

## Senses

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Defined: Haptic

Defined: (Opt)ics

Defined: Haptics

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Workspace vs Force

Haptic Wearables?

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# Wearable Technologies and Applications (Wearable Informatics)

Winfree

## Lecture 3

# What's Inside?

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(EE499/EE599)

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# Five Senses, Which is Most Important to You?

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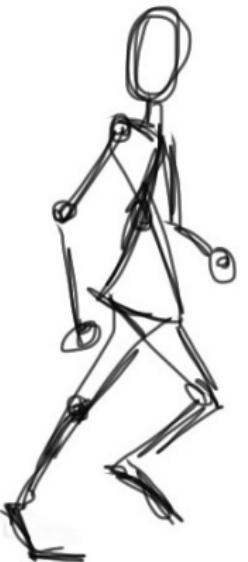
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- ▶ Hearing?
  - ▶ Sight?
  - ▶ Smell?
  - ▶ Taste?
  - ▶ Touch?
- 
- ▶ Which of these seems the most valuable to you?
  - ▶ Which would you relinquish last?

# Five Senses, Which is Most Important to You?

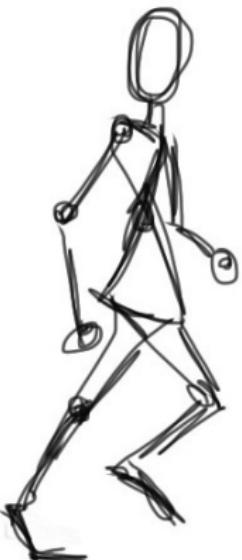
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## Sight



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



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# Five Senses, Which is Most Important to You?

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## Sight

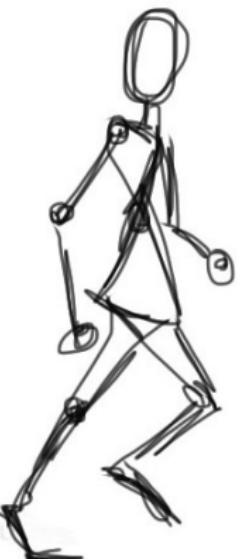


- ▶ Centralized
- ▶ Broad
- ▶ Passive
- ▶ Cognitive

## Touch



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



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# What is Haptics?

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## 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

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### Definition

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### Haptics

- ▶ the science and technology of touch

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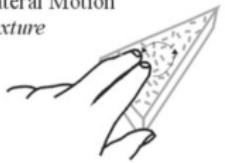
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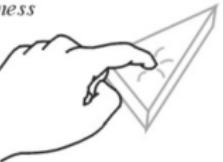
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Lateral Motion  
Texture



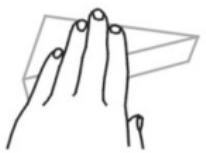
Pressure  
Hardness



Enclosure  
Global shape/Volume



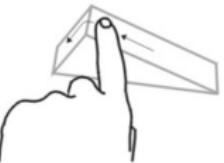
Static Contact  
Temperature



Unsupported Holding  
Weight



Contour Following  
Shape



# Types of Sensing

Cutaneous / Tactile  
Stems from skin contact



Kinesthetic / Proprioceptive  
Stems from body movement

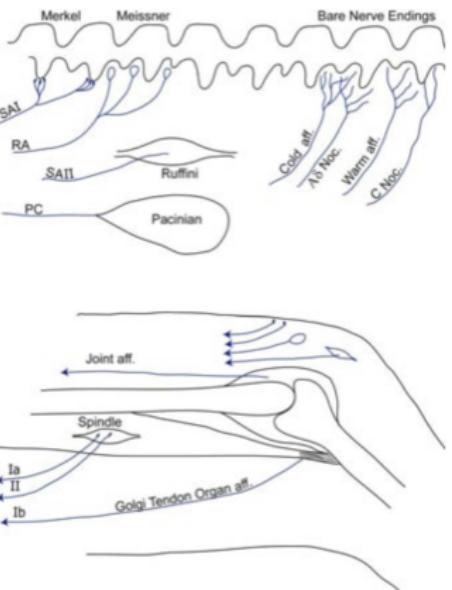


Illustration by A. M. Okamura.

