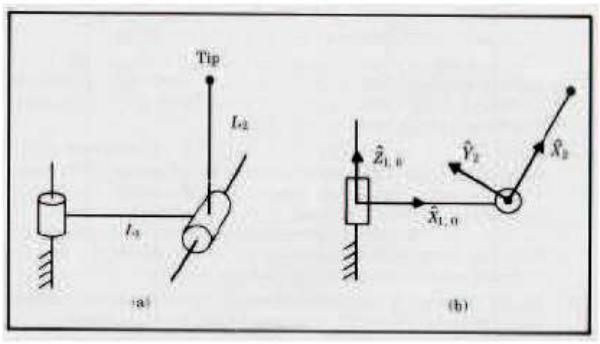
MMC Homework 2

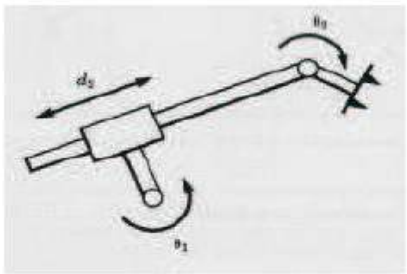
1. For the 2-link manipulator shown, the link transformations ${}^0_1T$ and ${}^1_2T$ were determined. Their product is

$$ {}^0_2T = \begin{bmatrix} c_1c_2 & -c_1s_2 & s_1 & l_1c_1 \\ s_1c_2 & -s_1s_2 & -c_1 & l_1s_1 \\ s_2 & c_2 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}. $$

The frame assingments used are indicated below in the figure. Note that frame 0 is coincident with frame 1 when θ_1 is 0. The length of the second link is l_2. Find an expression for the vector ${}^0P_{tip}$ which locates the tip of the arm relative to the 0 frame. (Courtesy of J. Craig)



2. Consider the following RPR manipulator.



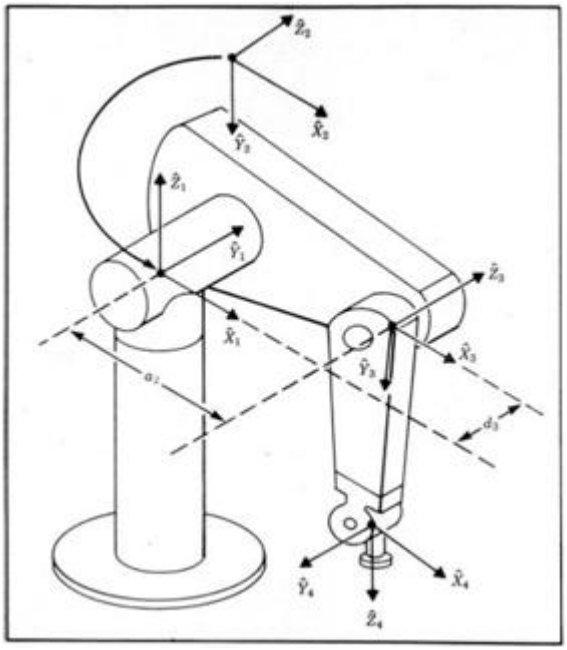
(a) Assign link frames {0} through {3} for the manipulator – that is, sketch the coordinate axes of each frame.

(b) Find the Denavit-Hartenberg parameters for this manipulator – that is, fill in the entries for the following table:

i	a_{i-1}	α_{i-1}	d_i	θ_i
1				
2				
3				

(c) Derive the forward kinematics for this manipulator – that is, find the matrix ${}^0_3T$.

3. Program Forward Kinematics for Puma 560 Robots using Matlab



choose [a2, a3, d3, d4] as [1 0.3 0.5 1] and ${}^{6}P_{T} = [0\,0\,0.2]^{T}$

When $\theta_1 = 45°$, $\theta_2 = 60°$, $\theta_3 = 45°$, $\theta_4 = 60°$, $\theta_5 = 45°$, $\theta_6 = 30°$, find ${}^{0}_{T}T$.