THE DEPARTMENT OF AUTOMOTIVE ENGINEERING

CLEMSON UNIVERSITY

AuE 8220: Autonomy: Mobility and Manipulation, Fall 2022

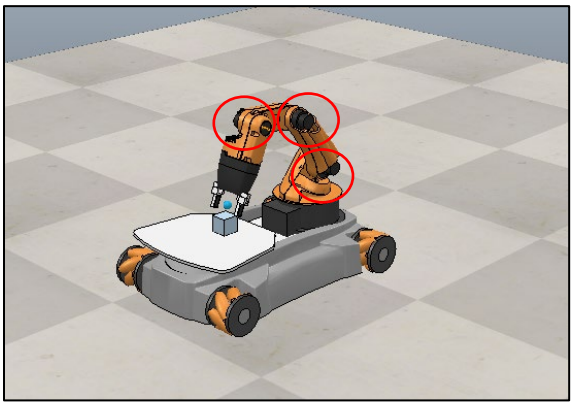
Homework #4: Mobile-Manipulator Kuka YouBot Control using CoppeliaSim-Matlab Interface

Assigned on: October 13th, 2022, Due: October 21st 2022, 1:00 PM

Instructions:

You will attempt all subsequent homework problems and software project together with your selected team-member for the rest of the course. Submit your scanned/printed work as a single ZIP file (include code, PPT/PDF anything relevant) on Canvas by the due date/time noted above.

Problem 1



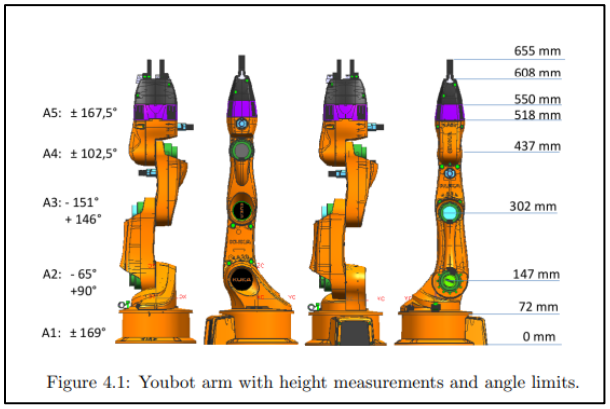


Figure 4.1: Youbot arm with height measurements and angle limits.

Image Source: https://www.merlin.uzh.ch/contributionDocument/download/6684#:~:text=The%20arm%20of%20the%20KUKA,to%200.5%20kg%20in%20weight.

Joints marked on the Kuka Arm in the diagram represent θ_1, θ_2, θ_3 respectively. Base joint and the gripper joints also rotate and, translate but for this assignment you would be working only on planar problems.

1.A) Given a base model of Kuka YouBot as shown, make the **mobile platform** travel 5 m in a straight line at a speed of 0.1 m/s.
1.B) Now, once it reaches the destination, make the **mobile platform** rotate on the spot at an angular rate of 0.5 rad/s.

1.C) For the same model, make the robot Kuka arm end-effector travel in a straight line
1.D) Next, make the Kuka arm end-effector travel a semi-circular trajectory of radius maximum possible radius (Planar condition). (Hint: Refer https://www.researchgate.net/publication/341813494_Low-Cost_Automation_for_Gravity_Compensation_of_Robotic_Arm to get an idea on the kinematics of the arm)

In separate graphs for all problems 1.A through 1.D, plot (i) X vs t (ii) Y vs t (iii) X vs Y. Problems 1.C and 1.D: plot all the joint angles vs t in a single graph for each problem. You can use CoppeliaSim or Matlab to obtain your graphs.

Bonus points: Additional bonus points would be awarded if you can integrate the use of Peter Corke's Robotics Toolbox functions.