Teaching Haptics Through Course Projects

Haptics Symposium Tutorial: Best Practices for Teaching Haptics

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Outline

- Questions you may want addressed???
- Overview of guidelines for running successful haptics course projects
- Present “course project slides” from my haptics course slides on projects
  - This is my 6th class (Allison’s 4th lecture)
  - Slides with 

 symbol in upper right are directly from my past lecture slides
- Comments and other important details
- Overview of provided reference materials

Questions/Issues you'd like addressed

- Are there any questions/concerns about running course projects that you'd like addressed during this presentation?

Guidelines for running successful haptics course projects

- Start early
  - Students should start thinking about projects on the first day of class
- Try to have a project be novel
  - This tends to be more inspiring for both you and the students
- Get student interest and buy-in
  - Have students help define project
  - Work with them in a collaborative manner
- Define proper scope (to avoid student discouragement)
  - Resources (tools, hardware, software…), skill set, time
- Match skill set of students to project
- Build a community
  - have students present and share their ideas
- Keep tabs on students' progress (just like in research)
  - But let them define milestones and report their progress to you
  - Your job is to help them achieve these goals

Haptics

ME7960, Sect. 007

Lect. 6, pt. 2: Course Projects

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Spring 2011

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We would like to acknowledge the many colleagues whose course materials were borrowed and adapted in putting together this course, namely: Drs. Allison Okamura (JHU), Katherine Kuchenbecker (U Penn), Francois Conti, Federico Barbagli, and Kenneth Salisbury (Stanford), Ed Colgate (Northwestern), Hong Tan (Purdue), Blake Hannaford and Ganesh Sankaranarayanan (U. Washington), and Karon MacLean (UBC).

Haptics Course Project

- Plan and execute a haptics research project that provides a specific new contribution to haptics/engineering science
- Document the work in a research paper (this is different than the reports that were written 2 years ago)
- Demonstrate your project at a course “Open House” in late April (4/28)
- Goals:
  - Learn about haptic technology and/or human haptics
  - Learn how to do haptics research

Some Project Ideas

- Arm-based skin-stretch feedback device (Nathan and Ryan)
  - Give direction cues without encumbering fingertips
- Use skin-stretch feedback to direct hand continuous movements (Erin Parsons + Palmer)
- Miniaturize skin stretch display
- Z-Axis Active Handrest (Hamid and Charles)
- 2-DOF contact location display device design (Muhammad + someone with shop skills/access)
- Shear feedback integrated with a game controller (Rebecca and Ashley)
- Shear feedback integrated with a smart phone (Markus, Peter, & Adam)
- Arm swing haptic device for gait rehabilitation (Babak + one more student)

Color Legend: Established Members and/or Full Team Project

Comments

- Some students start thinking about projects early – I told the class about where to find project reports on past projects on first day

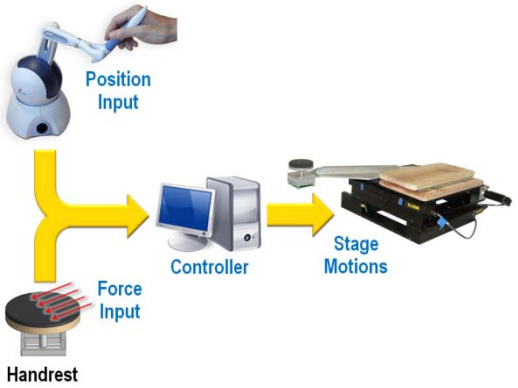
- I can do match-making by putting posting current projects and student names

Past projects from Sp. 2009

- Contact feedback in 3D (Doxon/Wellborn)
- **Active Handrest** (Brian and Mark F.)
- Omni Chair (3-DOF FFB joystick for wheelchair)
- **Dual Falcon Interface** (Scott and Amon)
- Haptic Paddle And Knob (Marq)
- Haptic Paddle Teleoperation (Mani)

