MIE301 – Lab 1 2022

Due: PRA0101: Sep 29, 4 pm, PRA0102: Oct 6 ,4 pm, PRA0103: Sep 26, 4 pm, PRA0104: Oct 3, 4 pm. One week after your assigned lab session on Quercus at 4 pm..

Example: for lab session on Thursday, the submission due time is next Thursday at 4 pm. Penalty will be given for late submission.

TA: Boran Kumral (boran.kumral@mail.utoronto.ca)

- Please include MIE301 Lab3 in the email subject

Before starting this lab, you must complete the pre-lab review sheet. During your Practical computer lab, the TA will go through this pre-lab as a brief introduction to using MATLAB.

This introductory MATLAB programming problem will cover basic calculations and visualization of mechanism motion in an animated and printed form. You will visualize the motion of two simple mechanisms.

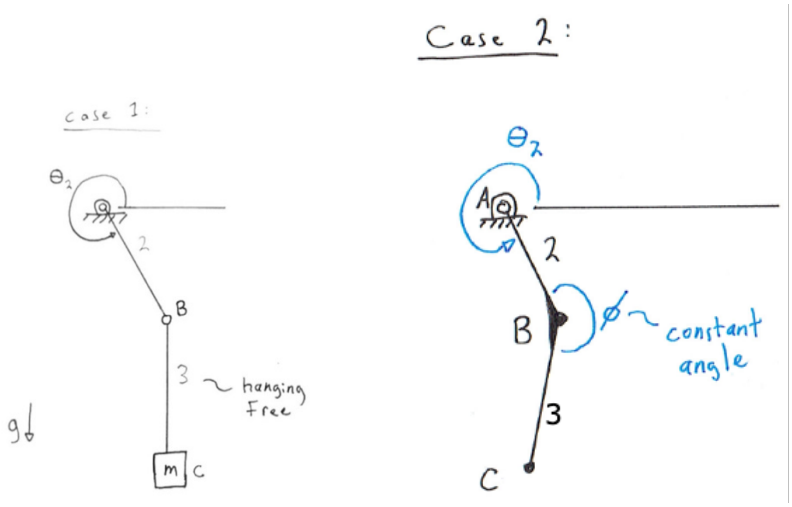
Report: Labeled figures and answers to parts a-e, following the report template.

Submission: Upload to the following files directly to Quercus:

report.pdf lab1_case1.m lab1_case2.m

Note: lab1_case1.m and lab1_case2.m should include all the MATLAB code that you use to answer the questions and generate the figures for each case. The MATLAB files should be clearly annotated, executable section by section and report no errors without any modification by the TA. Penalty will be given if non-executable code is submitted.

The given code (lab1_starter.m file on Quercus) simulates the rotation of a single link (link 2) about a fixed pivot (point O). In this assignment you will add to the code to simulate the two cases shown below. In case 1, link 3 hangs free under the influence of gravity. In case 2, the link 2 is extended out to point C with a rigid connection. There is a motor at the base of link 2 which rotates link 2 at a constant rate.



Figures not drawn to scale.

Report deliverables: Labelled figures and answers to parts a)-e)

a) Two figures (one figure for each case) showing the mechanism in the final configuration ($\theta_2 = 320°$), with the path of points B and C traced out from initial to final configuration.
b) The same motion from part a) but this time, include 5 configuration ($\theta_2 = 0°, 80°, 160°, 240°, 320°$) on the figure to visualize the motion like in this image.
c) For each case, use only N=6 equal-distanced data points ($\theta_2 = 0°, 64°, 128°, 192°, 256°, 320°$) to plot the path of points B and C. Repeat with N=10 and N=20.
Compare the figures with what you got with part a) and answer this question: how many datapoints are needed to get a good approximation of the motion and why?
d) Answer this question: what is the shape of the path traced out by point C in each case?
e) Answer this question: in case1, the angle between the two links is a function of θ_2. Derive a formula for this angle.

Notes/hints:

- θ_2 should rotate from 0 to 320°.
- In case 1, link 2 should be 8 cm long, while link 3 is 4 cm.
- In case 2, the link 2 (AB segment) is 4 cm long and link 3 (segment BC) is 8 cm.
- The constant angle ϕ should be equal to the last two digits of your student # in degrees (tell us what that number is in your report).
- For case1, draw the mass at C as a box using the Matlab command rectangle().
- All points and curves should be labelled. You can do this with Matlab commands (such as text()).
- Place the coordinate origin at point A with positive *x* direction to the right and positive *y* direction upwards.
- To draw point C in case2, calculate the *x* and *y* coordinates of point C using trigonometry. Start from point B.
- Try the command axis equal

Feeling confident? (optional advanced problem): make a third figure for a mechanism similar to case1, but with a motor at point B which rotates link 3 at a constant rate 80% that of $\dot{\theta}_2$. Draw the stick diagram and include the plot of motion.

Marking Rubric:

	2 pt	Report is clearly organized
	2 pt	Figures are properly formatted, with labels and units
	4 pt	Motion plotted is correct and shows what we asked for
	2 pt	Answer to questions