Homework 3

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Problem 1. Derive the Jacobian for your previous RRP manipulator.

The following derivation was produced using a MatLab script I developed to generate the symbolic representation of arbitrary manipulators' Jacobians. You may find the script on My GitHub (click here)

$$\begin{pmatrix} -d_3\,\sin\left(\theta_1\right)\,\sin\left(\theta_2\right) & d_3\,\cos\left(\theta_1\right)\,\cos\left(\theta_2\right) & \cos\left(\theta_1\right)\,\sin\left(\theta_2\right) \\ d_3\,\cos\left(\theta_1\right)\,\sin\left(\theta_2\right) & d_3\,\cos\left(\theta_2\right)\,\sin\left(\theta_1\right) & \sin\left(\theta_1\right)\,\sin\left(\theta_2\right) \\ 0 & d_3\,\sin\left(\theta_2\right) & -\cos\left(\theta_2\right) \\ 0 & \sin\left(\theta_1\right) & 0 \\ 0 & -\cos\left(\theta_1\right) & 0 \\ 1 & 0 & 0 \end{pmatrix}$$

Problem 2. Derive the Jacobian for a planar RRR manipulator.

$$\begin{pmatrix} -a_2\,\sin\left(\theta_1+\theta_2\right)-a_1\,\sin\left(\theta_1\right)-a_3\,\sin\left(\theta_1+\theta_2+\theta_3\right) & -a_2\,\sin\left(\theta_1+\theta_2\right)-a_3\,\sin\left(\theta_1+\theta_2+\theta_3\right) & -a_3\,\sin\left(\theta_1+\theta_2+\theta_3\right) \\ a_2\,\cos\left(\theta_1+\theta_2\right)+a_1\,\cos\left(\theta_1\right)+a_3\,\cos\left(\theta_1+\theta_2+\theta_3\right) & a_2\,\cos\left(\theta_1+\theta_2\right)+a_3\,\cos\left(\theta_1+\theta_2+\theta_3\right) & a_3\,\cos\left(\theta_1+\theta_2+\theta_3\right) \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{pmatrix}$$

Problem 3. Animate all three manipulators making a square using whichever path type (quintic, cubic, etc) you like

I used a cubic trajectory planner on the RRP and RRR mechanism.