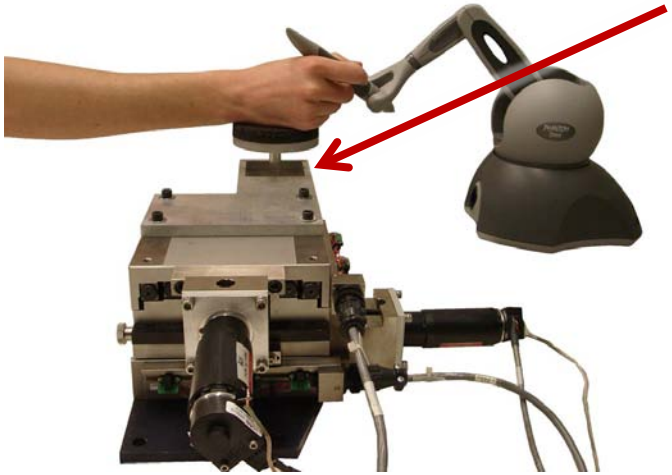
(see past project reports on class website)

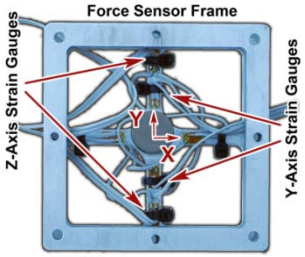
Active Handrest



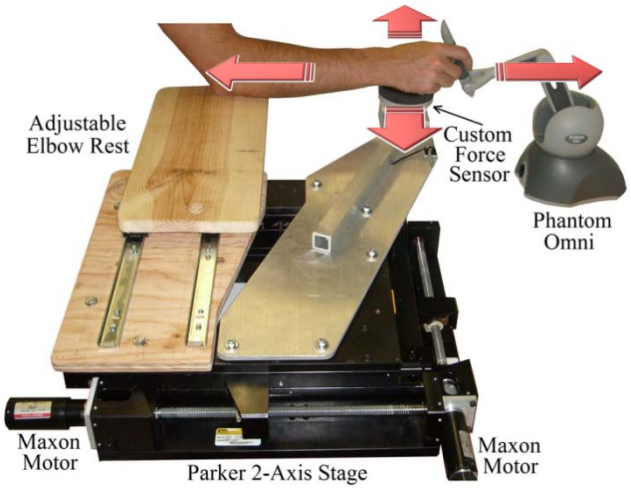
- Students: Brian Gleeson and Mark Fehlberg

