Automated Machine Design Synthesis	Homework 3	Due Time: 11:59pm, Feb 25

This homework assignment is long, start early, do not procrastinate!

Submission Rules

All submissions should be submitted by the start of class (11am, local time) on their due date as a zip file titled "LastName_HW_HW#.zip" where "LastName" is your last name and "HW#" is the current homework assignment that you are submitting. Any part of the assignment that is not code should be computer generated (*neatly* drawn and scanned images embedded within the PDF are acceptable) and compiled in a PDF that is included INSIDE of your zip file. Any code submitted should have all the necessary dependencies in your zip file as well.

1 Create a Voxel - Coding - (5 pts)

Write code that automatically generates your "myODEfn.m" file, see the expanded HW 2 hint and the generateEqns.m hint. This should be organized to allow placing "voxels" of 4 or 8 point masses (2D and 3D respectively) and all connections anywhere in the world space. This problem will have no answer in your PDF, just include your code in the zip file.

2 Create Video - Coding - (5 pts)

Write code that creates a 2D or 3D movie of your simulation (depending on whether you are simulating in 2D or 3D). Consider using plot3 or scatter3 for plotting. Also allow your springs to be plotted with a line or dashed line and allow this feature to be easily enabled and disabled. This problem will have no answer in your PDF, just include your code in the zip file.

3 2D Voxel Analysis - Written Response - (10 pts)

Use your code to simulate the following structure:

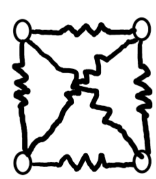

Figure 1: The layout of springs which connect four point masses to create a 2-dimensional voxel.

Change the value for the dash pots, springs, and masses so that the spring-mass pair are "reasonably well-damped". Consider using the critical-damping criterion when selecting the damper value. Why? Try simulating with no damping at all. Does it "work" with varying levels of initial disturbances? Why or why not? Show some (MATLAB-generated) plots of the system (just visualize the positions of the point masses, and maybe draw some dashed lines to show where the springs are) before, during and after the applied force. Choose "interesting" or informative times to plot the system. Include a plot of a single point mass's position vs time to demonstrate your system's damping. In this 2-D problem the two bottom points are fixed, and no gravity. I'm looking for plots of Y and X vs time, on the same plot of one of the upper point masses for initial displacements/velocities that affect that point mass. (Not looking for 2D plots or spring visualizations in this one).

4 Create a Row of Voxels - Coding - (10 pts)

Now make a row of three voxels, each having direct contact with its neighbor (see Figure 2). The springs that are shared should have an average of each voxel's spring coefficient (same principle applies for dash pots). Again, play with different displacements and ensure that they system behaves as you expect and show a few plots at various times. This is a 2-D problem, use the masses, k, b, from problem 3 that worked "best" and justify.

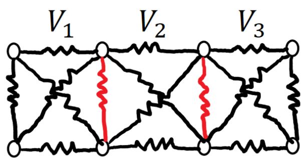

Figure 2: 3 voxels in a row (V_i, $i \in 1, 2, 3$). The red springs are shared between voxels and should have an average spring constant of $(k_i + k_{i+1})/2$.

5 3D Array of Voxels Analysis - Video Response - (10 pts)

Include in your zipped folder a video of the response of your simulator to each of the two cantilever beam test cases:

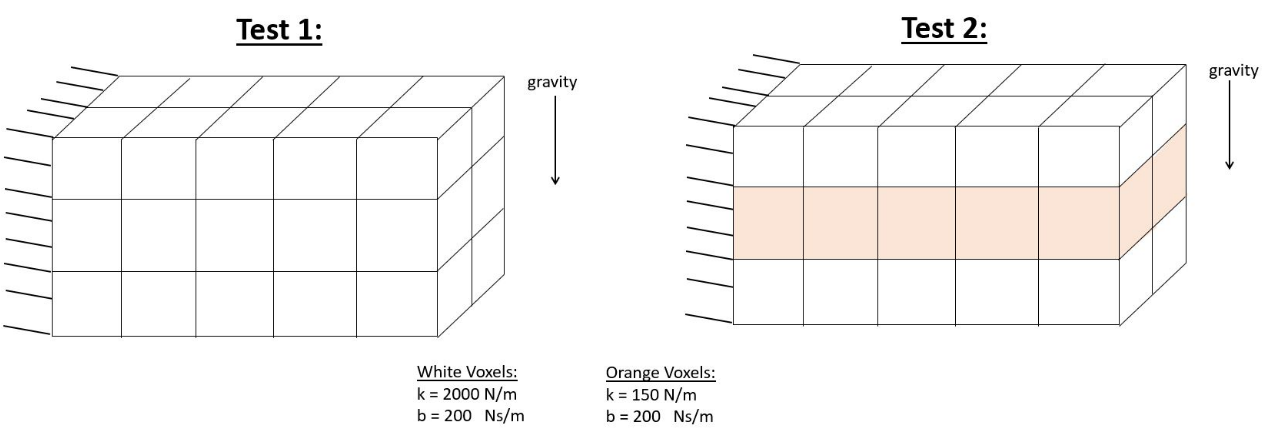

Figure 3: Each cube is a voxel with 8 point masses.

With each point having a mass of 1 kg, separated from its neighbor by 1 meter, gravity is 9.8, and each voxel is comprised of 8 point masses all interconnected (27 connections per voxel).