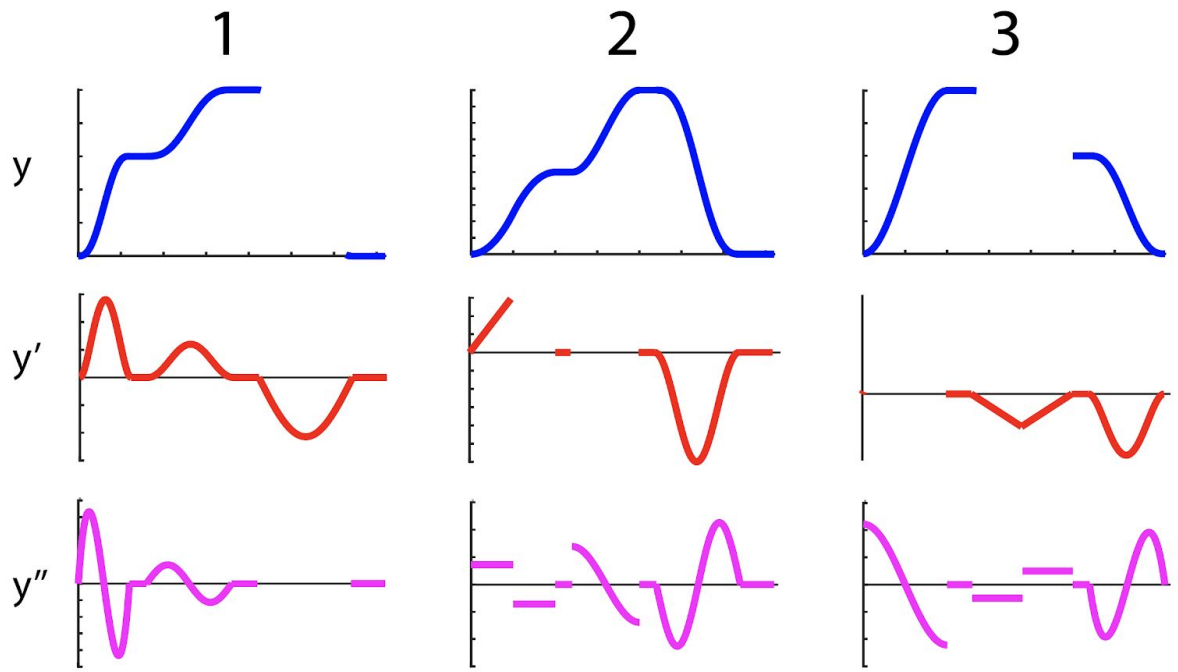
MAE 292 Spring 2020 Homework 3

Due on Friday April 24, 2020, at 11:59 PM

Problem 1: Sketch cam profiles (10 points)

Fill in the missing portions of the position, speed, and acceleration curves. You do not need to be exact but should be able to show the relative details of each missing piece.



a. Draw the missing pieces on the position, velocity, and acceleration trajectories.
b. For each of the three follower profiles, describe the sequence of cam motions as a list in order from left to right the type of movement (example: cycloidal rise, dwell, linear rise, 3-4-5 polynomial fall).

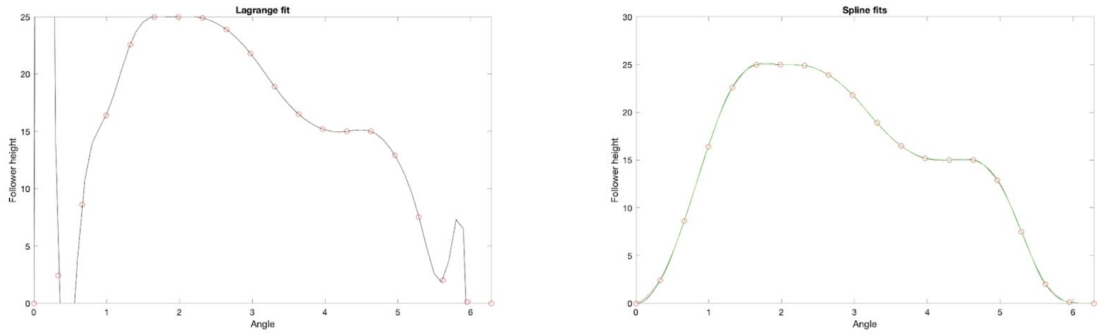
Problem 2: Reconstruct a cam surface profile from follower data (40 points)