At end of Semester





At end of Summer

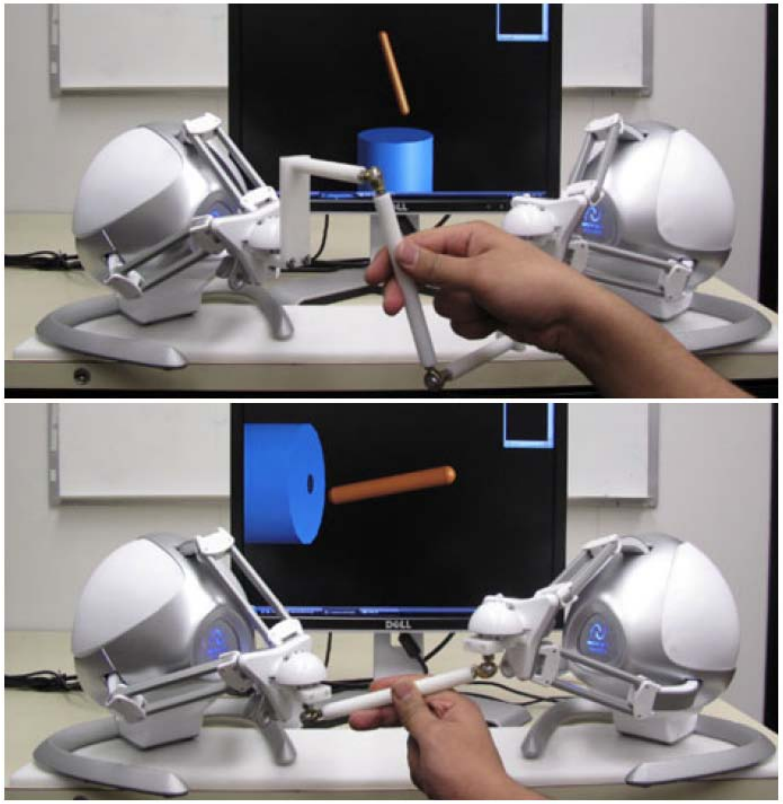


Started with bench-top Shear feedback device. Added custom force sensor and controller.

Ongoing PhD research for Mark Fehlberg

Dual Falcon Interface

- Students: Scott Teuscher and Amon Shah



Presented at EuroHaptics 2012

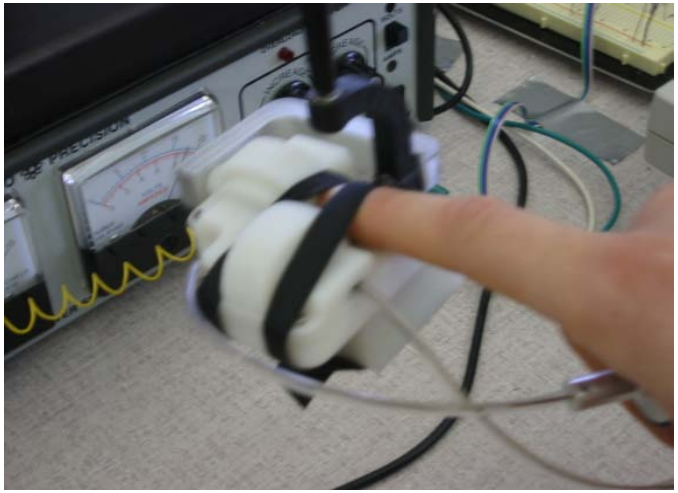
Past projects from JHU

- Interactive Haptic Rendering of Deformable Surfaces Based on the Medial Axis Transform
- Virtual Environment for Exploring Atomic Bonding
- A Magnetically-Actuated Friction Feedback Mouse
- The Effect of Visual and Haptic Feedback on Manual and Teleoperated Needle Insertion
- The **Snaptic Paddle**: A Modular Haptic Device
- Design and Performance of a **Two-Dimensional Tactile Slip Display**

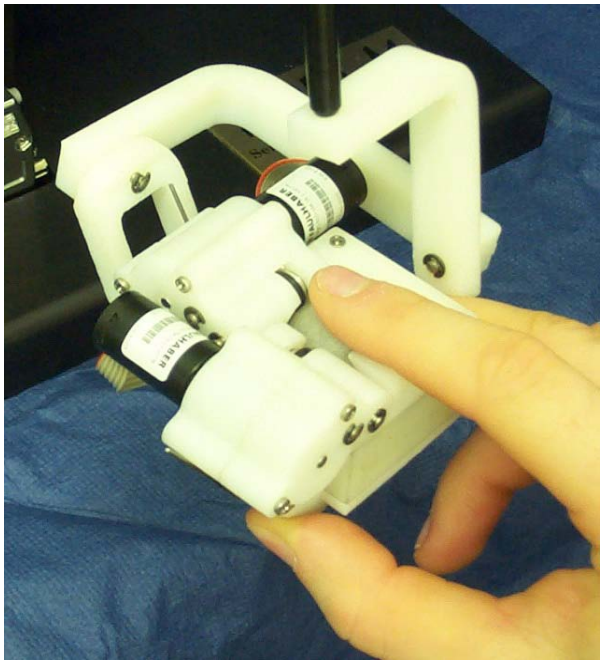
(see papers at http://haptics.lcsr.jhu.edu/Publications)

