

Senses

What's Inside?

Define

Defined: Haptic

Defined: (Opt)ics

Defined: Haptics

Haptic Exploration

What's Inside?

Exploratory Procedures

Types of Sensing

Haptic Devices

Tactile and Proprioceptive Devices

Tactile Device Challenges

Kinesthetic Device Challenges

Workspace vs Force

Haptic Wearables?

Readings

Thursday

Wearable Technologies and Applications (Wearable Informatics)

Winfree

Lecture 3

What's Inside?

INF632
(EE499/EE599)

Winfree



Senses

[What's Inside?](#)

Define

Defined: Haptic

Defined: (Opt)ics

Defined: Haptics

Haptic Exploration

[What's Inside?](#)

[Exploratory Procedures](#)

[Types of Sensing](#)

Haptic Devices

[Tactile and Proprioceptive Devices](#)

[Tactile Device Challenges](#)

[Kinesthetic Device Challenges](#)

[Workspace vs Force](#)

[Haptic Wearables?](#)

Readings

Thursday

Five Senses, Which is Most Important to You?

INF632
(EE499/EE599)

Winfree

Senses

[What's Inside?](#)

Define

[Defined: Haptic](#)

[Defined: \(Opt\)ics](#)

[Defined: Haptics](#)

Haptic Exploration

[What's Inside?](#)

[Exploratory Procedures](#)

[Types of Sensing](#)

Haptic Devices

[Tactile and Proprioceptive Devices](#)

[Tactile Device Challenges](#)

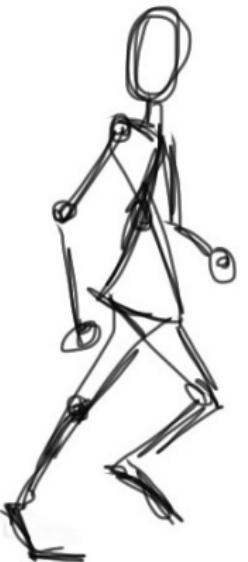
[Kinesthetic Device Challenges](#)

[Workspace vs Force](#)

[Haptic Wearables?](#)

Readings

[Thursday](#)



- ▶ Hearing?
 - ▶ Sight?
 - ▶ Smell?
 - ▶ Taste?
 - ▶ Touch?
-
- ▶ Which of these seems the most valuable to you?
 - ▶ Which would you relinquish last?

Five Senses, Which is Most Important to You?

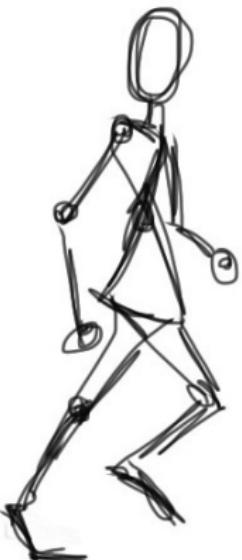
INF632
(EE499/EE599)

Winfree

Sight



- ▶ Centralized
- ▶ Broad
- ▶ Passive
- ▶ Cognitive



Senses

[What's Inside?](#)

Define

Defined: Haptic

Defined: (Opt)ics

Defined: Haptics

Haptic Exploration

[What's Inside?](#)

[Exploratory Procedures](#)

[Types of Sensing](#)

Haptic Devices

[Tactile and Proprioceptive Devices](#)

[Tactile Device Challenges](#)

[Kinesthetic Device Challenges](#)

[Workspace vs Force](#)

[Haptic Wearables?](#)

Readings

[Thursday](#)

Five Senses, Which is Most Important to You?

