ECE 111 - Homework #3

Math 105: Trigonometry.   Due Monday, January 29th
Please submit via BlackBoard

Polar to Rectangular Conversions

1) Determine the final position of A: (x,y)

$$A = (22\angle 77^0) + (17\angle - 38^0) + (12\angle 19^0)$$

2) Determine final position of B: (x,y)

$$B = (5\angle 2^0) + (22\angle 28^0) + (20\angle 55^0)$$

3) Where is B relative to A

- In (x,y) coordinates
- In polar coordinates

i.e. What is B - A?

Plotting Polar Functions

4) Plot the following functions in Matlab for $0 < \theta < 6\pi$

- Note: plot() plots in cartesian coordinates. Each function needs to be converted from polar to rectangular.

a) $r = \sin(\theta - 1)$

b) $r = \theta^3/7000$

c) $r = \theta(\theta - 6\pi)$

Robot Tip Position (Forward Kinematics)

A 2D robot has three arms with lengths of {0.5, 0.6, 0.7} meters. The final tip positionis

$$x_1 = 0.5\cos(\theta_1) \qquad\qquad y_1 = 0.5\sin(\theta_1)$$

$$x_2 = x_1 + 0.6\cos(\theta_1 + \theta_2) \qquad\qquad y_2 = y_1 + 0.6\sin(\theta_1 + \theta_2)$$

$$x_3 = x_2 + 0.7\cos(\theta_1 + \theta_2 + \theta_3) \qquad y_3 = y_2 + 0.7\sin(\theta_1 + \theta_2 + \theta_3)$$

5) Plot the tip position (x3, y3) for

$$\theta_1 = 77^0 \quad \theta_2 = 4^0 \quad \theta_3 = -75^0$$
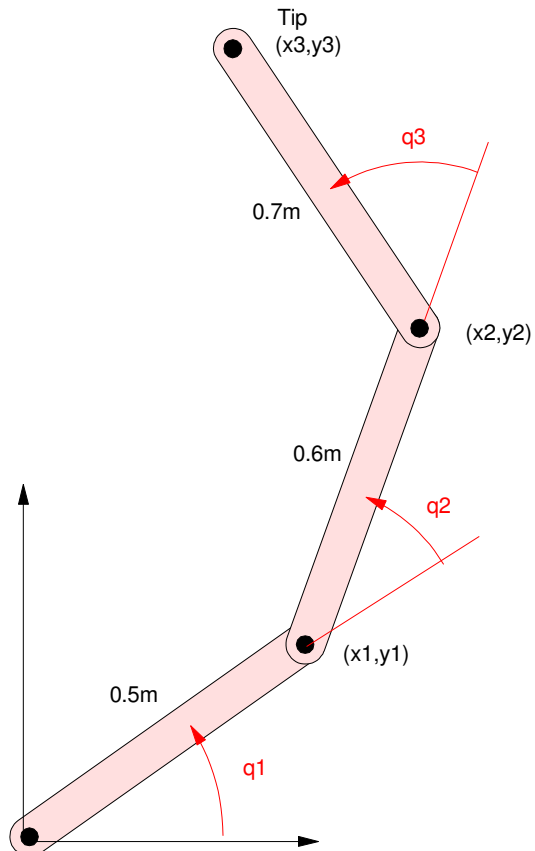
6) Plot the tip position (x3, y3) for

$$\theta_1 = 127^0 \quad \theta_2 = -53^0 \quad \theta_3 = 118^0$$

Robot Tip Position (Inverse Kinematics & fminsearch())

7) Write a Matlab function which

   - Is passed the angles $(\theta_1, \theta_2, \theta_3)$,
   - Computes the tip position, and
   - Returns the distance from the tip position and point (x = 1.2, y = 1.2)

8) Use the fminsearch() to determine the joint angles which place the robot at (x3 = 1.2, y3 = 1.2)

Problem 5-8: 2D Robotic Arm