ECE 111 - Homework #3

Math 105: Trigonometry.   Due Monday, September 11th
Please submit via BlackBoard

Polar to Rectangular Conversions

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

$$A = (10\angle 20^0) + (5\angle 65^0) + (3\angle -15^0)$$

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

$$B = (5\angle 45^0) + (7\angle -60^0) + (2\angle 90^0)$$

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) $r = \cos(\theta + 1)$

b) $r = \theta^2/400$

c) $r = \ln(\theta + 1)$

Robot Tip Position (Forward Kinematics)

A 2D robot has three arms with lengths of {1, 0.9, 0.8} meters. The final tip positionis

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

$$x_2 = x_1 + 0.9\cos(\theta_1 + \theta_2) \qquad y_2 = y_1 + 0.9\sin(\theta_1 + \theta_2)$$

$$x_3 = x_2 + 0.8\cos(\theta_1 + \theta_2 + \theta_3) \qquad y_3 = y_2 + 0.8\sin(\theta_1 + \theta_2 + \theta_3)$$

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

$$\theta_1 = 45^0 \quad \theta_2 = -70^0 \quad \theta_3 = -100^0$$

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

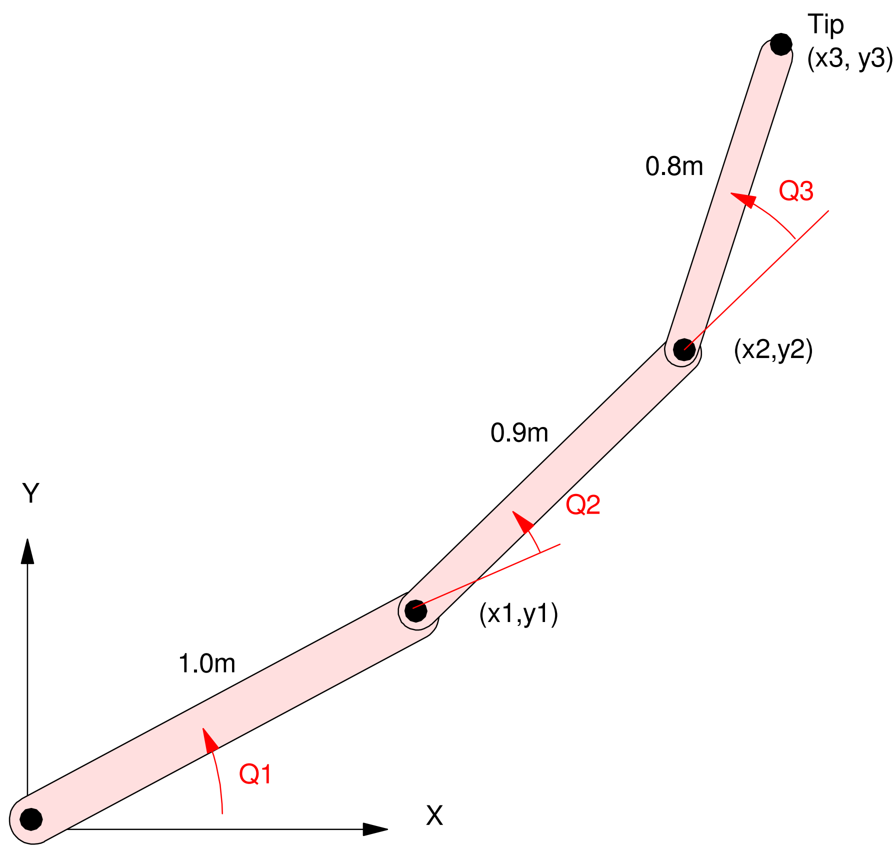
$$\theta_1 = 135^0 \quad \theta_2 = -70^0 \quad \theta_3 = -45^0$$

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 (x = 1.2, y = 1.2)



Problem 5-8: 2D Robotic Arm