INF632
(EE499/EE599)

Winfree

Sight

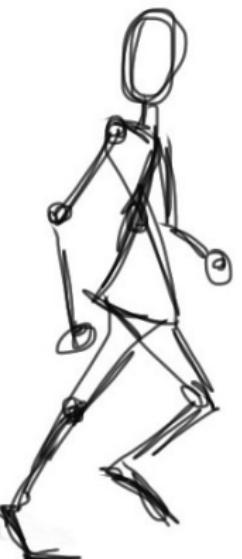


- ▶ Centralized
- ▶ Broad
- ▶ Passive
- ▶ Cognitive

Touch



- ▶ Distributed
- ▶ Narrow
- ▶ Interactive
- ▶ Fundamental



Senses

What's Inside?

Define

Defined: Haptic

Defined: (Opt)ics

Defined: Haptics

Haptic Exploration

What's Inside?

Exploratory Procedures

Types of Sensing

Haptic Devices

Tactile and Proprioceptive Devices

Tactile Device Challenges

Kinesthetic Device Challenges

Workspace vs Force

Haptic Wearables?

Readings

Thursday

What is Haptics?

INF632
(EE499/EE599)

Winfree

Senses

What's Inside?

Define

Defined: Haptic

Defined: (Opt)ics

Defined: Haptics

Haptic Exploration

What's Inside?

Exploratory Procedures

Types of Sensing

Haptic Devices

Tactile and Proprioceptive Devices

Tactile Device Challenges

Kinesthetic Device Challenges

Workspace vs Force

Haptic Wearables?

Readings

Thursday

Definition

haptic

adjective

1. of or relating to the sense of touch, in particular relating to the perception and manipulation of objects using the senses of touch and proprioception.

origin

1. late 19th century: from Greek *haptikos* ‘able to touch or grasp,’ from *haptein* ‘fasten.’

What is (Opt / Informat)ics?

Definition

optics

plural noun

1. the scientific study of sight and the behavior of light, or the properties of transmission and deflection of other forms of radiation.

Definition

in•for•mat•ics

plural noun

1. the science of processing data for storage and retrieval; informatics science

Senses

What's Inside?

Define

Defined: Haptic

Defined: (Opt)ics

Defined: Haptics

Haptic Exploration

What's Inside?

Exploratory Procedures

Types of Sensing

Haptic Devices

Tactile and Proprioceptive Devices

Tactile Device Challenges

Kinesthetic Device Challenges

Workspace vs Force

Haptic Wearables?

Readings

Thursday

What's Inside?

Senses

What's Inside?

Define

Defined: Haptic

Defined: (Opt)ics

Defined: Haptics

Haptic Exploration

What's Inside?

Exploratory Procedures

Types of Sensing

Haptic Devices

Tactile and Proprioceptive Devices

Tactile Device Challenges

Kinesthetic Device Challenges

Workspace vs Force

Haptic Wearables?

Readings

Thursday

What's Inside?

INF632
(EE499/EE599)

Winfree

Senses

What's Inside?

Define

Defined: Haptic

Defined: (Opt)ics

Defined: Haptics



Haptic Exploration

What's Inside?

Exploratory Procedures

Types of Sensing

Haptic Devices

Tactile and Proprioceptive Devices

Tactile Device Challenges

Kinesthetic Device Challenges

Workspace vs Force

Haptic Wearables?

Readings

Thursday

What's Inside?

INF632
(EE499/EE599)

Winfree



Senses

What's Inside?

Define

Defined: Haptic

Defined: (Opt)ics

Defined: Haptics

Haptic Exploration

What's Inside?

Exploratory Procedures

Types of Sensing

Haptic Devices

Tactile and Proprioceptive Devices

Tactile Device Challenges

Kinesthetic Device Challenges

Workspace vs Force

Haptic Wearables?

Readings

Thursday

Exploratory Procedures

INF632
(EE499/EE599)

Winfree

Senses

What's Inside?

Define

Defined: Haptic

Defined: (Opt)ics

Defined: Haptics

Haptic Exploration

What's Inside?

Exploratory Procedures

Types of Sensing

Haptic Devices

Tactile and Proprioceptive Devices

Tactile Device Challenges

Kinesthetic Device Challenges

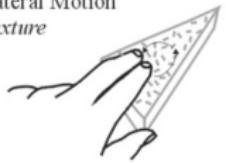
Workspace vs Force

Haptic Wearables?

