Class Updates

Presentations today

- https://goo.gl/forms/h5NXDvfeeAn7qO333

Weekly Meetings

- http://idealab.asu.edu/aukes_calendar
- Prefer current office hours or Mondays
- Fridays not possible

Project Updates

- From now on, everyone turns in a presentation report, even if they don't present.
- Final report is essentially a regrade of all group assignments. Chance to fix issues from homeworks.

Syllabus Update

Item	Percentage
Group Project	45%
Individual Homework	35%
Participation	10%
Quizzes and Tests	10%

Syllabus Update

Grade	Description
A+	Shows superior effort, quality, mastering of the concepts, and innovation in execution. Documentation is nearly publication-ready.
A	Demonstrates a complete understanding of the problem, and solution is well executed, documented, and presented.
B	Meets expectations. Minor mistakes are permitted, but student demonstrates a general understanding of the concepts. Documentation present but perhaps not comprehensive.
C	Some effort shown, though there may be some critical flaws in thinking or execution. Documentation is present but lacking in critical areas.
D	Minimal effort shown. Does not show understanding and may not have though through their methods. Documentation is severely lacking.
E	No effort shown. No documentation of work

Keen Connection -- Curiosity

Laminate robotics permits students to iterate quickly and investigate new mechanisms using ultra-low-cost, origami-inspired prototyping techniques. Motion can be prototyped via folding, permitting students without the technical, programming, or mathematical background to participate in a development process which is usually reserved for experts in design, simulation, robotics, control, and/or computer science. Through these manufacturing activities, students become motivated to become experts, leaving the class with a taste for the design process and an appreciation for the complexity of robotics. This class will accelerate those prototyping abilities by providing high-performance hardware for class projects as needed.

Creating Value

This course will focus on several real-world application areas (such as mine-clearing, terrestrial locomotion, agriculture, etc) in order to solve problems which laminate robots are better suited to address than traditional robots. These applications will be pitched by both instructor and student during the first few weeks. Each application should share core challenges in design, analysis, modeling, and experimentation, requiring teams to simulate, prototype, and test early and often. Applications should have a real-world connection in which traditional robot solutions have failed, or not yet been developed. Laminate robots, fabricated at low cost and with fewer moving parts, are more resilient to dirt, dust, and damage while lowering the impact if something does indeed break. Selected applications should also consider laminate robots' ability to operate in parallel to improve the health, safety, and security of high-risk areas around the world.

Connections

This class will connect students to opportunities in a way other classes don't. Whether its attached to the human body, out in the desert, or in an office, we will test projects in their native environments to help identify core design challenges related to their selected application. This will help focus designs early and to motivate how to address the real challenges of making robots solve "real world" challenges. In addition, this course will host guest lectures from several ASU faculty working on these concepts, as well as a special guest lecture from an industrial partner.

Overview So Far:

Syllabus, Introduction

- Project constraints will help focus teams and contribute to success. Closing off some of the infinite space of design choices helps eliminate arbitrary decisions

Laser Cutting Tutorial

- **Connections:** The introduction of a set of potentially familiar techniques for designing in solidworks, with a mindset towards rapid prototyping helps students see how eliminating steps in the CAD design process can make it possible to create prototypes faster, and the value of that
- **Curiosity:** We preview how popupCAD works with this workflow, show them the website, and encourage them to install and learn more via the tutorials online
- **Creating Value:** The technical skill of rapid prototyping facilitated by a design workflow that enhances speed means that students can spend more time focused on what matters: the design!

Biomechanics

- **Curiosity:** We show a variety of videos from the biomechanics field that are as of yet un-answered in robots. The point is to inspire them that not all problems are solved
- **Connections:** The field of biomechanics is rich. This overview of the field shows students the potential for creating new robotic platforms by jumpstarting their creativity with animal templates to start from.
- **Creating Value:** By showing existing bio-inspired robotic platforms, we show how biology has solved problems naturally, as well as identifying problems which are already solved, and those with potential because there is a solution in nature waiting to be tried on a robot.