We have to fabricate a new cam. All we have is a set of waypoints for the follower motion which are given below. The cam rotates once every 20s.

Time (s)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Height (inch)	0	2.4	8.6	16.4	22.6	25	25	24.9	23.9	21.8	18.9	16.5	15.2	15	15	12.9	7.5	2	0.1	0	0

In matlab:

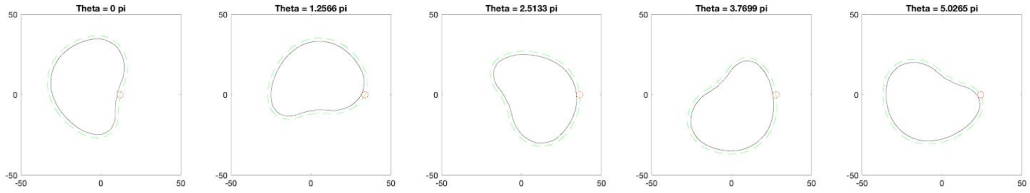
a. Plot the follower height versus rotation angle for the cam.
b. Construct a lagrange polynomial fit that passes through every point. Plot the fit with the data, make the lagrange polynomial a black line and the data points red circles.
c. Make a spline fit that passes through every point. Use both methods described in class (spline and pchip). Plot the fit with the data, make data points red circles and the pchip fit a green line, and the natural spline fit a black line.



(your plots should look like this)

The follower radius is R = 2 inches and the prime circle radius R_p = 10 inches

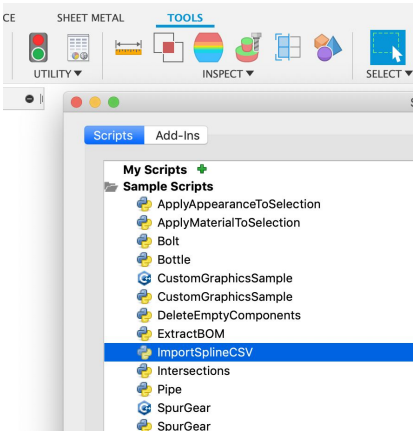
d. Using the pchip generated fit of the follower trajectory, generate a plot of the pitch curve and the cam surface profile. Make the pitch curve dashed and the cam surface solid. Plot this data over the angles $\theta = 0 : 0.1 : 2\pi$.
e. In a series of five horizontal subplots, plot the pitch and cam surface curves at the rotation angles $[0, \frac{1}{8}, \frac{2}{8}, \frac{3}{8}, \frac{4}{8}] * 2\pi$. Also draw the follower at the right location as a red circle. (Hint: use the homogeneous transformations from assignment 1).



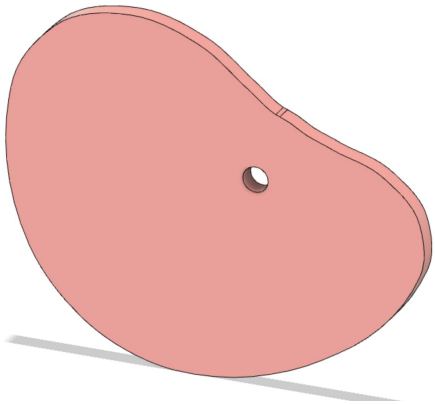
(Your plots should look the same as above. Please use the axis([-50,50,-50,50]) and daspect([1,1,1]) commands for each plot to properly show size)

Problem 3: Draw the cam in Fusion 360 (10 points)

a. In matlab export the cam surface profile (x,y) coordinates to a comma separated file using the following command writematrix(xyz_points, 'cam_points.csv'). You will have to add a third column of points for the z coordinate (z = 0).
b. In the tools option in Fusion 360 use the ImportSplineCSV script to import your cam profile.

