

# Haptics

The Touchy-Feely side of Robotics

Presented at

Tech Savvy 2011

<http://www.aauw-nys.org/Bufalo/techsavvy-info.htm>  
Saturday, March 12<sup>th</sup> 2011



## Outline

- What is robotics?
- Applications
- Disciplines
- Haptic Demo
- How can you get involved?
- Questions



Which is not a robot?



What is a robot?



## Robotics

- Multidisciplinary
  - Mechanical Engineering
  - Electrical Engineering
  - Software Engineering
- Perception
- Actuation
- Intelligence



## Perception

Sensors! - Must take in info about world.



## Actuation

- Machines must navigate
- Bad motion = inaccurate navigation
- Respond based on sensors/environment



## Intelligence

- **Where** should it move?
- **How** can it avoid obstacles?
- **What** is the optimal path?
- **When** should motors turn on?



## Applications



## Exploration

Surveillance



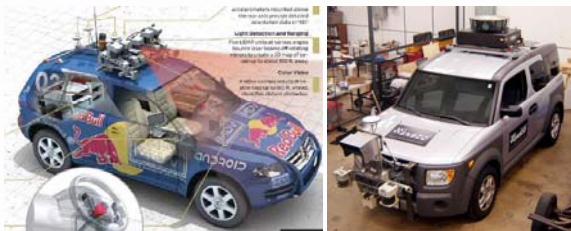
Deep Sea



Space

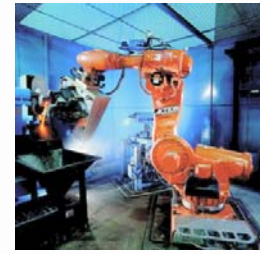


## Vehicles



## Industrial

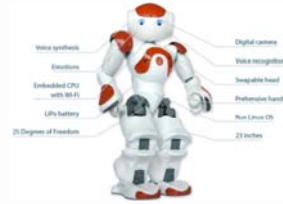
- Automate repetitive tasks
- Eliminate safety concerns



## Humanoids



Asimo



Nao



## Personal Robotics



## Haptics

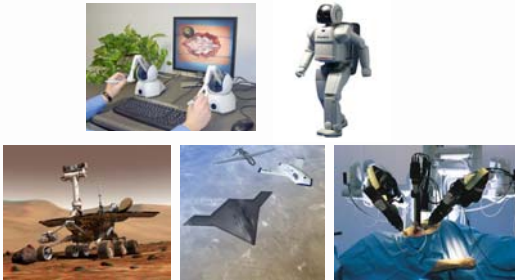
- Force Feedback Devices
- Uses:
  - Surgery
  - Flight Simulation
  - Education



## Which is not a robot?



~~Which is not a robot?~~  
They are all robots!



Disciplines



## Mechanical

- Physical Constraints
- Design structure
- Create graphical models



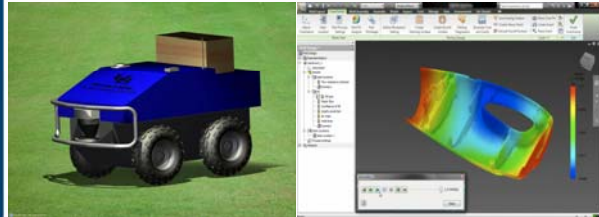
## Mechanical

Computer Aided Design (CAD)



## Mechanical

Computer Aided Design (CAD)



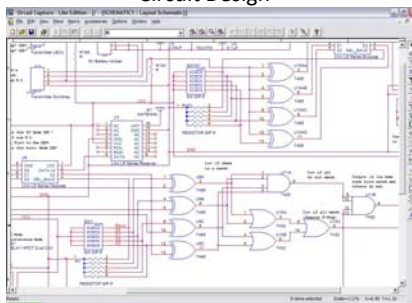
## Electrical

Integrate sensors:  
GPS Module  
LIDAR (Laser Radar)  
Digital Compass  
Wheel Encoders  
Motor Controllers



## Electrical

Circuit Design



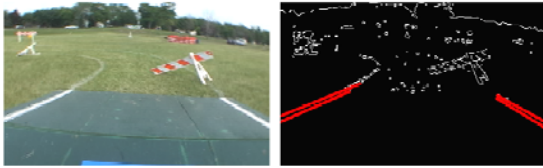
## Electrical

Circuit Design



## Software

Image Processing



## Software

Mapping and Path Planning



How can you get started?