Project Pitches

- **Curiosity:** Students share the problems important to them and introduce others to the background
- **Connections:** Students propose how their understanding of what foldable robotics is will help them solve a problem
- **Creating Value:** Student pitches are meant to engage other students and show them the value of solving their problem. Students see the possibilities if a particular problem is solved

Foldable Robotics Background

- **Curiosity:** I document the history of foldable robotics and discuss many of the side-roads this research has led. Hopefully this encourages students to seek out some of that research on their own to learn more
- **Connections:** The history of foldable robotics can teach us a lot about things that have worked, and perhaps the reasoning for why we are where we are. It also helps establish connections to the biomechanics topics already discussed
- **Creating Value:** The value here is that students see how some devices have persisted and become true platforms for study or commercial products, and those which have not. We should discuss the attributes of successful, well-implemented research and products and how they can integrate those same attributes in their own projects

Python

- **Curiosity:** Many people are curious about learning Python but need an excuse to switch to this language. I will whet their appetites with a grab-bag of useeful syntax and packages that can make their coding experiences go faster.
- **Connections:** Show those templates in use in existing packages, and how by adopting a "Pythonic" way of writing code matches the mentality of rapid prototyping in foldable robotics.
- **Creating Value:** Show students relative hireability of people with Matlab vs Python programming experience, lists of companies that seek python developers

Kinematics

- **Curiosity:** Show lots of videos of origami inspired mechanisms doing things other than folding *shape*
- **Connections:** Demonstrate the connection between kinematics and origami / folding, joints and folds, links and paper. Helps cement why informal methods are useful design and prototyping tools
- **Creating Value:** There are no good tools out there that permit one to compute the path of a complex mechanism, analyze its motion, and calculate forces without a lot of "click" overhead.(So many menus, so many user interfaces to learn that efficiency, and interest, goes way down). This workflow will introduce students to how to visualize and compute the performance of mechanisms quickly and easily.

Forces, Torques, Motors

- Curiosity: Students learn robotics terms in the context of foldable, laminate devices, and get to solve forces and torques they need to implement their project
- Connections: This module directly connects the motion computations they did with kinematics to traditional robotics concepts
- Creating Value: Being able to select and specifiy a motor is useful both in academic and industry-focused careers. Getting to this point means students are more hireable in whatever context.

Foldable Robotics Code

- **Curiosity:** We go through examples of using computational solid geometry to solve some problems that are typically hard. the homework assigned permits them to explore how to use it to solve a new problem
- **Connections:** CSG logic has connections to the traditional rules of logic, geometry, image processing, etc. We will discuss those connections and how it is applied to solve problems in laminate manufacturing
- **Creating Value:** This is the underlying logic of popupCAD. Students now will be able to script their own manufacturing tools!

Foldable Robotics Algorithms

- **Curiosity:** We go through examples of using computational solid geometry with scripting to solve even tougher problems. We will look under the hood of popupCAD to see how it is implemented, and then repeat it in simple scripts.
- **Connections:** CSG within algorithms can permit a wide range of problems to be solved across manufacturing. We will discuss some of the open issues stilll with popupCAD and the research community
- **Creating Value:** The assigned homework will challenge them to solve one of those unmet needs. I will discuss open-source platforms like github and encourage them to share their work back to popupCAD and the foldable robotics scripting I provide.

Laminate Fabrication Lab

- Curiosity: Students finally get to make the things they have been computing throughout the cours
- Connections: Finally, there is a physical thing students can hold which permits them to understand all the manufacturing they have ben learning
- Creating value: Students finally have the entire workflow to be able to create a laminate, foldable, origami inspired device through fabrication. This lab is essential to close the loop

Coming up

- Mechatronics
- Beam Bending
- Dynamics
- Entrepreneurial Mindset
- Guest Lectures