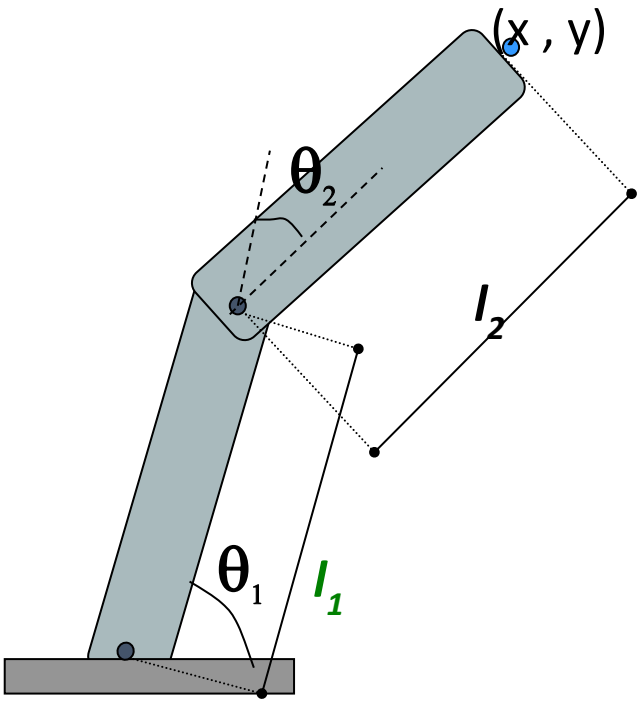
Robotics Homework #8



Consider the planar manipulator shown above where

$\theta_1 = \exp(0.2t)$ and $\theta_2 = \exp(0.1t)$ (angles measured in radians, t measured in seconds, moving counter clockwise)

l1= 2 meters and l2 = 1 meter

What will be the values of X and Y after 2 seconds?

What will be the values of $\dot{X}$ and $\dot{Y}$ after 2 seconds?

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HOMEWORK 08

$a_1 = l_1 = 2 \qquad \theta_1 = e^{0.2t}$
$a_2 = l_2 = 1 \qquad \theta_2 = e^{0.1t}$

$$x(t) = a_1\cos\theta_1 + a_2\cos(\theta_1+\theta_2)$$
$$= 2\cos(e^{0.2t}) + \cos(e^{0.2t} + e^{0.1t})$$
$$x(2) = 2\cos(e^{0.4}) + \cos(e^{0.4} + e^{0.2})$$
$$= -0.752$$
$$y(t) = a_1\sin\theta_1 + a_2\sin(\theta_1+\theta_2)$$
$$= 2\sin(e^{0.2t}) + \sin(e^{0.2t} + e^{0.1t})$$
$$y(2) = 2\sin(e^{0.4}) + \sin(e^{0.4} + e^{0.2})$$
$$= 2.409$$

$$J = \begin{bmatrix} -a_1\sin\theta_1 - a_2\sin(\theta_1+\theta_2) & -a_2\sin(\theta_1+\theta_2) \\ a_1\cos\theta_1 + a_2\cos(\theta_1+\theta_2) & a_2\cos(\theta_1+\theta_2) \end{bmatrix}$$
$$= \begin{bmatrix} -2\sin(e^{0.4}) - \sin(e^{0.4}+e^{0.2}) & -\sin(e^{0.4}+e^{0.2}) \\ 2\cos(e^{0.4}) + \cos(e^{0.4}+e^{0.2}) & \cos(e^{0.4}+e^{0.2}) \end{bmatrix}$$
$$= \begin{bmatrix} -2.409 & -0.415 \\ -0.752 & -0.910 \end{bmatrix}$$

$$\begin{bmatrix} \dot{x} \\ \dot{y} \end{bmatrix} = J\begin{bmatrix} \dot{\theta}_1 \\ \dot{\theta}_2 \end{bmatrix} = \begin{bmatrix} -2.409 & -0.415 \\ -0.752 & -0.910 \end{bmatrix}\begin{bmatrix} 0.2e^{0.2t} \\ 0.1e^{0.1t} \end{bmatrix} = \begin{bmatrix} -2.409 & -0.415 \\ -0.752 & -0.910 \end{bmatrix}\begin{bmatrix} 0.2e^{0.4} \\ 0.1e^{0.2} \end{bmatrix}$$

$$= \begin{bmatrix} -0.770 \\ -0.335 \end{bmatrix}$$