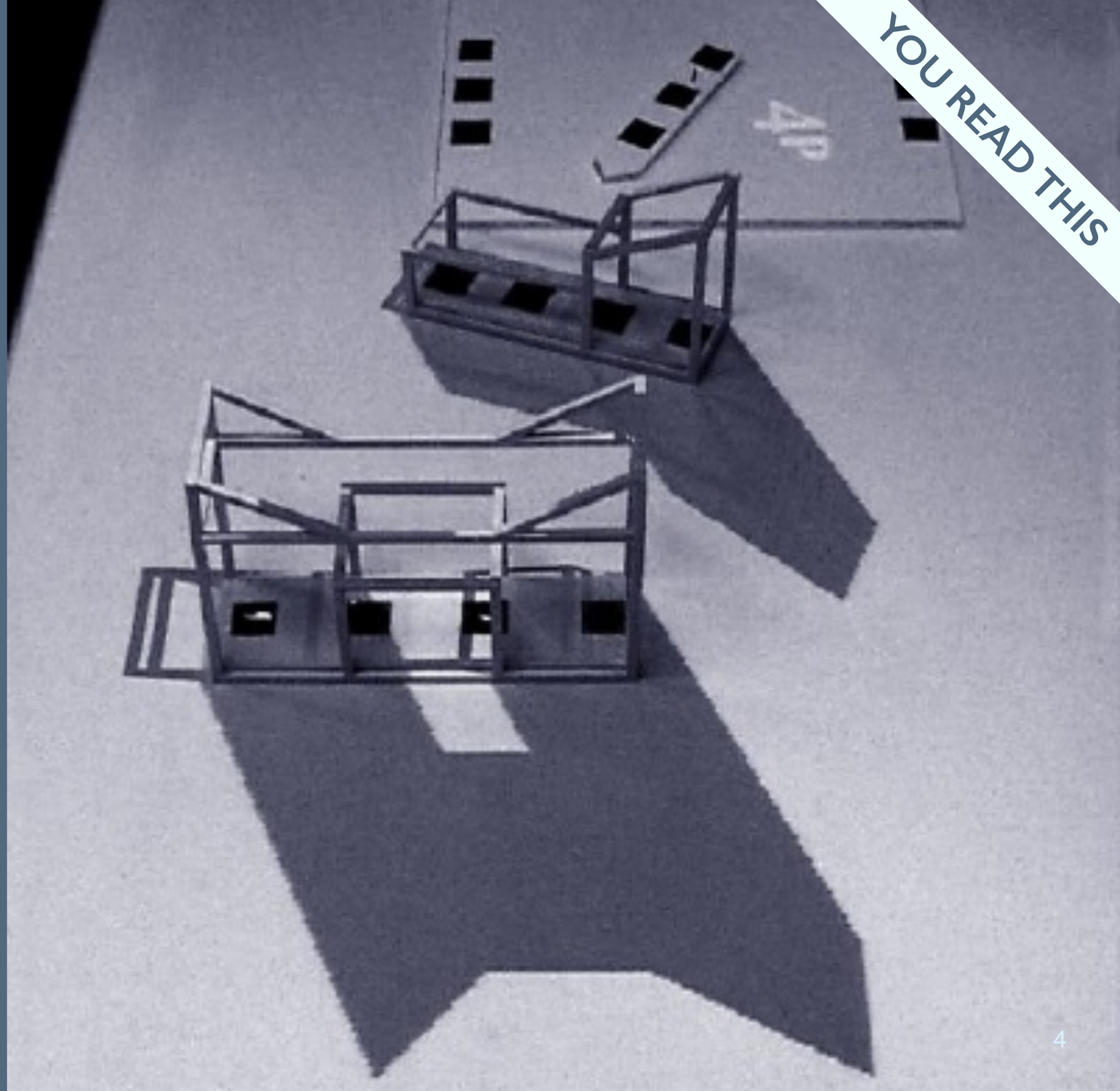
- Project Ideas Round 2 due Friday

Course Overview

INTRO	week 1	Intro to Interaction; Intro to Social Computing
	week 2	Intro to Design; Interaction
DEPTH	week 3	Interaction; Social Computing
	week 4	Social Computing
	week 5	Design
BREADTH	week 6	AI+HCI; Media
	week 7	Foundations
	week 8	Access; Programming
	week 9	Collaboration; Visualization
	week 10	Education; Critiques of HCI

