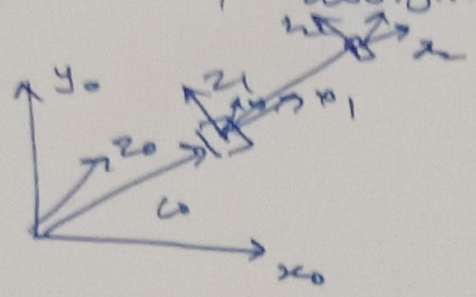
ME 604 assignment #3

(1)



θ_i	d_i	a_i	α_i
θ_1	0	1	-90°
θ_2	0	1	90°
θ_3	0	1	0

$$ {}^{i-1}_{i}T = \begin{bmatrix} c\theta_i & -s\theta_i c\alpha_i & s\theta_i s\alpha_i & a_i c\theta_i \\ s\theta_i & c\theta_i c\alpha_i & -c\theta_i s\alpha_i & a_i s\theta_i \\ 0 & s\alpha_i & c\alpha_i & d_i \\ 0 & 0 & 0 & 1 \end{bmatrix} $$

$$ {}^{0}_{1}T = \begin{bmatrix} c\theta_3 & -s\theta_3 & 0 & c\theta_3 \\ s\theta_3 & c\theta_3 & 0 & s\theta_3 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} $$

$$ {}^{1}_{2}T = \begin{bmatrix} c\theta_2 & 0 & s\theta_2 & c\theta_2 \\ s\theta_2 & 0 & -c\theta_2 & s\theta_2 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} $$

$$ {}^{2}_{3}T = \begin{bmatrix} c\theta_3 & -s\theta_3 & 0 & c\theta_3 \\ s\theta_3 & c\theta_3 & 0 & s\theta_3 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} $$

$$ {}^{0}_{3}T = {}^{0}_{1}T\,{}^{1}_{2}T\,{}^{2}_{3}T $$

$$ = \begin{bmatrix} c\theta_1 c\theta_2 c\theta_3 - s\theta_1 s\theta_3 & -c\theta_1 c\theta_2 s\theta_3 - s\theta_1 c\theta_3 & -c\theta_1 c\theta_2 s\theta_3 - s\theta_1 s\theta_3 & c\theta_1 c\theta_2 c\theta_3 + s\theta_1 c\theta_3 \\ s\theta_1 c\theta_2 c\theta_3 + c\theta_1 s\theta_3 & -s\theta_1 c\theta_2 s\theta_3 + c\theta_1 c\theta_3 & s\theta_1 c\theta_2 s\theta_3 + c\theta_1 c\theta_3 & s\theta_1 c\theta_2 c\theta_3 - c\theta_1 s\theta_3 \\ -s\theta_2 c\theta_3 & s\theta_2 s\theta_3 & -s\theta_2 & -s\theta_2 \\ 0 & 0 & 0 & 1 \end{bmatrix} $$

(2)

θ_i	d_i	a_i	α_i
θ_1	0	a_1	α_1
θ_2	$-d_2$	0	$-\pi/2$
$-\pi/2$	d_3	0	$-\pi/2$
θ_4	d_4	a_4	0
θ_5	0	a_5	0

(3)

θ_i	d_i	a_i	α_i
θ_1	13	0	$-\pi/2$
θ_2	0	8	0
θ_3	-4	8	0
θ_4	0	0	$\pi/2$
θ_5	0	0	$\pi/2$
θ_6	1	0	0

(4)

a	α	d	θ
l_1	-90°	0	θ_1
0	0	d_2^*	θ_1
0	-90	0	$\theta_3 - 90$

$$A_1 = \begin{bmatrix} C\theta_1 & 0 & -S\theta_2 & C_1 C\theta_1 \\ S\theta_1 & 0 & C\theta_1 & L_4 S\theta_1 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \qquad A_2 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & d_2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$A_3 = \begin{bmatrix} S\theta_3 & 0 & C\theta_3 & 0 \\ -C\theta_3 & 0 & S\theta_3 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T_3^0 = A_1 A_2 A_3 = \begin{bmatrix} C\theta_1 S\theta_3 & S\theta_1 & C\theta_1 C\theta_3 & l_1 C\theta_1 - d_2 \\ S\theta_1 S\theta_3 & -C\theta_1 & C\theta_3 S\theta_1 & d_2 C\theta_1 + l_4 \\ C\theta_3 & 0 & -S\theta_3 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$ {}^{3}_{E}T = \begin{bmatrix} 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 1 & l_2 \\ 0 & 0 & 0 & 1 \end{bmatrix} $$

$$ {}^{W}_{E}T = {}^{W}_{3}T \; {}^{3}_{E}T = \begin{bmatrix} s\theta_1 & c\theta_1 s\theta_3 & c\theta_1 c\theta_3 & d_1 c\theta_1 - d_2 s\theta_1 + l_2 c\theta_1 \\ c\theta_1 & s\theta_1 s\theta_3 & c\theta_3 s\theta_1 & d c\theta_1 + l_2 s\theta_1 + l_1 \\ 0 & c\theta_2 & -s\theta_3 & 0 \\ 0 & 0 & 0 & -l_2 s\theta_3 \end{bmatrix} $$

(5)

a	α	d	θ
305	-90°	740	θ_1
1075	0	0	$\theta_2 - 90^\circ$
250	-90°	0	θ_3
0	90°	1275	θ_4
0	-90°	0	θ_5
0	0	240	$150 + \theta_6$

(54)