Lecture 1: Introduction to haptics

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Stanford University
today’s objectives

introduce you to the field of haptics
(definition, why it is important, and why haptic technology is challenging)

give an overview of course content and policies
what is haptics?
haptic box

Pass it around. Feel inside. Try to identify three objects.
which sense is most valuable to you?

which would you relinquish last?
hap·tic ('hap-tik) adj. Of or relating to the sense of touch. [Greek haptikos, from haptesthai, to grasp, touch. (1890)]

The haptic senses work together with the motor control system to:
- Coordinate movement
- Enable perception

Johansson and Westling

Kinesthesia
Location/configuration
Motion
Force
Compliance

Cutaneous
Temperature
Texture
Slip
Vibration
Force

J. Edward Colgate
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what would life be like without touch?

Cutaneous

https://www.youtube.com/watch?v=0LfJ3M3Kn80

Kinesthesia

http://www.youtube.com/watch?v=FKxyJfE83IQ
why do we have brains?

sea squirt

Daniel Wolpert
sight
centralized
broad
passive
cognitive

touch
distributed
narrow
active
physical
how does your computer/
smartphone/iPad see you?
how does your computer/smartphone/iPad see you?

multi-touch
what if...

you could make any surface feel fuzzy, sticky, soft...?

you could touch priceless works of art?

there was a haptic holodeck?

haptics could teach you?
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<th>Retention</th>
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<td>What one reads</td>
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what about what one feels?

haptic metaphors

Emotion
   Touching, tactful, stroke one’s ego

Exploration
   Get a feel for, poke around, scratch the surface

Contact
   At one’s fingertips, touch base, keep in touch, on/at hand

Constraint/Manipulation
   Get a grip, massage an ego, pushy, magic touch

Surface Properties
   Sticky situation, hot idea, abrasive personality, smooth operator
haptic box

what was in there?
how did you know?
tactual stereognosis

• Tactual = tactile = via the sense of touch

• Stereognosis = the mental perception of three-dimensionality by the senses, usually in reference to perceiving the form of solid objects by touch

• One study (Klatzky et al., 1985) showed that subjects could identify 100 common objects almost perfectly, taking about 2 seconds per object.

• People are very good at tactual stereognosis.
haptic exploratory procedures

Lateral Motion
Texture

Pressure
Hardness

Enclosure
Global shape/Volume

Static Contact
Temperature

Unsupported Holding
Weight

Contour Following
Shape

**Tactile Devices**
Stimulate skin to create contact sensations

**Hybrid Devices**
Attempt to combine tactile and kinesthetic feedback

**Kinesthetic Devices**
Apply forces to guide or inhibit body movement
existing applications of haptics

entertainment

education

human-computer interfaces
course overview
course objectives

by the end of this course, you should:

• understand selected topics in haptics for virtual environments and teleoperation (see specific objectives on syllabus)

• improve your paper reading and presentation skills

• experience defining a design/research problem and investigating it

• be creative and have fun!
structure

Lectures by Allison and the CAs give way to lectures by you as the quarter progresses

grading

10% class participation
30% assignments
10% paper presentation
50% project
course content

Part 1  Design and control of kinesthetic interfaces
Part 2  Tactile devices
Part 3  Teleoperation
Part 4  Human haptics
Part 5  Haptic interface evaluation
Part 6  Student presentations
by the end of this course, you should be able to:

- Identify the primary mechanisms of human haptic sensing
- Understand a number of methods for sensing the position of and actuating haptic interfaces
- Describe the differences between grounded and ungrounded force feedback
- Identify salient features of a haptic device design
- List a variety of different types of haptic interfaces
- Implement controllers to render various dynamics (stiffness, damping, inertia)
- Describe and implement basic telemanipulation controllers
- Understand the causes of instability in virtual reality and teleoperation systems
- Design psychophysical and perceptual tests
- Describe applications of haptic devices
- Develop a new haptic device or application of a haptic device
- Read, evaluate, and critique research papers
- Design and deliver a research presentation
don’t be shy

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fill out the survey
http://www.stanford.edu/class/me327/assignments/survey.pdf
(return to my office or in class by Thursday class time)

fill out when2meet poll
http://www.when2meet.com/?3475411-82MyB
(by Friday at 4:30 pm, after your class schedule has settled)

pay lab materials fee
($50 check made out to Stanford University, by class time Tuesday 9/29)

get access to PRL
(if necessary, sign up at http://productrealization.stanford.edu)