## Robot Kits



3pi Robot  
[www.Sparkfun.com](http://www.Sparkfun.com)



BoE Bot



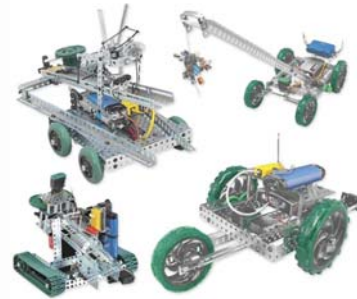
Scribbler  
[www.Parallax.com](http://www.Parallax.com)



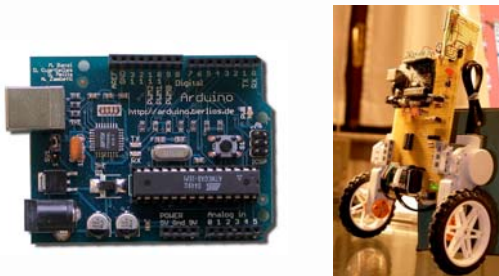
## Lego Mindstorms



## Vex Robotics



## Arduino Microcontroller



Questions?




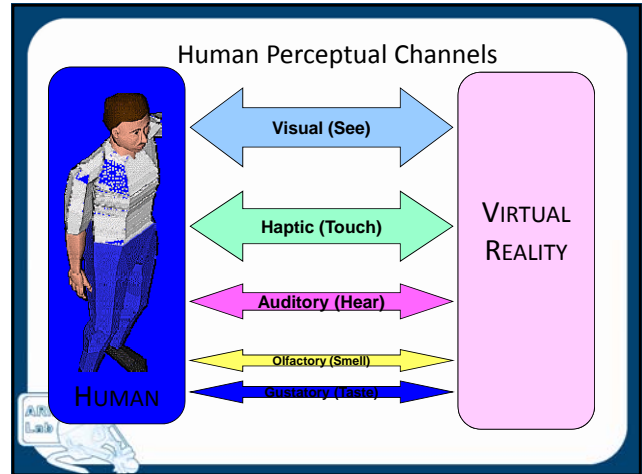
# Overview of Haptics/Robotics at University at Buffalo

Venkat Krovi

Acknowledgements:

- Bhatt, Rajan
- Jadhav, Chetan
- Jun, Seung-kook
- Nair, Pravin
- Tang, Chin-Pei
- White, Glenn

Slide 33

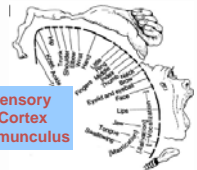



## What is haptics?

Using the sense of touch to interact with computers and virtual environments

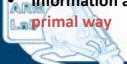

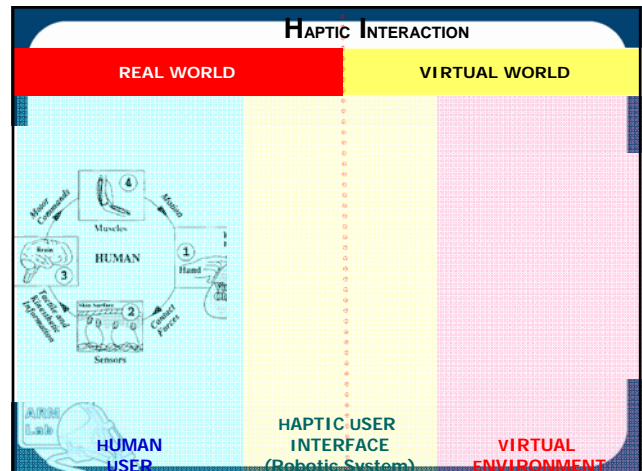
Greek "haptesthai" meaning "to touch"