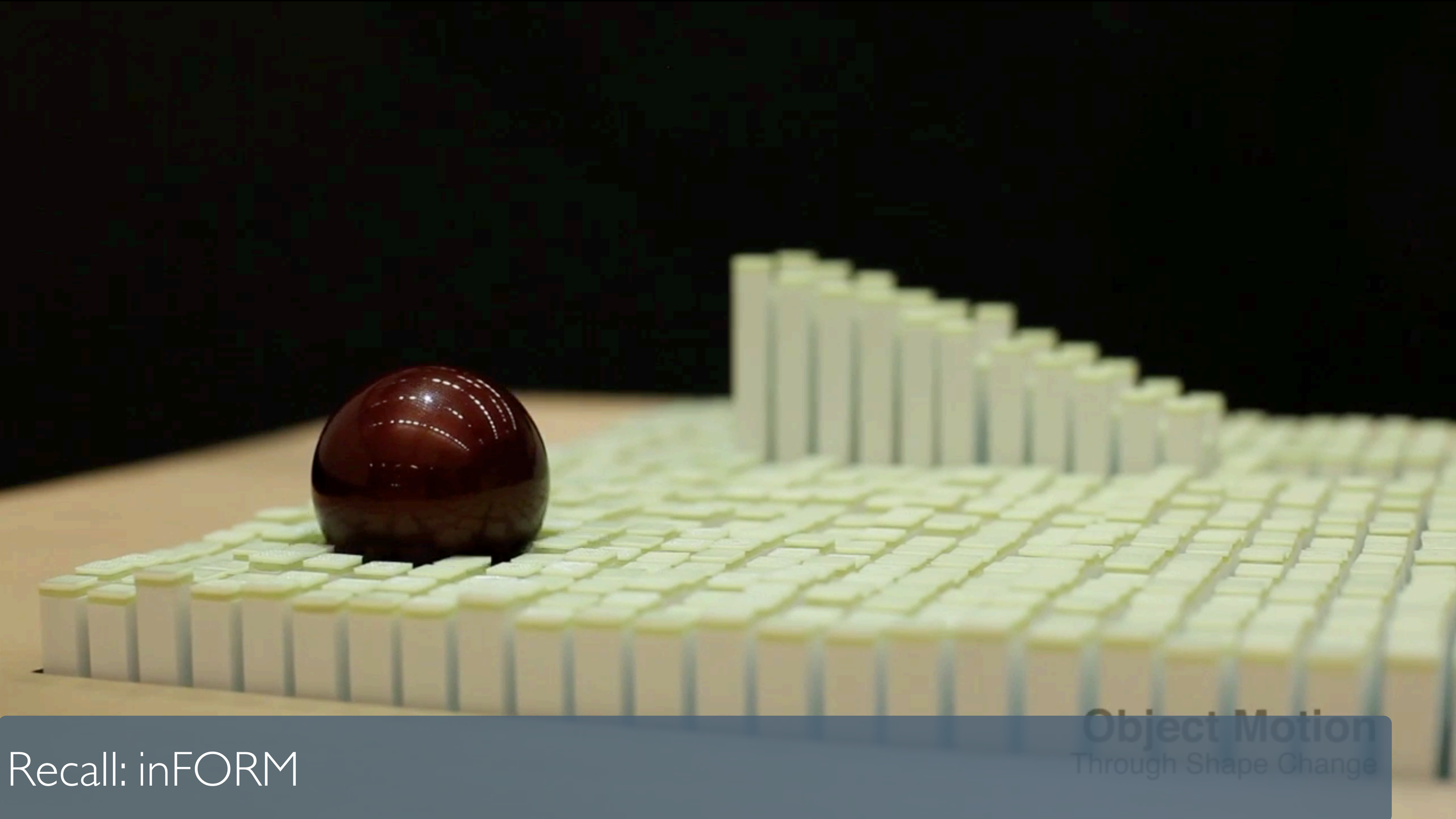
Recall...

- Tangible Computing



Recall: Skinput

Recall: Omnitouch



Recall: inFORM

User interface tech. research

- How can the user interact fluidly with the world around them?
  - New input modalities: e.g., depth cameras
  - New output modalities: e.g., pico projectors and fabrication
  - New user vocabulary: e.g., gestures
- This research is often driven by, or involves the creation of, new hardware

Foundations

Bolt. “Put-that-there”: voice and gesture at the graphics interface. SIGGRAPH ’80.

Put That There

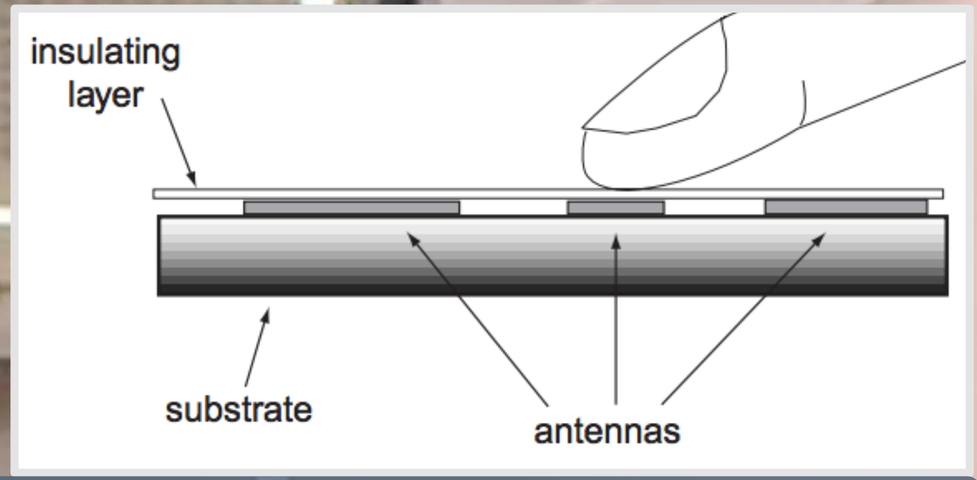
- Contribution: combined gesture and voice input
  - In a closed world
  - With a toy goal
  - Using simple manipulation operations
  - Using a laser attached to the wrist
- In many ways, our goal since 1980 has been to relax those assumptions

Wellner. Interacting with paper on the DigitalDesk. CACM ‘93.

DigitalDesk

- Contribution: fluid boundaries between digital and physical objects
  - In a constrained space
  - On a small set of tasks
  - With predefined behaviors
- Again, we work to relax these assumptions