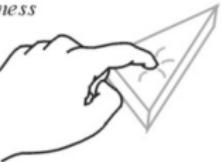
Readings

Thursday

Lateral Motion
Texture



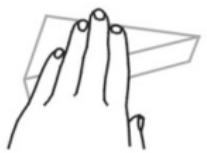
Pressure
Hardness



Enclosure
Global shape/Volume



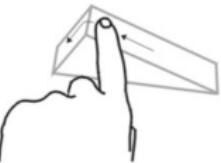
Static Contact
Temperature



Unsupported Holding
Weight



Contour Following
Shape



Types of Sensing

Cutaneous / Tactile
Stems from skin contact



Kinesthetic / Proprioceptive
Stems from body movement

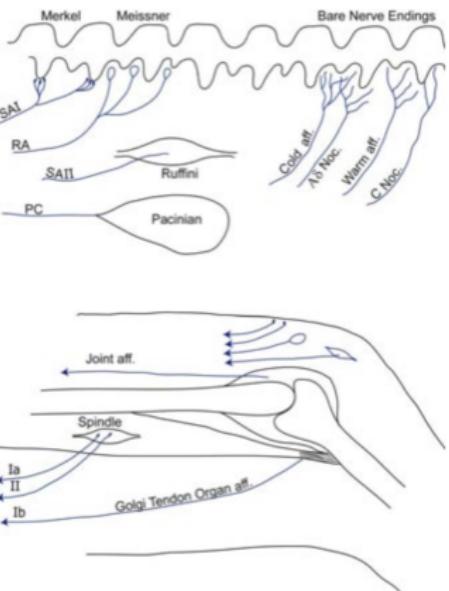


Illustration by A. M. Okamura.

Senses

What's Inside?

Define

Defined: Haptic

Defined: (Opt)ics

Defined: Haptics

Haptic Exploration

What's Inside?

Exploratory Procedures

Types of Sensing

Haptic Devices

Tactile and Proprioceptive Devices

Tactile Device Challenges

Kinesthetic Device Challenges

Workspace vs Force

Haptic Wearables?

Readings

Thursday

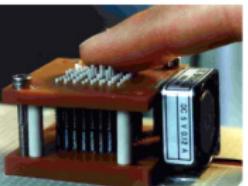
Tactile and Proprioceptive Devices

INF632
(EE499/EE599)

Winfree

Haptic Interfaces

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

Senses

[What's Inside?](#)

Define

[Defined: Haptic](#)

[Defined: \(Opt\)ics](#)

[Defined: Haptics](#)

Haptic Exploration

[What's Inside?](#)

[Exploratory Procedures](#)

[Types of Sensing](#)

Haptic Devices

[Tactile and Proprioceptive Devices](#)

[Tactile Device Challenges](#)

[Kinesthetic Device Challenges](#)

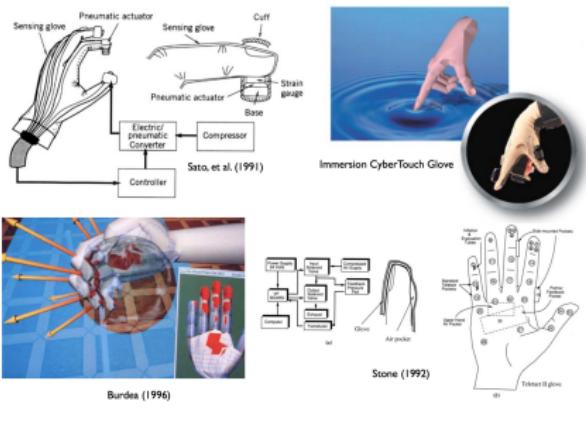
[Workspace vs Force](#)

[Haptic Wearables?](#)

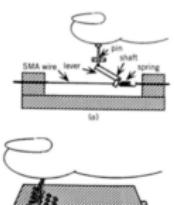
Readings

[Thursday](#)

Tactile Device Challenges



Wagner & Howe (2002)



- ▶ Stimulation density needs to be high.
- ▶ Multimodal sensations are very hard to overlay.
- ▶ High complexity and weight diminish portability.
- ▶ Passive touch does not feel real.
- ▶ Tactile device design is difficult!