Two-dimensional tactile slip display

End of Semester 1: Demo Day



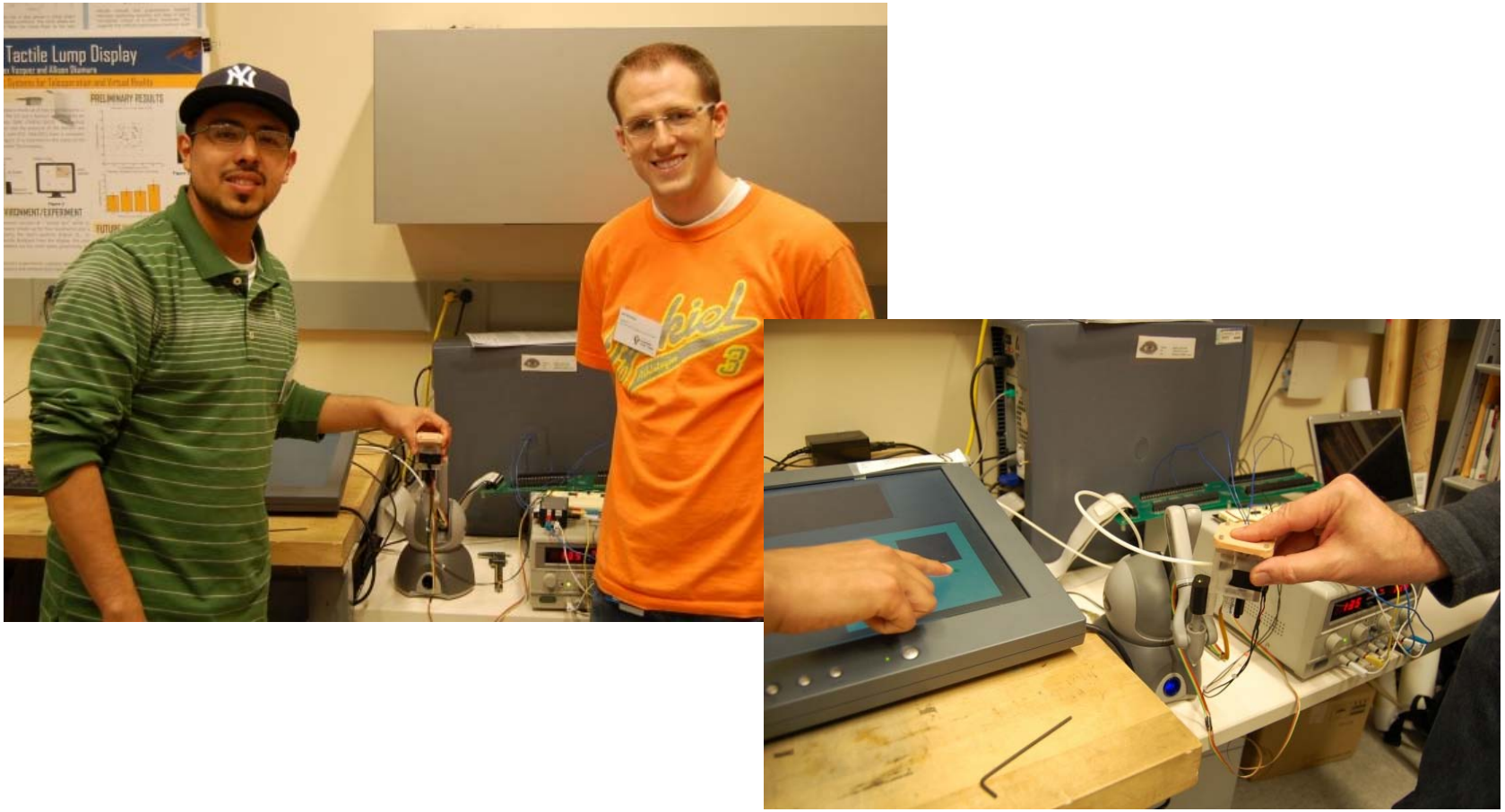
Semester 2: Redesign



Johns Hopkins University Haptic Exploration Laboratory

Slide from A. Okamura, Stanford University

Tactile display for simulating lumps in tissue



Slide from A. Okamura, Stanford University

Other project ideas that other haptic classes have done

- Hardware/Systems
  - Multi-dimensional vibrotactile feedback
  - Haptic display for science/tech museum
  - Foot haptics for prosthetic sensory substitution
  - Effects of device dynamics on user perception of virtual environments