Tabletop



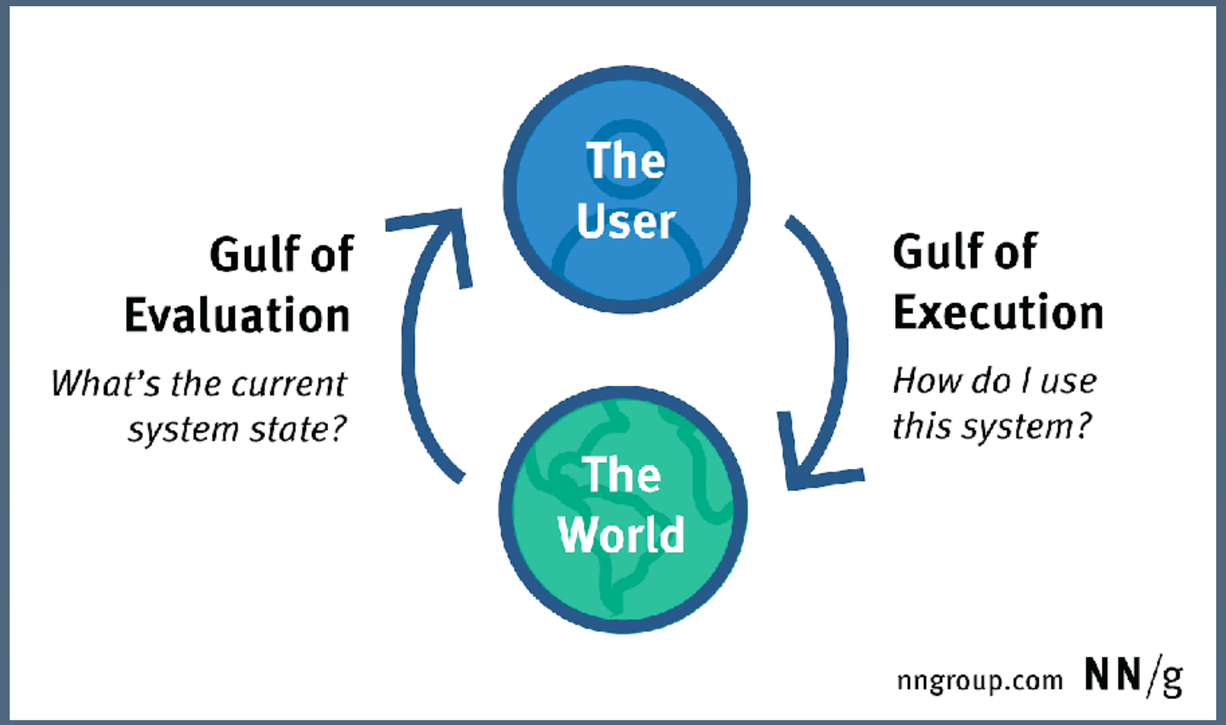
Dietz and Leigh. DiamondTouch: a multi-user touch technology. UIST' 01.

Today's outline

- UI technology research focuses on techniques that make our manipulation of interactive systems more fluent