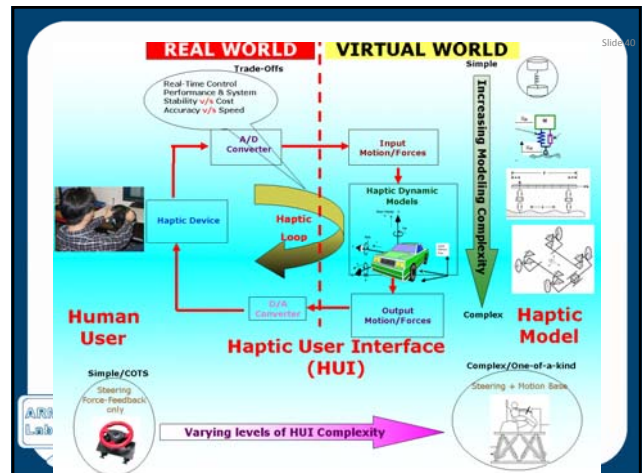
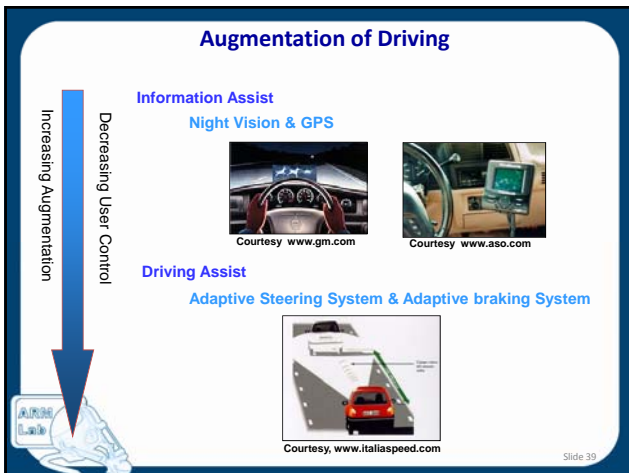
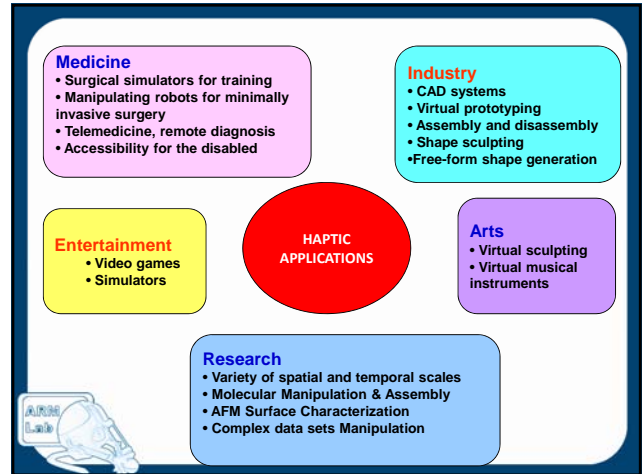
Sensory Cortex Homunculus

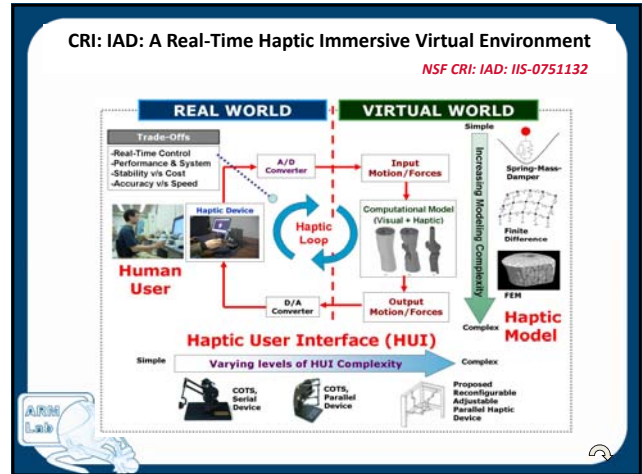
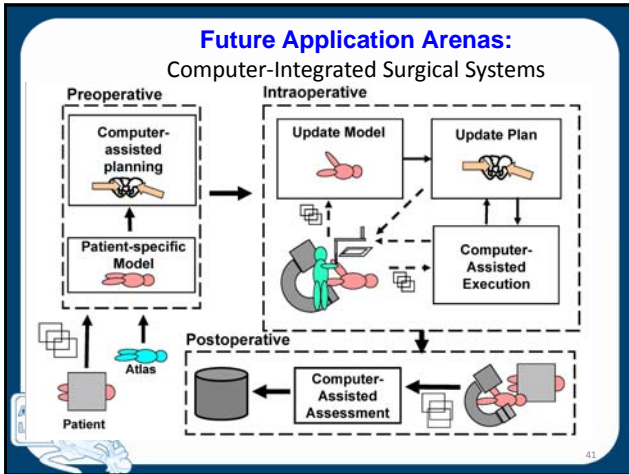


## Why use haptics?

- Increases the information flow between the computer and the user
- Intrinsically bilateral interaction
- Our sensing of forces is closely tied to our sense of three-dimensional space
- Information and intent can be conveyed in a physically direct a... primal way





### Future Application Arenas:

#### Tele-Immersive Collaboration Environments

Multiple people in a **dextrous materials handling task (DMH)**

- Negotiating which objects to handle
- Mapping a route through virtual environment
- Navigating through the environment

**Haptic Assist** within the environment

- Augmented Reality overlays
- Virtual Fixturing

**Performance Characterization**

- Task Performance
- Co-presence

Co-presence is significantly and positively associated with

- How well the user felt they had contributed to the task
- How well the user felt their collaborator had contributed to the task

**Collaborative Haptics Handling Scenario**

