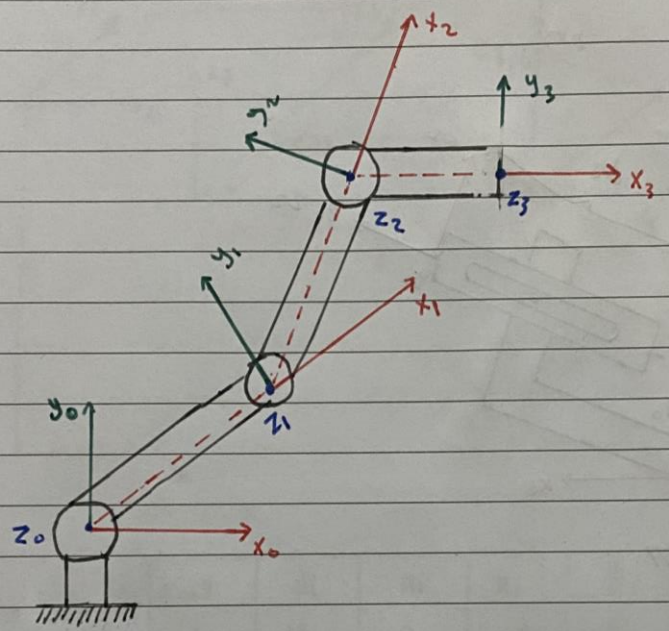
Almuthanna Aljajan

Oblig 2

Almuthannu Jamal Aljajan.

oblig 2

oppgave 3-1



DH - tabell

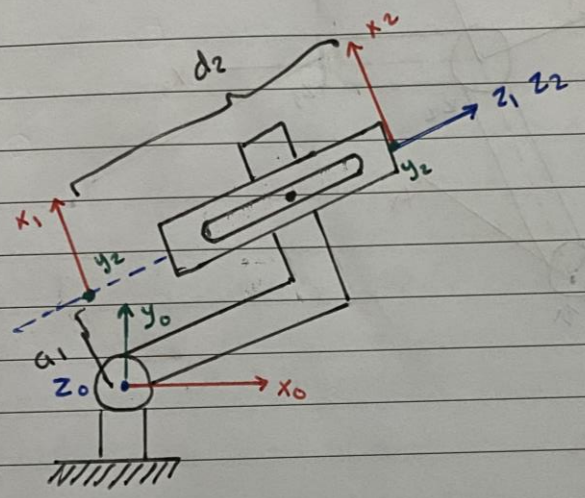
Link	a_i	α_i	d_i	θ_i
1	a_1	0	0	θ_1^x
2	a_2	0	0	θ_2^x
3	a_3	0	0	θ_3^x

$$T_3^0 = A_1 \cdot A_2 \cdot A_3$$

$$A_1 = \begin{bmatrix} C_1 & -S_1 & 0 & C_1 a_1 \\ S_1 & C_1 & 0 & S_1 a_1 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \quad A_2 = \begin{bmatrix} C_2 & -S_2 & 0 & C_2 a_2 \\ S_2 & C_2 & 0 & S_2 a_2 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$A_3 = \begin{bmatrix} c_3 & -s_3 & 0 & c_3 a_3 \\ s_3 & c_3 & 0 & s_3 a_3 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Oppgave 3.3



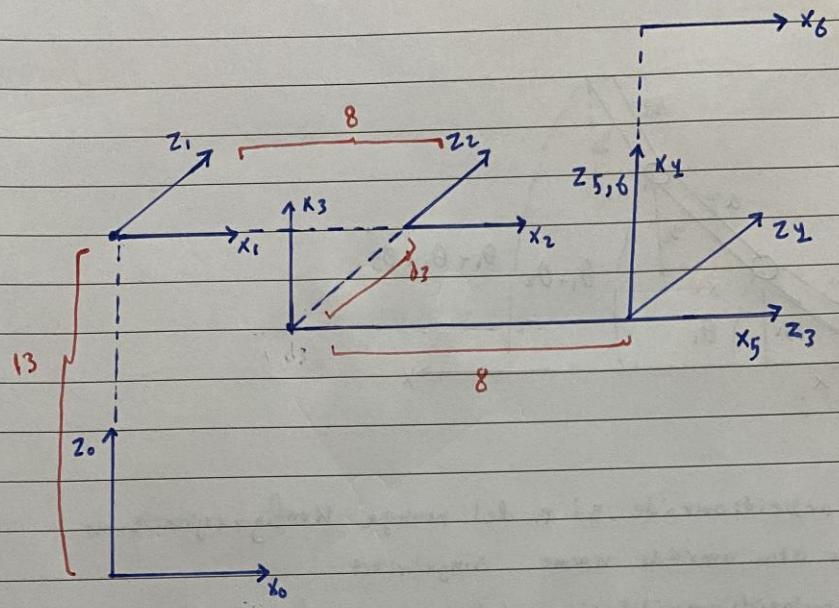
DH - tabell:

link	a_i	α_i	d_i	θ_i
1	a_1	$90°$	0	θ_1^*
2	0	0	d_2^*	0

$$A_1 = \begin{bmatrix} c_1 & 0 & s_1 & c_1 a_1 \\ s_1 & 0 & -c_1 & s_1 a_1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \quad A_2 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & d_2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