- How do we cross the gulf of execution?: input technologies

- How do we cross the gulf of evaluation?: output technologies

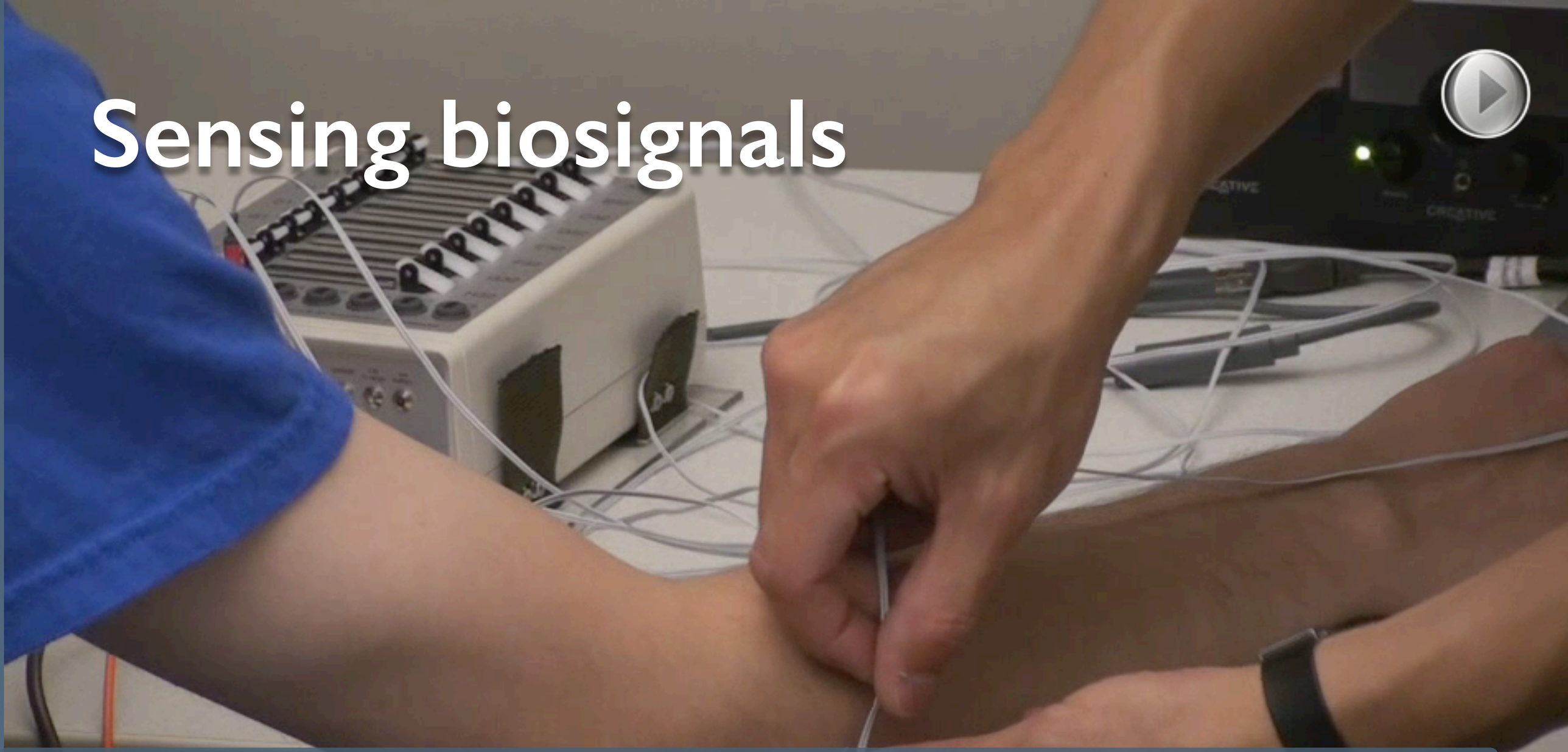


Input technologies

Goals

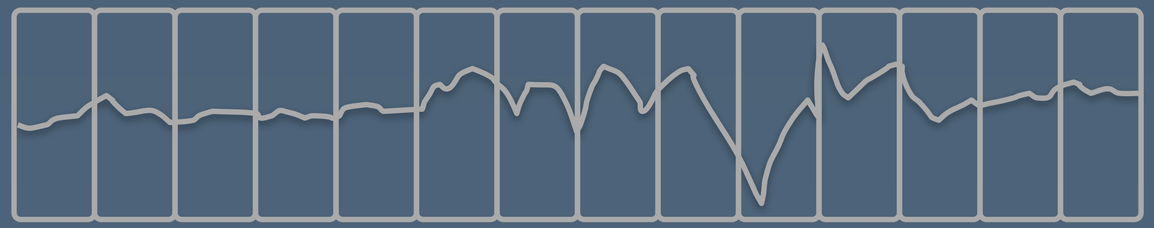
- How might people provide more fluent and effective input to interactive systems?
- Typical approaches
  - Come up with new signals
  - Find new ways to recombine known signals
- Always: demonstrate the technique in compelling interaction scenarios

Sensing biosignals



Saponas et al. Enabling Always-Available Input with Muscle-Computer Interfaces. UIST '09.

Common ML model



x6 Sensors

30 millisecond sample

Root Mean Square (RMS)
ratios between channels

Frequency Energy
10 Hz bands

Phase Coherence
ratios between channels

user specific model

Support Vector Machine

gesture classification

EM-Sense

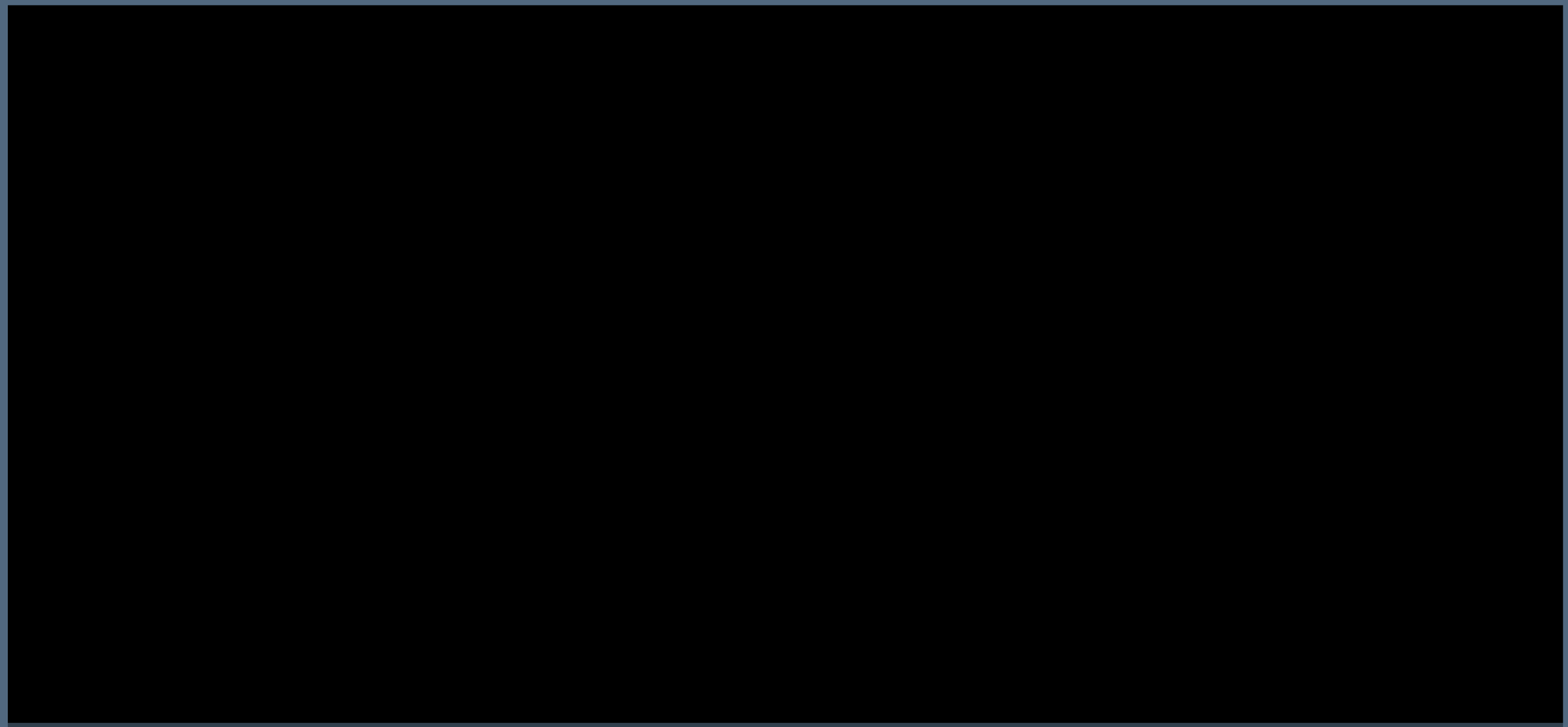
Touch Recognition of Uninstrumented, Electrical and Electromechanical Objects

Gierad Laput Chouchang Yang Robert Xiao
Alanson Sample Chris Harrison

Carnegie Mellon University
Disney Research

Laput, G. et al. 2015. EM-Sense: Touch Recognition of Uninstrumented, Electrical and Electromechanical Objects. UIST '15.