Other project ideas that other haptic classes have done

- Software/Analysis
  - Implementation of linear/nonlinear FEM with haptic feedback
  - Effects of position quantization on rendering
  - Scaled haptic feedback for optimized training in VEs
  - Simulation to teach residents to insert bone screws without stripping them

- … or propose your own

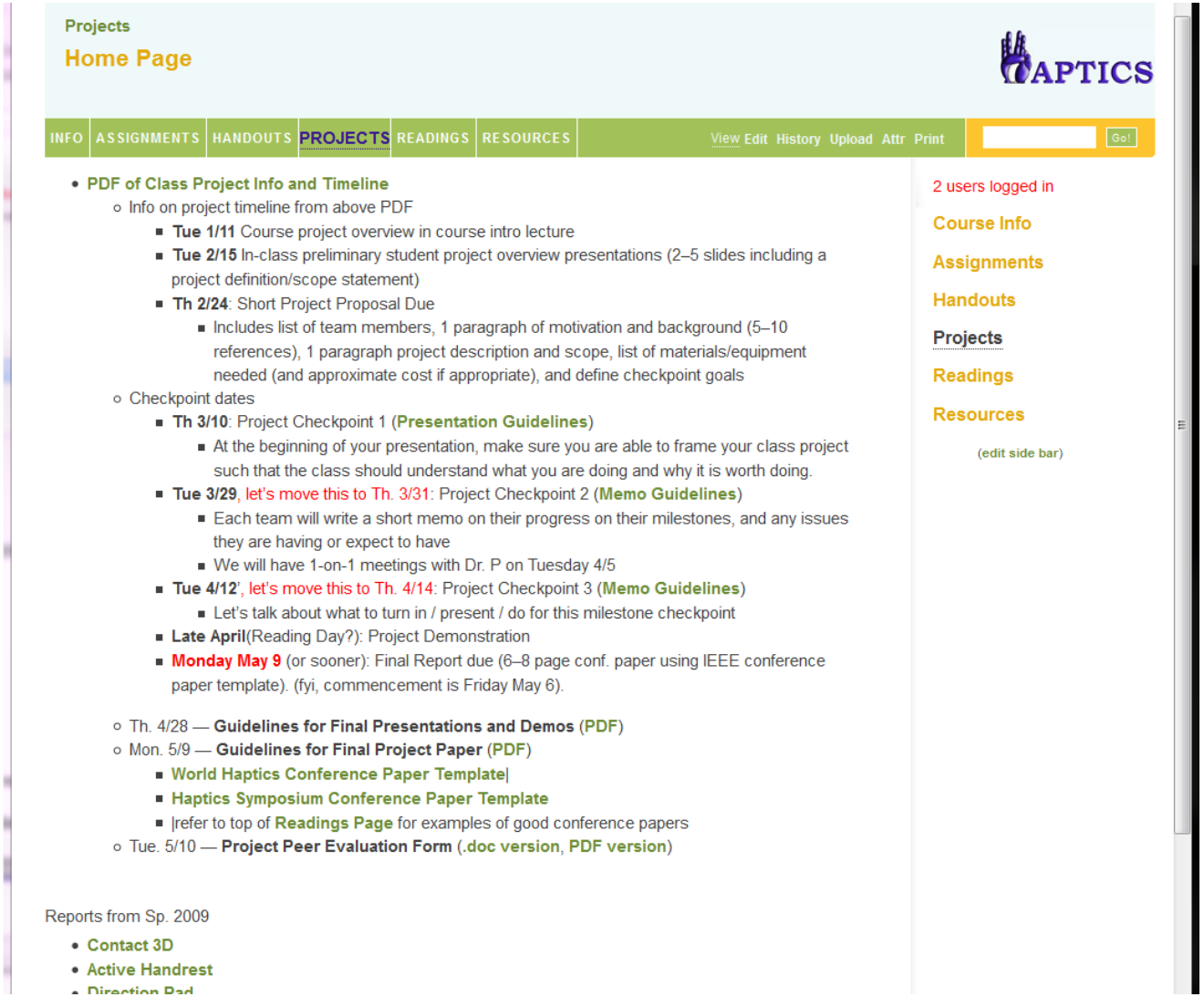
Project Time Line

- Tue 1/10: Tell students about class projects on day 1 of class
- Tue 2/15: In-class preliminary student project overview presentations (2–5 slides including a project definition/scope)
- Th 2/24: Short Project Proposal Due
  - Includes list of team members, 1 paragraph of motivation and background (5-10 references), 1 paragraph project description and scope, list of materials/equipment needed (and approximate cost if appropriate)
  - Define checkpoint goals
- Th 3/10: Project Checkpoint 1 – In-Class presentation (good class feedback)
- Tue 3/31: Project Checkpoint 2 – meet 1-on-1 with Prof.
- Tue 4/14: Project Checkpoint 3 – meet 1-on-1 with Prof.
  - and adjust extpected final project outcome
- April 28: Final Project Presentation and Demonstration
- May 9: Report due (in style of 6-page conference paper)

Lab's done. Students work on projects & paper presentations during this time

- And if you are highly successful, a conference paper. There are some deadlines in early fall (ICRA, Haptics Symposium)

Project schedule also on class website



Projects

Home Page

HAPTICS

INFO | ASSIGNMENTS | HANDOUTS | PROJECTS | READINGS | RESOURCES | View Edit History Upload Attr Print | Go!

- **PDF of Class Project Info and Timeline**
  - Info on project timeline from above PDF
    - **Tue 1/11** Course project overview in course intro lecture
    - **Tue 2/15** In-class preliminary student project overview presentations (2–5 slides including a project definition/scope statement)
    - **Th 2/24**: Short Project Proposal Due
