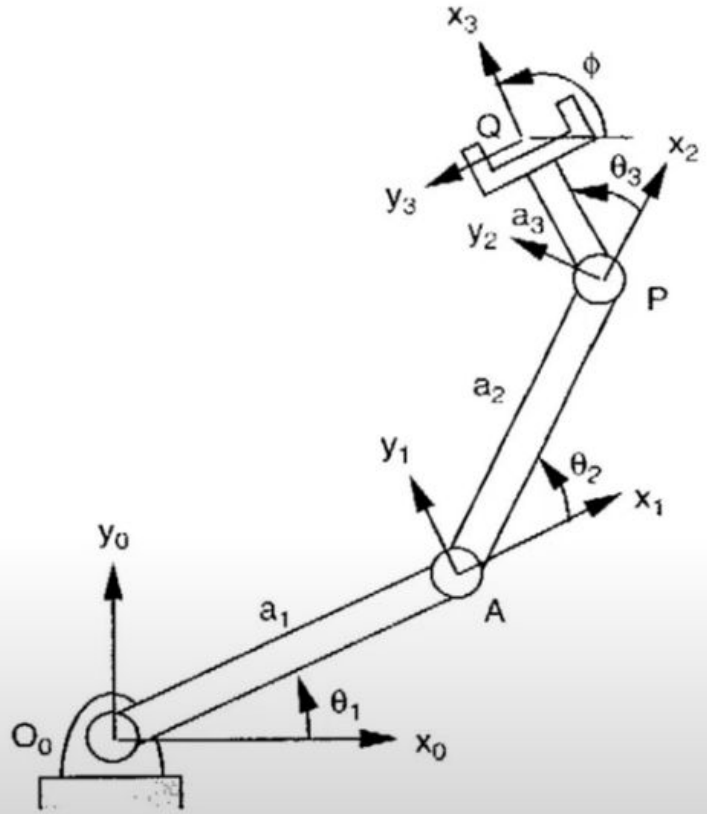
Introduction to Robotics

CSE 461

Lecture 6: Forward Kinematics

Md Toki Tahmid
Lecturer, Dept. of Computer Science and Engineering
Brac University



Angles of three joints are 30 degree, 45 degree and 10 degree. Length of arms are 20 cm, 32 cm and 10 cm.

Joint	α	a	d	θ
1	0	20	0	30°
2	0	32	0	45°
3	0	10	0	10°

$$T_i = \begin{bmatrix} c\theta_i & -c\alpha_i s\theta_i & s\alpha_i s\theta_i & a_i c\theta_i \\ s\theta_i & c\alpha_i c\theta_i & -s\alpha_i c\theta_i & a_i s\theta_i \\ 0 & s\alpha_i & c\alpha_i & d_i \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Joint	α	a	d	θ
1	0	20	0	30°
2	0	32	0	45°
3	0	10	0	10°

$$T_i = \begin{bmatrix} c\theta_i & -c\alpha_i s\theta_i & s\alpha_i s\theta_i & a_i c\theta_i \\ s\theta_i & c\alpha_i c\theta_i & -s\alpha_i c\theta_i & a_i s\theta_i \\ 0 & s\alpha_i & c\alpha_i & d_i \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T_1 = \begin{bmatrix} cos30^\circ & -cos0^\circ sin30^\circ & sin0^\circ sin30^\circ & 20cos30^\circ \\ sin30^\circ & cos0^\circ cos30^\circ & -sin0^\circ cos30^\circ & 20sin30^\circ \\ 0 & sin0^\circ & cos0^\circ & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T_1 = \begin{bmatrix} 0.87 & -0.50 & 0 & 17.32 \\ 0.5 & 0.87 & 0 & 10 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Joint	α	a	d	θ
1	0	20	0	30°
2	0	32	0	45°
3	0	10	0	10°

$$T_i = \begin{bmatrix} c\theta_i & -c\alpha_i s\theta_i & s\alpha_i s\theta_i & a_i c\theta_i \\ s\theta_i & c\alpha_i c\theta_i & -s\alpha_i c\theta_i & a_i s\theta_i \\ 0 & s\alpha_i & c\alpha_i & d_i \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T_2 = \begin{bmatrix} 0.71 & -0.71 & 0 & 22.72 \\ 0.71 & 0.71 & 0 & 22.72 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

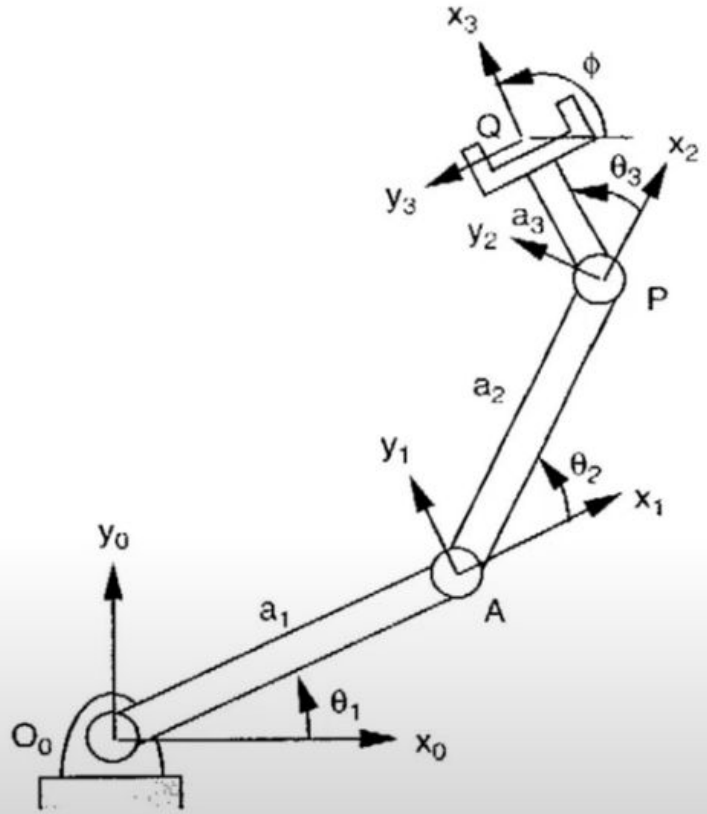
$$T_3 = \begin{bmatrix} 0.98 & -0.17 & 0 & 9.85 \\ 0.17 & 0.98 & 0 & 1.74 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T_1 = \begin{bmatrix} 0.87 & -0.50 & 0 & 17.32 \\ 0.5 & 0.87 & 0 & 10 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad T_2 = \begin{bmatrix} 0.71 & -0.71 & 0 & 22.72 \\ 0.71 & 0.71 & 0 & 22.72 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad T_3 = \begin{bmatrix} 0.98 & -0.17 & 0 & 9.85 \\ 0.17 & 0.98 & 0 & 1.74 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Overall Transformation Matrix $T = T_1.T_2.T_3$

$$= \begin{bmatrix} 0.09 & -0.99 & 0 & 26.6 \\ 0.99 & 0.09 & 0 & 51.14 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

So from overall Transformation Matrix, $x = 26.6, y = 51.14$ and $z = 0$



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