Lecture 3.4: Assignment

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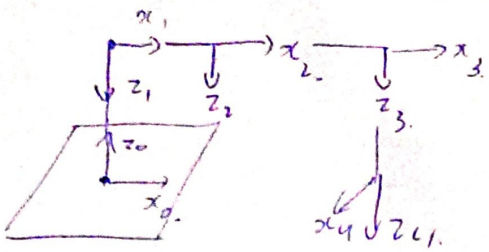

DH parameters

i	α_{i-1}	a_{i-1}	d_i	θ_i
1	180	0	-877	θ_1
2	0	425	0	θ_2
3	0	375	d_3	0
4	0	0	100	θ_4

$$ {}^0_1T = \begin{bmatrix} C_1 & -S_1 & 0 & 0 \\ S_1 & C_1 & 0 & 0 \\ 0 & 0 & -1 & 877 \\ 0 & 0 & 0 & 1 \end{bmatrix} $$

$$ {}^1_2T = \begin{bmatrix} C_2 & -S_2 & 0 & 425 \\ S_2 & C_2 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} $$

$$ {}^2_3T = \begin{bmatrix} 1 & 0 & 0 & 375 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & d_3 \\ 0 & 0 & 0 & 1 \end{bmatrix} $$

$$ {}^3_4T = \begin{bmatrix} C_4 & -S_4 & 0 & 0 \\ S_4 & C_4 & 0 & 0 \\ 0 & 0 & 1 & 100 \\ 0 & 0 & 0 & 1 \end{bmatrix} $$

$$ {}^0_4T = {}^0_1T\ {}^1_2T\ {}^2_3T\ {}^3_4T $$

Simplify $\left({}^0_4T\right) = \begin{bmatrix} C_{124} & -S_{124} & 0 & 375C_{12}+425C_1 \\ -S_{124} & -C_{124} & 0 & -375S_{12}-425S_1 \\ 0 & 0 & -1 & 777-d_3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

Assuming given matrix to be of the form:

$$ \begin{bmatrix} n_x & s_x & a_x & p_x \\ n_y & s_y & a_y & p_y \\ n_z & s_z & a_z & p_z \\ 0 & 0 & 0 & 1 \end{bmatrix} $$

$\theta_{124} = \text{atan2}(-s_x, n_x)$

$d_3 = 777 - p_z$

$375\cos(\theta_1+\theta_2)+425\cos(\theta_1) = P_x$

$\sin(\theta_1+\theta_2)+425\sin(\theta_1) = -P_y$ } → standard form.

$\cos(\theta_2) = P_x^2 + P_y^2 - 375^2 - 425^2$

$\sin\theta_2 = \sqrt{1-\cos\theta_2}$ } → solution

$\theta_2 = \text{atan2}(\sin\theta_2, \cos\theta_2)$

$\theta_1 = \text{atan2}(-\gamma P_y - P_x s, P_x \gamma - P_y s)$.

$\gamma = 375\cos\theta_2 + 425.$

$s = 375\sin\theta_2$

From ①,

$\theta_4 = \text{atan2}(-s_x, n_x) - \theta_1 - \theta_2$

$d_3 = 777 - P_z$.