      - Includes list of team members, 1 paragraph of motivation and background (5–10 references), 1 paragraph project description and scope, list of materials/equipment needed (and approximate cost if appropriate), and define checkpoint goals
  - Checkpoint dates
    - **Th 3/10**: Project Checkpoint 1 (**Presentation Guidelines**)
      - At the beginning of your presentation, make sure you are able to frame your class project such that the class should understand what you are doing and why it is worth doing.
    - **Tue 3/29**, let's move this to Th. 3/31: Project Checkpoint 2 (**Memo Guidelines**)
      - Each team will write a short memo on their progress on their milestones, and any issues they are having or expect to have
      - We will have 1-on-1 meetings with Dr. P on Tuesday 4/5
    - **Tue 4/12**', let's move this to Th. 4/14: Project Checkpoint 3 (**Memo Guidelines**)
      - Let's talk about what to turn in / present / do for this milestone checkpoint
    - **Late April**(Reading Day?): Project Demonstration
    - **Monday May 9** (or sooner): Final Report due (6–8 page conf. paper using IEEE conference paper template). (fyi, commencement is Friday May 6).
  - Th. 4/28 — **Guidelines for Final Presentations and Demos** (PDF)
  - Mon. 5/9 — **Guidelines for Final Project Paper** (PDF)
    - **World Haptics Conference Paper Template**|
    - **Haptics Symposium Conference Paper Template**
    - |refer to top of **Readings Page** for examples of good conference papers
  - Tue. 5/10 — **Project Peer Evaluation Form** (**.doc version**, **PDF version**)

Reports from Sp. 2009

- **Contact 3D**
- **Active Handrest**
- **Direction Pad**

2 users logged in

Course Info

Assignments

Handouts

Projects

Readings

Resources

(edit side bar)

Available Hardware
(so that students know what resources they have access to)

- Falcon force feedback devices (3-DOF)
- Haptic paddles (1-DOF)
- Various A/D and D/A cards
- Need to purchase/use other materials? Depends on cost/availability.
- Machine shop, rapid prototyping machine, and waterjet cutter are available, but need to be trained and not free.