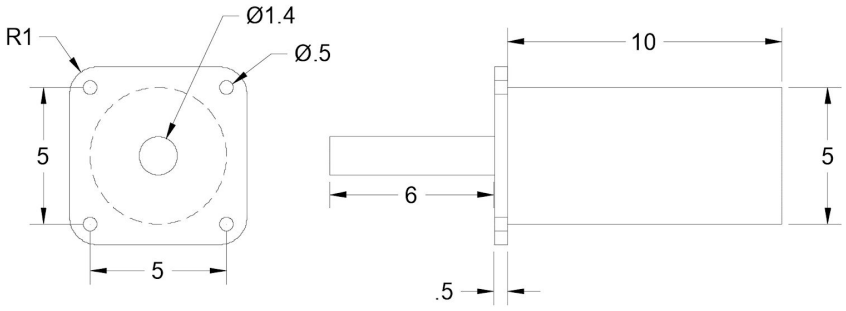


c. Close the spline and extrude the cam to a thickness of 1 inch and place a 1.4” diameter hole at the center point of rotation of the cam.

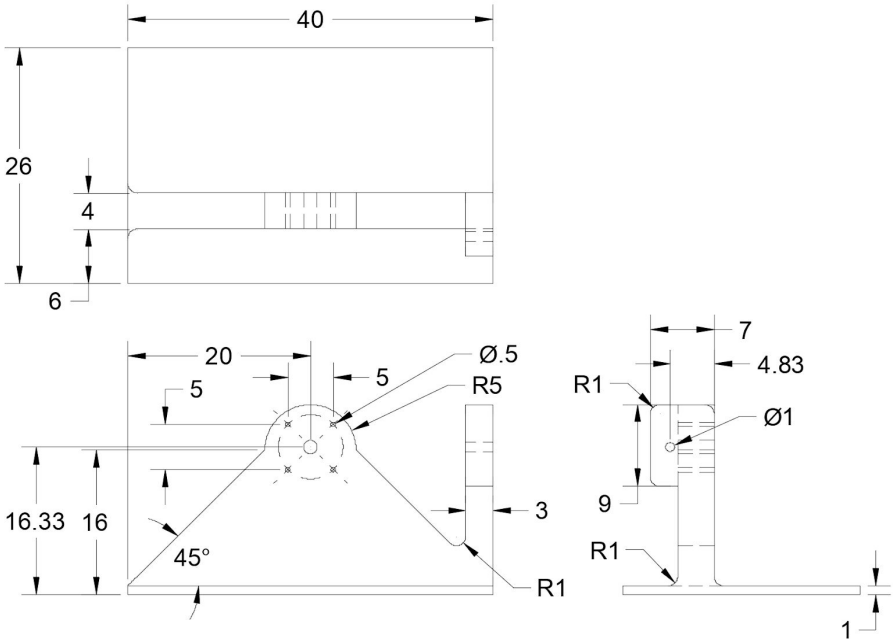


Problem 4: Create the rest of the components (20 points)

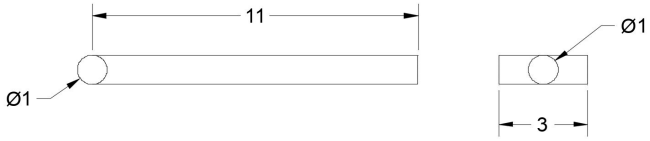
Part 1: Motor



Part 2: Support base



Part 3: Follower



Problem 5: Build the final cam-follower assembly (20 points)

Be sure to use the correct joints for the required motion. The follower should slide within the support-base hole and the cam should rotate about the motor shaft.