Senior Design Info Session
ESE Senior Design (ESE 450/451)

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ESE Senior Design Overview

- Two semesters, 2 cu
- “Design, implement, test, validate, and demo a product prototype.”
- 2-5 students per team, but 3-4 is preferred
  - Interdisciplinary teams are encouraged
  - Skills of members in team should complement each other (try to find people who know different things than you do)
ESE Senior Design Overview

- **Fall semester:**
  - Form teams, develop project goals and specifications, find project advisor
  - Mostly research, planning, preliminary testing/experimenting, and defining/fine-tuning project specifications throughout semester
  - Two reports and two rounds of oral presentation

- **Spring semester:**
  - Complete design, implementation, and validation
  - Meetings with course instructors and project advisor(s)
  - Demo Day
  - Final report
How to select a project?

- **Start with a team**, then select project and find an advisor.
- **Start with a project idea**, then find and advisor and put together a team.
- **Start with an advisor and a project**, then put together a team.

- Project ideas offered by advisors are listed on ESE Senior Design website.
- Or you can create your own project idea or enhance/expand on a previous project.
Freshmen Mentoring Program

- Freshmen paired with participating senior design teams
- Opportunity for freshmen to:
  - experience the engineering process early on
  - network with upperclassmen who can offer valuable advice
  - learn new skills
- Opportunities for awards for both senior design teams and freshmen
- Entirely voluntary, but strongly encouraged
PHAT:
Primate Hand Actuation Tracker

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Advisor: Jan Van der Spiegel – jan@seas.upenn.edu
Project Goals

- Develop precise motion capture system for movement in primate hand and wrist
- Research tool for Dr. Timothy Lucas

Specifications
- 23 degrees of freedom (DOF)
- Sampling rate of 100 Hz
- High precision (error < 1° per DOF)
- No noise within neurophysiological recording spectrum (< 10 kHz)
System Overview

- Raw Camera Footage
- Position Data
- Extended Kalman Filter
- Data Set Usable by GUI
- Raw IMU Data
- Acceleration Data

Time:
- Raw Data Acquisition
- Post-Processing
- Union of Data
- Visual Representation
Bioengineering

Adding Haptic Feedback to Monopolar Electrocautery

Advisor: Dr. Kuchenbecker
Members: Anna Brzezinski, Zach Shurden, Brian Horwich, Nicki Blumenfeld
CBE Senior Design

- **Two course sequence**
  - **Fall - CBE 400: Process/Product Design**
    - Design for various processes
    - ASPEN PLUS, Simulation Methods
    - Cost/Profitability Analyses
  
  - **Spring - CBE 459: Senior Design**
    - Process or Product Design
    - Projects proposed by industrial consultants or professors
    - Design may focus on flow diagramming, equipment design, optimization, profitability analysis, and market analysis
    - Note: generally not producing a physical product
Sample 2013 CBE Design Projects

- **Process or Product Design**
  - **Process:**
    - Propylene from Marcellus Gas Shale
    - Photosynthesis of Ethylene
    - Natural Gas to BTX (Benzene, toluene, and xylene)
    - A Green Process for the Production of Niacin
  - **Product:**
    - Non-Egg Based Platform for Flu Vaccine
    - A Moore’s Law for DNA Sequencing
    - On-Site Clinical Testing of Citrated Blood Samples
Structure and Timeline

- **Fall:**
  - Survey
  - Group members chosen (3-4) and projects assigned in latter half of semester
  - Note: can propose own design projects*

- **Spring:**
  - Full design course begins
  - Weekly meetings with consultants (DuPont, Arkema, Eli Lilly) and advisors
  - Full reports and presentations due at end of semester
Picking Teams

OPTIONS

- Create a team based on project interest

OR

- Create a team with a well rounded skill set

TIMELINE

- Spring of Junior Year:
  - Begin thinking about people with which you work well

- Fall of Senior Year:
  - First 2 weeks is devoted to solidifying teams
  - Groups are not restricted by major!
1. Brainstorm your own project idea
   - Feasible (time, costs, labor?)
   - Interesting and innovative?
   - Talk to faculty
2. Take over a previous team’s project and improve or complete
3. Choose a faculty proposed project
Current Projects

- Titan – A Powered Upper Body Exoskeleton
- Ornithopter
- Sleep Alarm
- Towne Hall Clock
- Tracking and Locking Solar Panel
- CARTer – Autonomous Push Cart
Current Projects

- Towne Concierge Robot
- HydraVita – High Speed Water Sterilization System
- Robotic Rescue Team
- Water Based Robot
- Heliwing
- Rocket UAV Glider
- Bicycle powered water pump
Class Expectations

LECTURE

- First semester dedicated to preparation and planning
  - Lectures on:
    - Patent process
    - Prototyping
    - Risk Management
  - Individual team meetings
- Second semester focused on execution
  - Small weekly meetings with faculty to track progress

DELIVERABLES

- Weekly status reports
- Problem statement report
- Solution sets
  - Brainstorm of all possible solutions to the posed problem
- Execution report
  - Cost breakdown
  - Gantt Chart Scheduling
- Mid-year Presentation
- Final Report
- Senior Design Days
FACULTY

- Professor:
  - Patrick McGinnis
    - 27 years of industry experience in aerospace, defense, and project management
- Small Group Meetings:
  - The entire MEAM faculty is involved and invested
- Advisor:
  - Not required, but EXTREMELY recommended

FUNDING

- $300 budget provided by the MEAM department per student
- Encouraged to search for additional funding/sponsorships
  - ASME
  - Design/Robotics Competitions
  - Weiss Tech House Innovation Fund
  - ASTM International
  - National Science Foundation
  - National/Local companies
My Advice

- Set and clarify team and individual **goals**
- **Be realistic** about goals and progress
- Set aside **time** every week for the project, alone or as a group
- Start **building / prototyping** as early as possible
- Pick a project that **excites** and **interests** you!
{
  p1:
  p2:
  p3:
}
{ }

p1 : People

p2 :

p3 :
{ 
  p1 : People
  p2 : Passion
  p3 : 
}
{ 
    p1 : People
    p2 : Passion
    p3 : Problem
}
People
Passion
Problem
That you hang out with
That you think are awesome
p1 : People
p2 : Passion
p3 : Problem
Passion
Can’t sleep
Something boring
Something boring
That you don’t care about
Do something awesome!
That you care about!
How?
People!
Timing?
Well you already know them...
Well you already know them...
And if you don’t, make friends now!
{ 
  p1 : People
  p2 : Passion
  p3 : Problem
}
@Penn!
@Philadelphia!
@The World!
Talking
Hypothesizing
Building
Demonstrate + Feedback
Hypothesizing
Building
Demonstrate + Feedback
Hypothesizing

Demonstrating + Feedback

Building
1 week cycle?

Hypothesizing

Demonstrating + Feedback

Building
Hypothesizing

1 week cycle?
Small increment changes

Demonstrating + Feedback

Building
What are we working on?
MSE
DID YOU KNOW...

...that you can work with engineers from other majors?
ROTORouter
CIS + ESE
Protecting against Denial of Service attacks

StoRC
MEAM + ESE
Autonomously delivering payloads to a GPS location
HOW DO I DO A MULTI-MAJOR PROJECT?

Project should use skill sets from each major
Dependent on approval from both departments
- Talk to senior design professors
- Have a project idea
BREAK OUT GROUPS