Senses

[What's Inside?](#)

Define

[Defined: Haptic](#)

[Defined: \(Opt\)ics](#)

[Defined: Haptics](#)

Haptic Exploration

[What's Inside?](#)

[Exploratory Procedures](#)

[Types of Sensing](#)

Haptic Devices

[Tactile and Proprioceptive Devices](#)

Tactile Device Challenges

[Kinesthetic Device Challenges](#)

[Workspace vs Force](#)

[Haptic Wearables?](#)

Readings

[Thursday](#)

Kinesthetic Device Challenges

INF632
(EE499/EE599)

Winfree

Senses

What's Inside?

Define

Defined: Haptic

Defined: (Opt)ics

Defined: Haptics

Haptic Exploration

What's Inside?

Exploratory Procedures

Types of Sensing

Haptic Devices

Tactile and Proprioceptive Devices

Tactile Device Challenges

Kinesthetic Device Challenges

Workspace vs Force

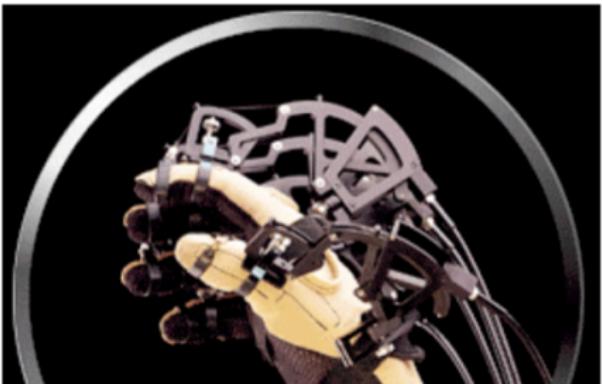
Haptic Wearables?