Acoustics

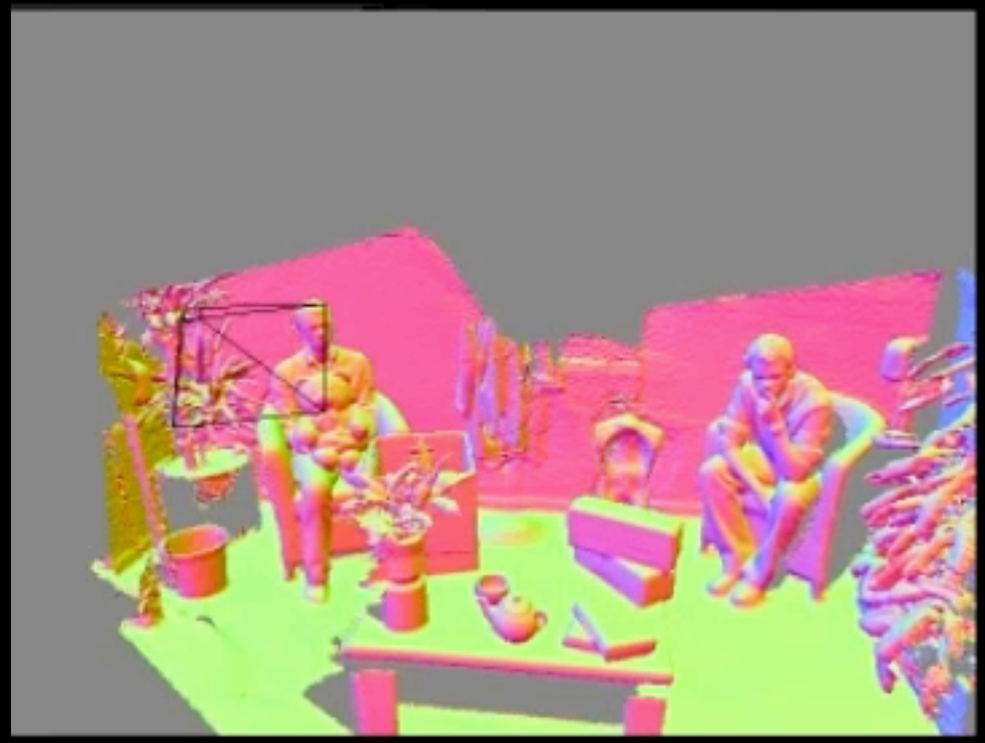


Laput et al. Acoustruments: Passive, Acoustically-Driven Interactive Controls for Hand Held Devices. UIST ’15.

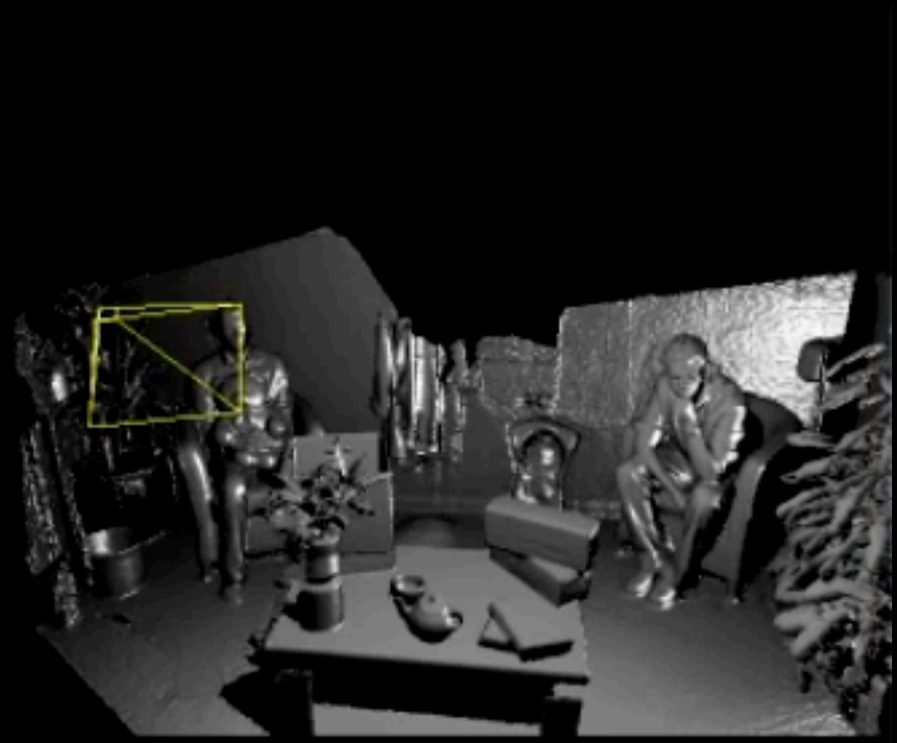
Soli

Lien, Jaime, et al. "Soli: Ubiquitous gesture sensing with millimeter wave radar." *ACM Transactions on Graphics (TOG)* 35.4 (2016): 142.

Depth sensing



Model normal map



Phong shaded model

Izadi et al. KinectFusion. UIST '11.

Output technologies

Goals

- How might interactive systems provide more effective or immersive signals to people, allowing them to capitalize on embodied cognition and other cognitive strengths?
- Typical approaches are the same
  - Come up with new signals
  - Find new ways to recombine known signals
- Always: demonstrate the technique in compelling interaction scenarios

