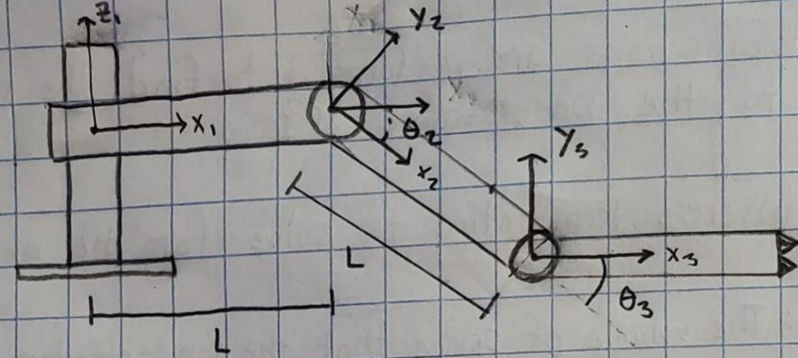
Extra Cedit:

PRR Manipulator; find L_1, θ_2, and θ_3 ; $L_2 = L_3 \Rightarrow L$, Ω_1

Use inverse kinematics and compute Jacobian.



i	α_{i-1}	a_{i-1}	d_i	θ
1	0	0	L_1	Ω_1
2	0	L	0	θ_2
3	0	L	0	θ_3

$${}^0_3T = {}^0_1T\,{}^1_2T\,{}^2_3T$$

$$\begin{bmatrix} C_1 & -S_1 & 0 & 0 \\ S_1 & C_1 & 0 & 0 \\ 0 & 0 & 1 & L_1 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} C_2 & -S_2 & 0 & L \\ S_2 & C_2 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\begin{bmatrix} C_{12} & -S_{12} & 0 & LC_1 \\ S_{12} & C_{12} & 0 & LS_1 \\ 0 & 0 & 1 & L_1 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} C_3 & -S_3 & 0 & L \\ S_3 & C_3 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$${}^0_3T = \begin{bmatrix} C_{123} & -S_{123} & 0 & L(C_1 + C_{12}) \\ S_{123} & C_{123} & 0 & L(S_1 + S_{12}) \\ 0 & 0 & 1 & L_1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$x = L(C_1 + C_{12})$

$y = L(S_1 + S_{12})$

$z = L_1 = 0$

$$x^2 + y^2 = \cancel{L^2 S_1^2} + L^2 S_{12}^2 + 2L^2 S_1 S_{12} + \cancel{L^2 C_1^2} + L^2 C_{12}^2 + 2L^2 C_1 C_{12}$$

$$= L^2 + L^2 + 2L^2 C_2$$

$$x^2 + y^2 + \cancel{z^2} = 2L^2 + \cancel{L_1^2} + 2L^2 C_2$$

$$C_2 = \frac{x^2 + y^2 - 2L^2}{2L^2} = \frac{x^2 + y^2}{2L^2} - 1$$

$$S_2 = \pm\sqrt{1 - C_2^2}$$

$$\theta_2 = \operatorname{Atan2}(S_2, C_2)$$