5th. Nov, 2019

(60)

Assignment (Robotics I, Robotics) 4th

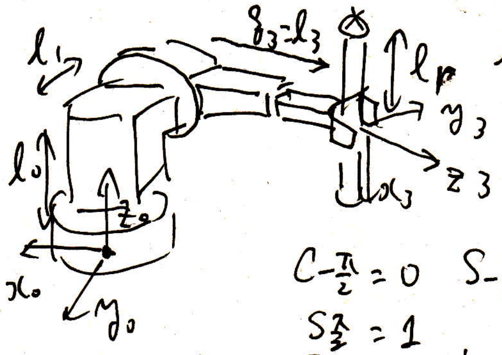
(M2, M1, B4, B3, others: CIRCLE ONE) Major (Department)

Name(KANJI or English)

(1) D-H table

i	1	2	3
a_i	0	0	0
α_i	0	$\pi/2$	$\pi/2$
d_i	l_0	l_1	q_3
θ_i	q_1	$q_2-\frac{\pi}{2}$	0

when $q_1 = q_2 = 0,\ q_3 = l_3$ calculate $\mathbb{r}_r$ in Σ_0



$$^{i-1}T_i = \begin{bmatrix} C\theta_i & -S\theta_i & 0 & a_i \\ C\alpha_i S\theta_i & C\alpha_i C\theta_i & -S\alpha_i & -d_i S\alpha_i \\ S\alpha_i S\theta_i & S\alpha_i C\theta_i & C\alpha_i & d_i C\alpha_i \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$C_{-\frac{\pi}{2}} = 0 \quad S_{-\frac{\pi}{2}} = -1$

$S_{\frac{\pi}{2}} = 1 \quad \alpha_2 = \frac{\pi}{2}$ $\quad \alpha_3 = \frac{\pi}{2}$

$$^0T_1 = \begin{bmatrix} C_0 & -S_0 & 0 & 0 \\ 1\times S_0 & 1\times C_0 & 0 & 0 \\ 0 & 0 & 1 & l_0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \quad {}^1T_2 = \begin{bmatrix} C_{-\frac{\pi}{2}} & -S_{-\frac{\pi}{2}} & 0 & 0 \\ 0\times S_{-\frac{\pi}{2}} & 0\times C_{-\frac{\pi}{2}} & -1 & -l_1 \\ 1\times S_{-\frac{\pi}{2}} & 1\times C_{-\frac{\pi}{2}} & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \quad {}^2T_3 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0\times S_0 & 0\times C_0 & -1 & -q_3 = l_3 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

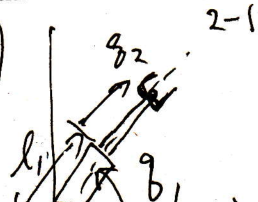
$S\alpha_1 = 0$

$C\alpha_1 = 1$

$$^0T_1\,{}^1T_2\,{}^2T_3 = \begin{bmatrix} 1&0&0&0 \\ 0&1&0&0 \\ 0&0&1&l_0 \\ 0&0&0&1 \end{bmatrix} \begin{bmatrix} 0&1&0&0 \\ 0&0&-1&-l_1 \\ -1&0&0&0 \\ 0&0&0&1 \end{bmatrix} \begin{bmatrix} 1&0&0&0 \\ 0&0&-1&-l_3 \\ 0&1&0&0 \\ 0&0&0&1 \end{bmatrix} = \begin{bmatrix} 0&0&-1&-l_3 \\ 0&-1&0&-l_1 \\ -1&0&0&l_0 \\ 0&0&0&1 \end{bmatrix}$$

$$^0\mathbb{r}_r = {}^0T_3\,{}^3\mathbb{r}_r = \begin{bmatrix} 0&0&-1&-l_3 \\ 0&-1&0&-l_1 \\ -1&0&0&l_0 \\ 0&0&0&1 \end{bmatrix} \begin{bmatrix} -l_r \\ 0 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} -l_3 \\ -l_1 \\ l_r + l_0 \\ 1 \end{bmatrix} \Leftarrow \begin{bmatrix} {}^0x_r \\ {}^0y_r \\ {}^0z_r \\ 1 \end{bmatrix}$$

(2)



2-1)

$$\begin{cases} x = (l_1 + q_2)\cos q_1 \\ y = (l_1 + q_2)\sin q_1 \end{cases}$$

2-2)

$$\dot{\mathbb{r}} = \begin{pmatrix} \dot{x} \\ \dot{y} \end{pmatrix} = \begin{pmatrix} \frac{\partial x}{\partial q_1} & \frac{\partial x}{\partial q_2} \\ \frac{\partial y}{\partial q_1} & \frac{\partial y}{\partial q_2} \end{pmatrix} \begin{pmatrix} \dot{q}_1 \\ \dot{q}_2 \end{pmatrix}$$

$$= \underbrace{\begin{pmatrix} -(l_1+q_2)\sin q_1 & \cos q_1 \\ (l_1+q_2)\cos q_1 & \sin q_1 \end{pmatrix}}_{J(q)} \dot{q}$$