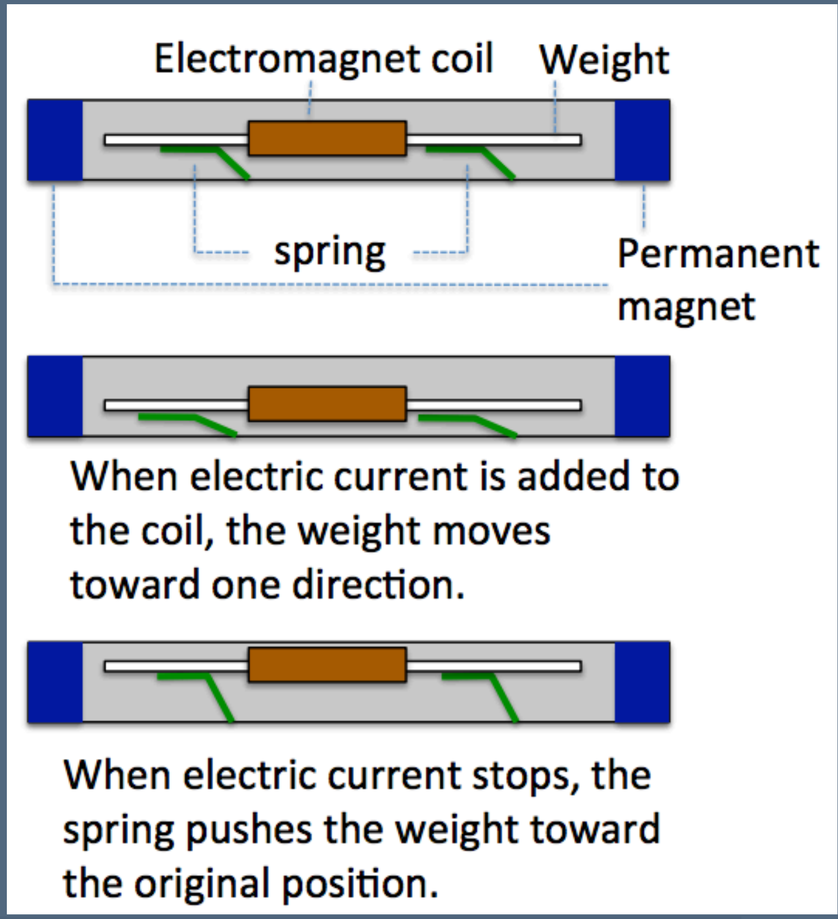
Haptic Retargeting

- Use “perceptual hacks” to make a single cube appear multiplied

Azmandian et al. Haptic Retargeting: Dynamic Repurposing of Passive Haptics for Enhanced Virtual Reality Experiences. CHI ’16.