Readings

Thursday

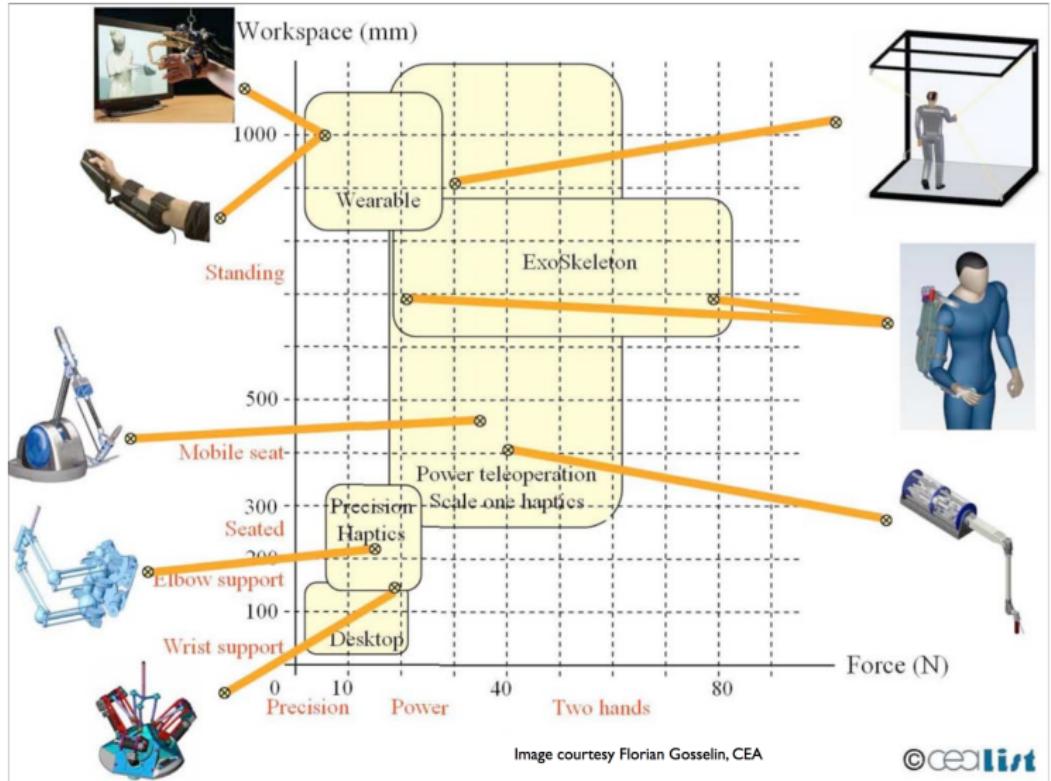


Immersion CyberGrasp Glove



- ▶ Competing goals of high stiffness and low mass.
- ▶ Force feedback feels soft - “Nerfworld”.
- ▶ Point based interactions are overly simple.
- ▶ High quality devices are expensive.
- ▶ Limited workspace.

Workspace vs Force



©cea list

Senses

[What's Inside?](#)

Define

[Defined: Haptic](#)
[Defined: \(Opt\)ics](#)
[Defined: Haptics](#)

Haptic Exploration

[What's Inside?](#)
[Exploratory Procedures](#)
[Types of Sensing](#)

Haptic Devices

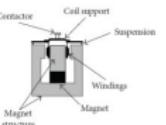
[Tactile and Proprioceptive Devices](#)
[Tactile Device Challenges](#)
[Kinesthetic Device Challenges](#)
[Workspace vs Force](#)
[Haptic Wearables?](#)

Readings

[Thursday](#)

But what can you do with haptic wearables?

- ▶ Vibration (eccentric mass motor or tactor)
- ▶ Skin stretch
- ▶ Kinesthetic force
- ▶ Inertial changes



Senses

What's Inside?

Define

Defined: Haptic

Defined: (Opt)ics

Defined: Haptics

Haptic Exploration

What's Inside?

Exploratory Procedures

Types of Sensing

Haptic Devices

Tactile and Proprioceptive Devices

Tactile Device Challenges

Kinesthetic Device Challenges

Workspace vs Force

Haptic Wearables?

Readings

Thursday

Senses

[What's Inside?](#)

Define

[Defined: Haptic](#)

[Defined: \(Opt\)ics](#)

[Defined: Haptics](#)

Haptic Exploration

[What's Inside?](#)

[Exploratory Procedures](#)

[Types of Sensing](#)

Haptic Devices

[Tactile and Proprioceptive Devices](#)

[Tactile Device Challenges](#)

[Kinesthetic Device Challenges](#)

[Workspace vs Force](#)

[Haptic Wearables?](#)

Readings

[Thursday](#)

- ▶ OPTIONAL - Embodied Auxetic Intelligence in a Glove-Type Wearable Haptic Interface Connecting Humans.pdf
- ▶ ...
- ▶ OPTIONAL - Ultralight Soft Wearable Haptic Interface with Shear-Normal-Vibration Feedback.pdf
- ▶ TO DISCUSS - Haptic Perception and Its Relation to Action.pdf
- ▶ TO DISCUSS - Haptic Rendering Introductory Concepts.pdf
- ▶ TO DISCUSS - The future of wearable technologies.pdf

Senses

What's Inside?

Define

Defined: Haptic

Defined: (Opt)ics

Defined: Haptics

Haptic Exploration

What's Inside?

Exploratory Procedures

Types of Sensing

Haptic Devices

Tactile and Proprioceptive Devices

Tactile Device Challenges

Kinesthetic Device Challenges

Workspace vs Force

Haptic Wearables?

Readings

Thursday