Robotic Manipulators Project: Step #4

ECE 9053A "Robot Manipulators"

Fall 2024

Objective

The purpose of this step is to implement the dynamic equations of motion and design a control algorithm for the manipulator chosen in Step #1, within the workspace created. Include any scripts or procedures used to develop the controller and tune the gains and describe the steps that were implemented in order to evaluate it. Include any figures required to show the results obtained. You can use any of the scripts already developed as part of previous project steps.

Instructions

1. **Cover page.** List project title and student name.

   Recommended length: 1 page

2. **Dynamic Equations of Motion - calculations:** Compute the dynamic Euler-Lagrange equations of motion of your manipulator. Assign your own physical parameters for the location of the centres of mass of each link, the mass of each link and the inertia of each link.

   Recommended length: 2 – 3 pages

3. **Dynamic Equations of Motion - implementation:** Create a MATLAB function for the dynamic equations of motion. Show that for a few given inputs (joint torques), the model generates response in the form of robot motion (positions and velocities). Discuss whether the results make sense or not and explain why.

   Recommended length: 1 page, plus scripts in the appendix.

4. **Control System Design:** Design an inverse dynamics control algorithm and implement it in Matlab/Simulink using the arm's dynamic model developed above. Recommended length: 2 pages

5. **Control System Simulation:** Simulate the motion of the controller arm along the trajectory selected in Step #3, and incorporate a time scale so that the velocity of the motion is known. Provide all the relevant plots for the joints (position, velocity, torque, etc.). Discuss the results obtained.

   Recommended length: 2 – 3 pages

Evaluation

- Marks will be assigned on the basis of originality, correctness of solution, thoroughness and clarity of presentation.
- Present all MATLAB scripts developed as an appendix. Add comments to the scripts to explain what each command does. Include all figures necessary to assess the effectiveness of the methods implemented.

Warnings

Scholastic offences are taken seriously, and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_grad.pdf. This report will be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (http://www.turnitin.com).

You must write your report in your own words. Whenever students take an idea, image, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Please note that this includes software code. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

Reports

Project reports are due on **December 15th, 2024, 11:59pm**, and should be submitted electronically through OWL (section "Assignments"). Reports are to be completed individually. No group work is allowed.