Sharif University of Technology
Department of Electrical Engineering

Introduction to robotic systems
Assignment 2

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Problem 1: Consider a circular unicycle robot with diameter of 50cm. Assume that the robot is initial located at

$$[x(0), y(0), \theta(0)] = [0, 0, 0]$$

The maximum linear and angular velocities of the robot are 2m/s and 1rad/s.

a. Implement mathematical model of the robot in Matlab-Simulink and verify it numerically. Simulate with fixed integration steps and $T_s \leq 0.01$s.
b. Find and implement a control law such that the robot is placed at $[x_d, y_d, \theta_d] = [2, 2, \pi/4]$. Here, x_d and y_d are in meters and θ_d is in radians. Plot $x(t), y(t), \theta(t)$. Plot y in terms of x in a single diagram. Observe edges of the path.
c. Repeat part b. with $[x_d, y_d, \theta_d] = [-1, 0, \pi]$.
d. Repeat part b. with $[x_d, y_d, \theta_d] = [2, 2, -\pi/4]$.
e. Repeat part b. with $[x_d, y_d, \theta_d] = [4, 2, 0]$ such that the robot does not hit the obstacles $A, \cdots E$ shown in Fig. 1. Try to minimize the number of path edges together with total path length.

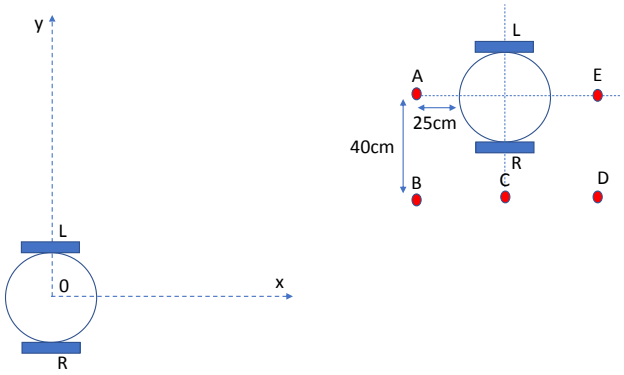

Fig. 1. Unicycle for part e.
