ME/CS 133(a): Final Project Guidelines

(Fall 2017/18)

I. Overview

Instead of taking a written final exam, which will be a 5 hour open-notes take-home exam, students can optionally pursue a final project. Below are some suggestions for the ME/CS 133(a) final project. However, you need not follow any of these suggestions for your project. Group projects are allowed with consent. The quality and scope of a group project should be proportional to the number of students involved.

Note that ME/CS 133(b) will have a "larger" final project requirement. Thus, some students may wish to choose a project that can be continued into the next quarter.

The final project might take one of the following forms:

- Analyze a mechanism or linkage.
- Construct a model of a mechanism or linkage. For complex mechanisms, the construction itself may be sufficient. Simpler mechanisms would likely be accompanied by some analysis.
- Geometric/Kinematic simulation of a linkage.
- Development of kinematic software.

II. Project Suggestions.

Listed below are some project suggestions. This is not an exhaustive list of ideas. It is only meant to stimulate your creativity.

Mechanism Analysis Projects

- Develop some notion of the inverse kinematics for the 5 degree-of-freedom "Armatron" manipulators model. One needs to be clever about how to define its inverse kinematics.

Simulation Projects

- Develop a graphical simulation of the elbow manipulator using Mathematica, MATLAB, or another other software environment. Given trajectories for the joints angles, and then graphically display the movement of a simple physical model of the manipulator. Optionally, let the user of your software define a goal, and then have your system solve the inverse kinematic problem and move the system to the goal.
- Graphically simulate the operation of a multi-speed planetary gear car transmission.

- Simulate the Theo Jansen walking mechanism (see below)

Kinematic software

- Previous students have successfully developed software that will symbolically derive the forward kinematic equations and manipulator Jacobian matrix, given the Denavit-Hartenberg parameters of a manipulator mechanism.
- Implement the "guts" of a motion capture system–given N points on a rigid body and *velocities*, determine the net displacement of the rigid body between frames, and the velocity of the object in one frame.

Mechanism Construction

- Construct, and analyze, a geared 6-bar planar mechanism.
- Simple "passive" walking machines (which don't required any actuators to move downhill) are a lot of fun. This web site might give you some ideas:

  http://ruina.tam.cornell.edu/research/topics/robots/index.html.
- Build and analyze a model of the Theo Jansen *Strandbeest* walking mechanisms. A starting point for more information is: *http://www.ted.com/index.php/talks/view/id/162* , as well as *http://www.strandbeest.com.*

III. Final Project Grading: Since the possibilities for the final project are quite varied, the details of how I grade your project will vary with the style of the project. However, the write-up of each completed project should consist of at least:

- **A summary** that details the nature of the project, the motivation for the project, the scope of the project, and the approach taken to solve the project.
- **The details** of how the project was solved. This might consist of analytical derivations, software flow charts, etc.
- **The "output"** of the project. This will consist of a piece of hardware, a simulation (which is captured by images and code), or a set of equations or analyses.
- **A conclusion** that summarizes the project shortcomings and possible future improvements.

Students who do not pursue one of the suggestions should discuss their project ideas with me before starting so that we can define an appropriate project scope.

IV. Final Project Time Table: Due on the last day of finals week (5:00 p.m.)