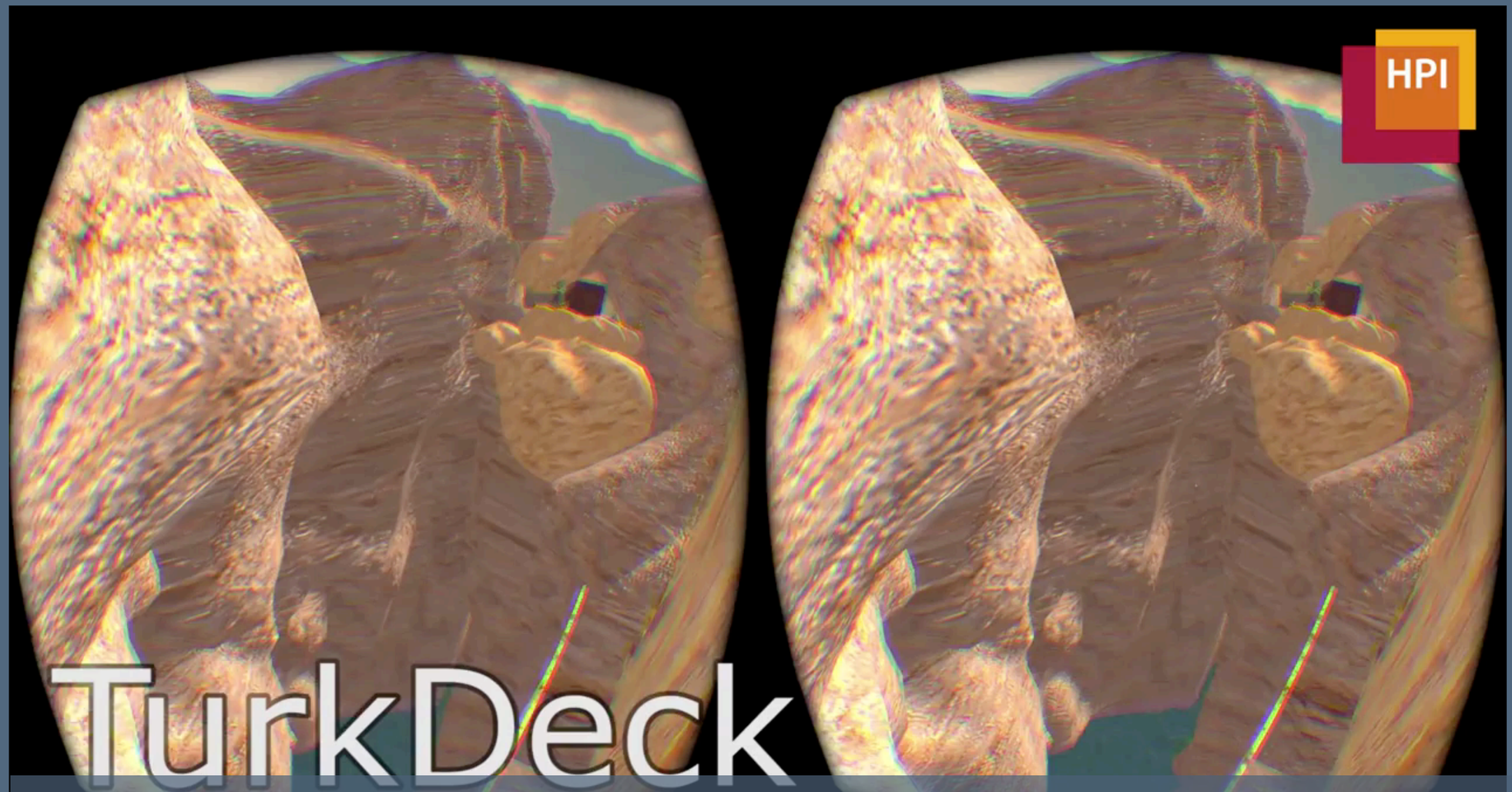
Traxtion: perceived forces

- Creates a haptic sensation without mechanical links to the ground



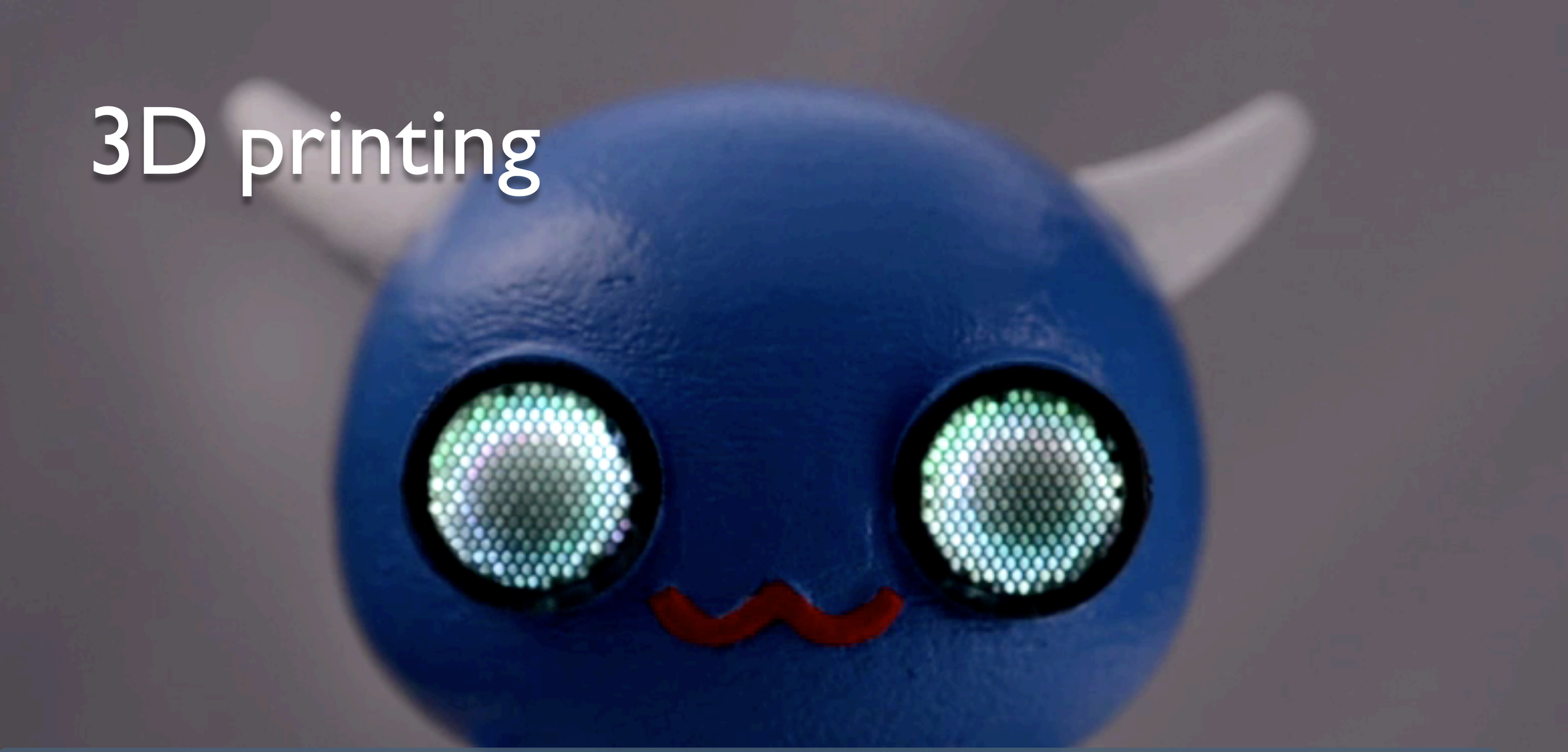
Rekimoto. Traxion: a tactile interaction device with virtual force sensation.

TurkDeck: Fake It



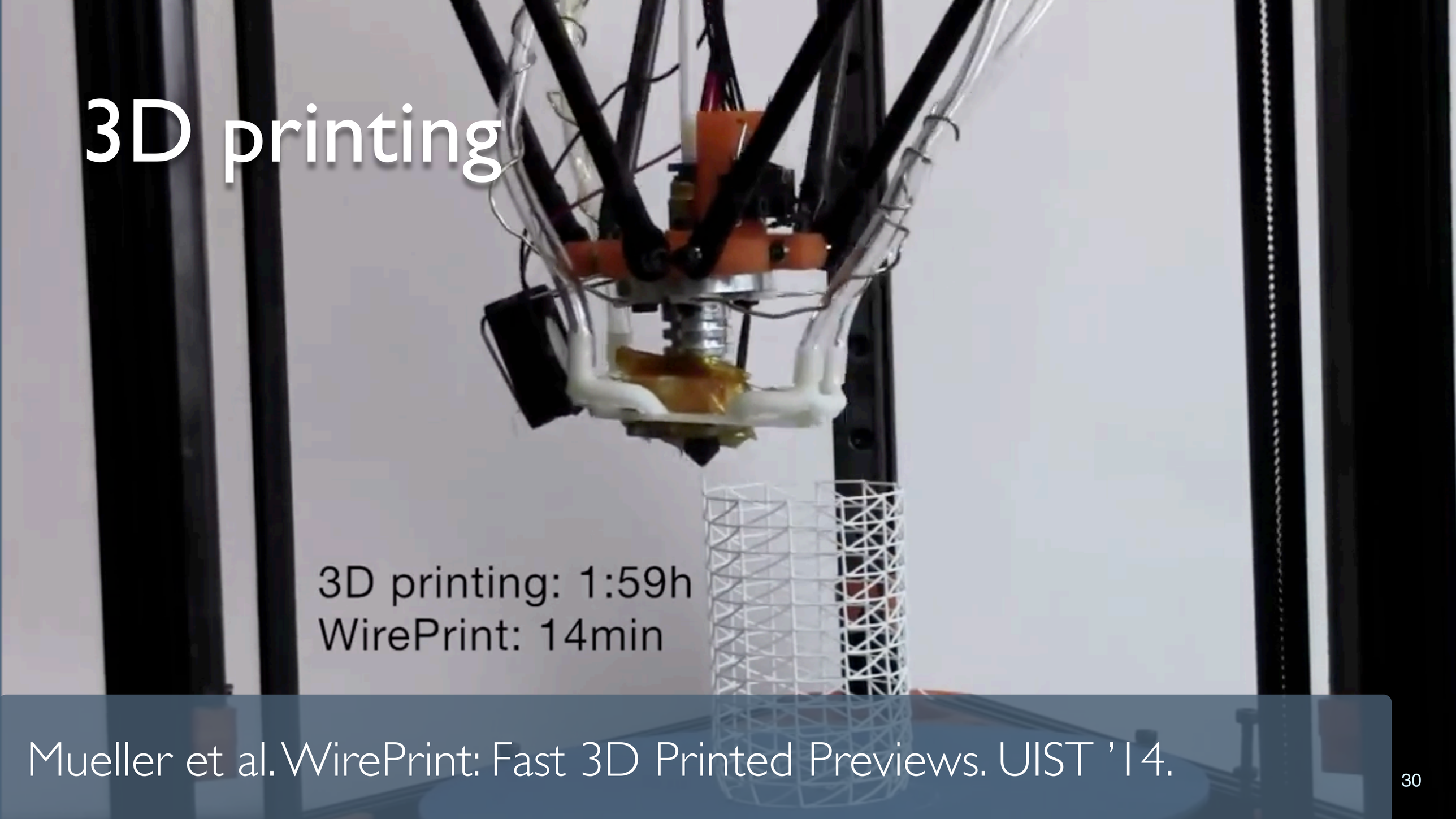
Cheng et al. TurkDeck: Physical Virtual Reality Based on People. UIST '15.

