Coursework 2 (20% of the total marks for this course, 10% on part 1 and 10% on part 2)

DEADLINE: 11:55 pm, 30 November 2022

This coursework has two parts.

Part one – Essay (10%)

Write an essay on one of the following topics

Topic 1: Comparison of electric bicycles (e-bikes, eBikes) with cars by considering health, energy, environment, safety, efficiency, functions, value, sustainability, traffic jams, net-zero targets, etc

Topic 2: As rise of robotics, will robotics human in the future?

Topic 3: In your view, how to help human understand robots?

Your team is required to produce an essay (max 10 pages).

Your essay may have the following contents

Introduction and motivation

Problem statement - Identification of challenging issues (research gaps) through the state o art literature review

Methodologies of classification of the past and current work and their impact

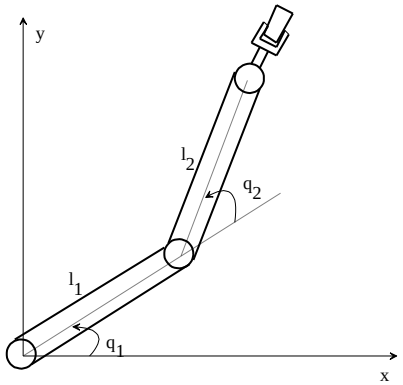
Identify and present the future work

Analysis and discussion of your finds

Conclusion and future works

Part Two (10%)

A two-link robot shown in the Figure. The parameters of the robot are given in the Table.



Parameter	Meaning	Value without payload	Value with payload
1_1	Length of link 1	0.432 m	0.432 m
1_{c1}	The distance from the joint position 1 to the center of mass of link 1	0.216 m	0.216 m
m_1	Mass of link 1	15.91 kg	15.91 kg
I_1	Moment of inertia of link 1	0.247 khm^2	0.247 kgm^2
1_2	Length of link 2	0.432 m	0.5 m
1_{c2}	The distance from the joint position 2 to the center of mass of link 2	0.216 m	0.4 m
m_2	Mass of link 2	11.36 kg	20 kg
I_2	Moment of inertia of link 2	0.177 kgm^2	0.68 kgm^2

Tasks:

1) Developing the equations of motion for the two-link robot using both Newton approach and Lagrange approach
2) Developing a simulation model using Matlab/Simulink. You can try to calibrate your robot model to make sure that the simulation model you developed is working.
3) Designing a computed torque control law to control the robot model developed in 2). In this step, assume that the parameters of Link 2 are not changed, i.e. the robot dose not carry a payload. You may consider to use various inputs, e.g. step inputs, square inputs, sine wave and their combinations. Plot your results and provide your analysis
4) Assume that the robot picks up a payload at a time t=2 [s], then the parameters affected by the payload change to m_2=31.36[kg], I_2=0.88[kgm^2], l_2=0.5[m], and l_{c2}=0.4[m] after t=2[s]. Simulate your model using the control law you used in 3). Do you still obtain the satisfactory results? If not, why?
5) You may consider to adopt the approaches such as adaptive control, robust control (e.g. “Robust Combined Adaptive and Variable Structure Adaptive Control of Robot Manipulators”) to overcome the parameters changes. (this is a optional task to challenge you).