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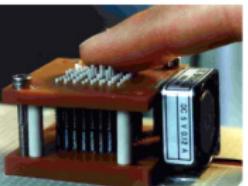
# Tactile and Proprioceptive Devices

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## 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

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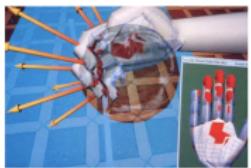
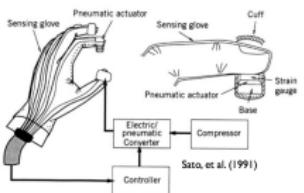
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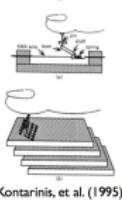
# Tactile Device Challenges



Stone (1992)



Wagner &amp; Howe (2002)



Kontarinis, et al. (1995)

- ▶ 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!

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# Kinesthetic Device Challenges

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- ▶ 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.
- ▶ Constrained to a desk!

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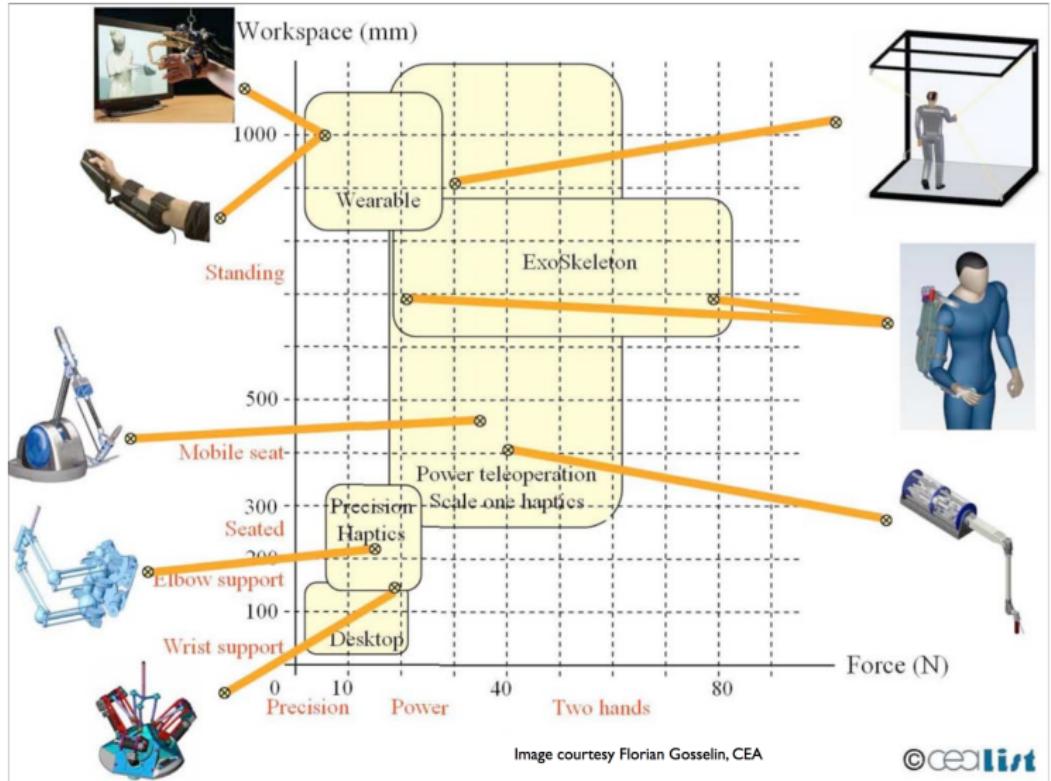
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# Workspace vs Force



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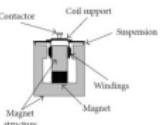
- Haptic Wearables?

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# But what can you do with haptic wearables?

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



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