3D printing



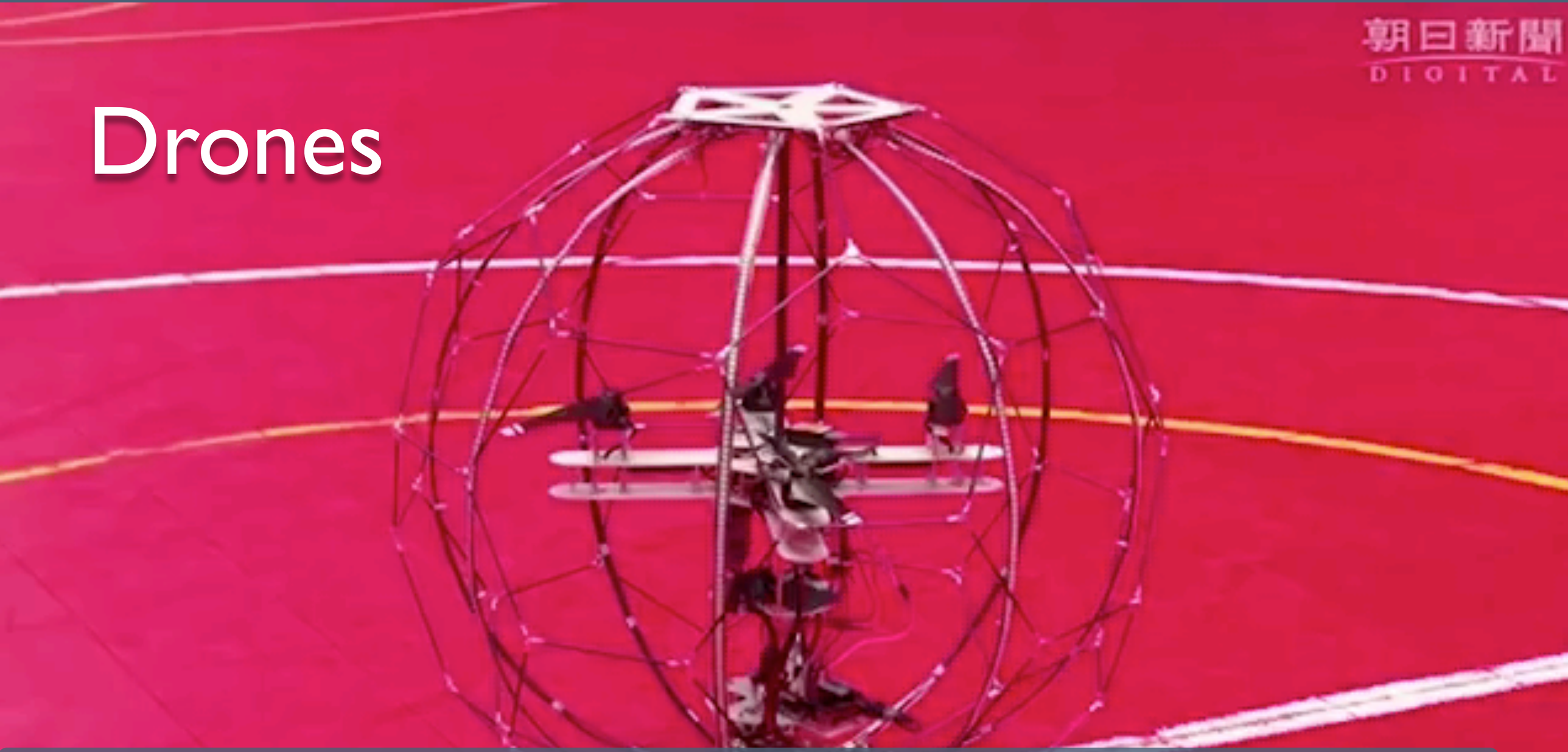
Willis et al. Printed Optics: 3D Printing of Embedded Optical Elements for Interactive Devices. UIST ’12.

3D printing



Mueller et al. WirePrint: Fast 3D Printed Previews. UIST '14.

Drones



Yamada et al. iSphere: Self-Luminous Spherical Drone Display. UIST '17.

Skill sets for UI technology research

- Learn “enough to get by” in...
  - Electrical engineering
  - Mechanical engineering
  - Computer graphics
- Known techniques for research in these domains often have direct mappings onto open questions in interaction