# DH Parameter Manipulator 2 DOF

| n | $\theta$ | d | a | r |
|---|---|---|---|---|
| 1 | $\theta_1$ | 30cm | 90 | 50cm |
| 2 | $\theta_2$ | 5 cm | 0 | 60cm |

1.
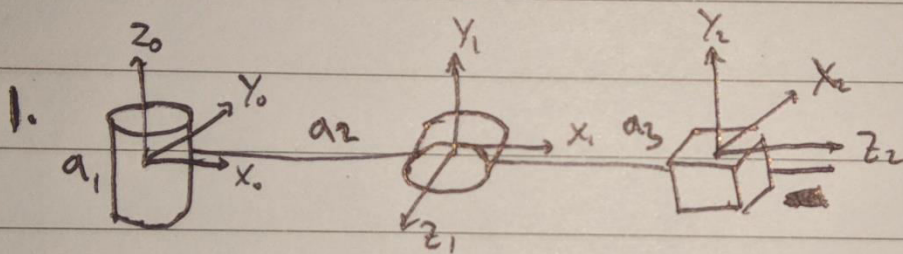

$$H_1^0 = \begin{bmatrix} R_1^0 & d_1^0 \\ 0\,0\,0 & 1 \end{bmatrix} \qquad H_2^0 = \begin{bmatrix} R_2^0 & d_2^0 \\ 0\,0\,0 & 1 \end{bmatrix}$$

$$R_1^0 = \begin{bmatrix} C\theta_1 & -S\theta_1 & 0 \\ S\theta_1 & C\theta_1 & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & -1 \\ 0 & 1 & 0 \end{bmatrix} \qquad R_2^0 = \begin{bmatrix} C\theta_2 & -S\theta_2 & 0 \\ S\theta_2 & C\theta_2 & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ -1 & 0 & 0 \end{bmatrix}$$

$$H_1^0 = \begin{bmatrix} C\theta_1 & 0 & S\theta_1 & a_2 C\theta_1 \\ S\theta_1 & 0 & -C\theta_1 & a_2 S\theta_1 \\ 0 & 1 & 0 & 3_1 \\ 0 & 0 & 0 & 1 \end{bmatrix} \qquad H_2^0 = \begin{bmatrix} 0 & -S\theta_2 & C\theta_2 & a_3 C\theta_2 \\ 0 & C\theta_2 & S\theta_2 & a_3 S\theta_2 \\ -1 & 0 & 0 & a_2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Invers kinematic $(P_x, P_y, P_z)$

$$S_2 = P_2 / L_2$$
$$C2 = \sqrt{1 - S_2^2}$$

$$\theta_2 = A\tan 2 (S2, C_2)$$

$$a = (L_1 + L_2 \times C_2)$$
$$C_1 = P_x / a$$
$$S_1 = P_2 / a$$

$$\theta_1 = A\tan 2 (S_1, C_1)$$

Forward kinematic

$$P_x = L_2 \times \cos \theta_1 \times \cos \theta_2 + L_1 \times \cos \theta_1$$

$$P_y = L_2 \times \sin \theta_1 \times \cos \theta_2 + L_1 \times \sin \theta_1$$

$$P_z = L_2 \times \sin \theta_2$$