Teams

- Should be chosen based on common research interests
- A multidisciplinary team is most appropriate for some projects
-
- I'll be working with students currently without projects to get them matched up in the next week or so

  (preliminary project presentations will be in 2 weeks).

More details…

Choosing projects
(for instructor)

- Your lab's pet projects are fine for your own students or highly motivated students
  - Most important that a student is interested and motivated in the project
- Student (or people other than you) generated projects
  1. should have the resources to complete them
  2. Should understand the project goals and scope and they are achievable/appropriate
     1. And the student should be invested in refining the project scope and goals

Limiting Scope

- While defining projects early helps to be able to have more accomplished, the project should be something that can be realistically completed in ~10-25 hours per week in 2-4 weeks (despite best intentions).

- Appropriate scope
  (mainly hardware, software, or testing)
  - Some virtual environment and a focused study
  - A more elaborate virtual scenario and few “results”
  - An alpha prototype with little or no “results”
  - You can expect more out of your own or highly motivated students.

Preliminary student project overview

- 2–5 slides including a project definition/scope statement

- Purpose
  - Get students defining their projects and to get feedback before they turn in their project proposal in 9 days
  - For class to learn about other projects
    - They can also better scale their projects after hear what others are doing

(Short) Project Proposal

- List of team members
- 1 paragraph of motivation and background (plus 5–10 relevant references)
- 1 paragraph project description and scope
- list of required materials/equipment (and approximate cost if appropriate)
- define checkpoint goals for the 3 checkpoints

- Others do a more formal project proposal

Checkpoint 1 presentation logistics

Project Checkpoint Presentation Guidelines

5-7 min. PowerPoint presentation (7 min. max)

We also have a little time for classroom Q&A

Please email your PPT slides before 10:30am

and/or

bring your presentation on a flashdrive to class *(please also do this regardless)*

Checkpoint 1 presentation guidelines

1-2 Min.	**Problem statement:**	Statement of what **problem you will solve** in your project **and/or** a **stated hypothesis** for your project
	Project statement:	What you will do for your project and what your project will involve
½ Min.	**Motivation:**	Motivation and why we should care about your project
1 Min.	**List of checkpoint milestones:**	List all checkpoint milestones briefly to give the class more of a sense of what you'll be doing
2-3 Min.	**Update on first milestone:**	Quick statement of what you've accomplished towards your 1st (and any other) checkpoint milestones. Any evidence (a picture of a prototope, diagram, etc) would also be good to show.
	Please **also mention any anticipated issues** with completing your project.	

See provided handout

Checkpoint 1 benefits

- Gives students more practice and feedback on presenting their project definition and motivation (they stated these in class ~1 mo. ago)
  - And get feedback from students and Prof.
- Helps class mates understand what others are working on and helps build community
  - Students with similar challenges help each other

Checkpoints 2 and 3

- Meet 1-on-1 with student project groups
- 20 min. per project
- Discuss progress and any issues students are having
- Follow-up meetings scheduled in lab as appropriate

- A short progress memo was turned in advance of meetings (to make the best of the short meeting time)

Paper presentations

- Students choose a paper that is relevant to their project (probably identified in project proposal)
- 4 presentations per 1:15 min. class (to condense total days required – others do 2 per 50 min. class)
- Presentations include
  - Summary
  - Important/relevant methods presented
  - Ways to extend or improve the work
  - How paper relates to his/her class project
  - Discussion

This is a nice reminder to the class about each project and provides context for the paper

Paper presentation evaluation

- Presentations peer evaluated by class-mates
  - Using evaluation form from Allison's course (see posted handouts) – provides better consistency

Student Presentation Evaluation Form

Presenter Name: _____ Date: __T / Th_____

Title/topic of Presentation: _____

Evaluator Name: _____

	0	7	14	20	Grade
Organization	• Audience cannot understand presentation because there is no sequence of information. • Requested presentation content is missing. • Presentation timing of content is significantly out off balance and the presentation is significantly too short or too long.	• Audience has difficulty following presentation because student jumps around. • Only some of the requested presentation content is provided. • Presentation timing of content is out off balance and overall presentation length is too short or too long.	• Student presents information in logical sequence which audience can follow. • Most requested presentation content is provided. • Presentation timing of content is a little out off balance and overall presentation length is a bit off.	• Student presents information in logical, interesting sequence which audience can follow. • All requested presentation content is provided. • Presentation timing of content is well balanced and presentation length is nearly perfect (i.e. ~10 min.) or if more time is taken it seems warranted.	
Subject knowledge	Student does not have grasp of information; student cannot answer questions about subject.	Student is uncomfortable with information and is able to answer only rudimentary questions.	Student is at ease with the topic but cannot elaborate on all issues raised in paper and in Q&A session.	Student demonstrates full subject knowledge.	
Slides	Student uses superfluous graphics or no graphics. Student's presentation has many spelling errors and/or grammatical errors.	Student occasionally uses graphics that rarely support text and presentation. Presentation has several misspellings and/or grammatical errors.	Student's graphics relate to text and presentation. Presentation has almost no misspellings and/or grammatical errors.	Student's graphics explain and reinforce screen text and presentation. Presentation has no misspellings or grammatical errors. Graphics are properly labeled and citations for graphics are given.	
Presentation skills	Student mumbles, incorrectly pronounces terms, and speaks too quietly for students to hear. Student reads most of the report and does not make eye contact.	Student's voice is low. Audience members have difficulty understanding presentation. Only occasional eye contact.	Student's voice is clear. Student pronounces most words correctly. Most audience members can hear presentation. Student returns to notes/slides frequently.	Student uses a clear voice and correct, precise pronunciation of terms so that all audience members can hear presentation. Student maintains eye contact with audience, seldom returning to notes.	
Discussion period	Student does not lead a discussion period or have discussion topics prepared.	Student's discussion is not well organized or explained to the class.	Student organizes a discussion, but it is not particularly relevant or useful.	Student leads a compelling discussion.	
				Total Points:	

How well did the presenter tie his/her paper topic (or relate it to) the class project they are working on (0-10, where 10 means they did a good job with this): _____

Adapted from Allison Okamura's haptics presentation evaluation form, which was adapted from Information Technology Evaluation Services, NC Department of Public Instruction
Rev. 1, March 30, 2011

Turning projects into conference papers usually requires…

- Start with a novel, well informed topic
- Usually requires a more meaningful evaluation and analysis
- Refinement of a device, characterizing its performance, and demonstrating its use
- Some editing and inclusion of missing prior work

- Class projects are a great way to show concept feasibility

Review of guidelines for running successful haptics course projects

- Start early
  - Students should start thinking about projects on the first day of class
- Try to have a project be novel
  - This tends to be more inspiring for both you and the students
- Get student interest and buy-in
  - Have students help define project
  - Work with them in a collaborative manner
- Define proper scope (to avoid student discouragement)
  - Resources (tools, hardware, software…), skill set, time
- Match skill set of students to project
- Build a community
  - have students present and share their ideas
- Keep tabs on students' progress (just like in research)
  - But let them define milestones and report their progress to you
  - Your job is to help them achieve these goals

Provided reference materials

- All project related assignments
- An example of project related assignments for one typical project
  - this was a student suggested project on virtual lock picking
- Reference presentations from Allison Okamura
  - Her “projects presentation” lecture slides
  - Her former student’s how to do a haptics project presentation

Questions/Comments???