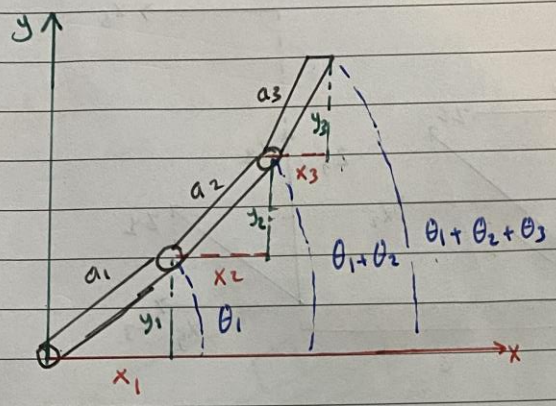
$$T_2^0 = A_1 \cdot A_2 = \begin{bmatrix} c_1 & 0 & s_1 & d_2 s_1 + c_1 a_1 \\ s_1 & 0 & -c_1 & a_1 s_1 + c_1 d_2 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Oppgave 3.9



Link	d_i	a_i	α_i	θ_i
1	13	0	-90	θ_1
2	0	8	0	θ_2
3	d_3	0	-90	θ_3
4	8	0	90	θ_4
5	0	0	90	θ_5
6	d_6	0	0	θ_6

oppgave 5.1



- innenfor sitt arbeidsområde, så er det mange konfigrasjon som kan nå, men uten område navne singularitet
- utenfor sitt arbeidsområdet så er det ingen konfigurasjon som kan nå
- ved grense så er en løsning

$$x = a_1 \cos\theta_1 + a_2 \cos(\theta_1 + \theta_2) + a_3 \cos(\theta_1 + \theta_2 + \theta_3)$$
$$y = a_1 \sin\theta_1 + a_2 \sin(\theta_1 + \theta_2) + a_3 \sin(\theta_1 + \theta_2 + \theta_3)$$

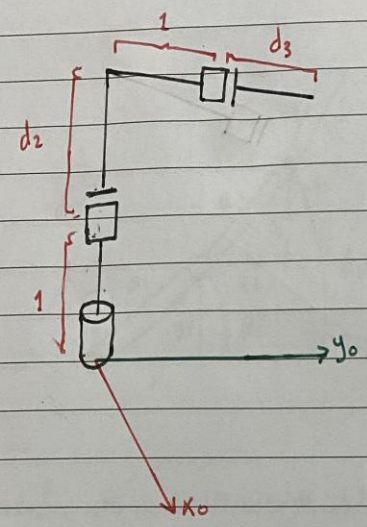
innenfor arbeids området, kan vi ha 2. løsninger dersom siste ledd skal være fast

$$\theta_3 = A\tan2(\cos\theta_2, \pm\sqrt{1 - \cos\theta^2})$$

$$\theta_3 = A\tan2(\sqrt{x_c^2 + y_c^2 - d^2}, z_c - d_1) - A\tan2(a_2 + a_3\cos\theta_3, a_3\sin\theta_3)$$

ved enten av sitt arbeidsområde 1.
utenfor arbeidsområde: 0.

oppgave 5.3



roboten består av 1 roterende ledd og 2 prismatiske ledd, så den kan ikke ha forskjellige konfigrasjoner

$$\theta_1 = A\tan 2(x_c, y_c)$$

$$r = d_3 + 1$$

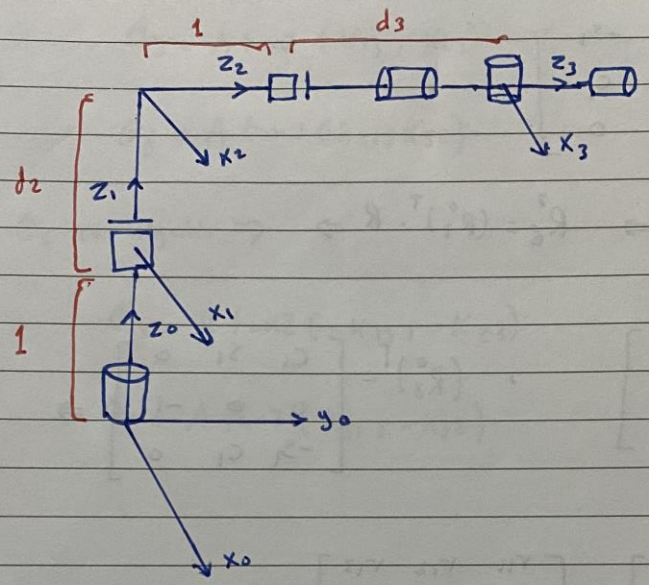
$$x_c^2 + y_c^2 = (1 + d_3)^2$$

$$1 + d_3 = \sqrt{(x_c^2 + y_c^2)}$$

$$d_3 = \sqrt{x_c^2 + y_c^2} - 1$$

$$d_2 = z_c - 1$$

oppgave 5.5



link	a_i	d_i	α_i	θ_i
1	0	1	0	θ_1^*
2	0	d_2	-90	0
3	0	$1+d_3$	0	0

$$A_1 = \begin{bmatrix} c_1 & -s_1 & 0 & 0 \\ s_1 & c_1 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \quad A_2 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & -1 & 0 & d_2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$A_3 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & l_4 + d_3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$R_3^0 = \begin{bmatrix} c_1 & 0 & -s_1 \\ s_1 & 0 & c_1 \\ 0 & -1 & 0 \end{bmatrix}$$

$$R = R_3^0 \cdot R_6^3 \Rightarrow \quad R_6^3 = (R_3^0)^T \cdot R \Rightarrow$$

$$R = \begin{bmatrix} r_{11} & r_{12} & r_{13} \\ r_{21} & r_{22} & r_{23} \\ r_{31} & r_{32} & r_{33} \end{bmatrix}, \quad (R_3^0)^T = \begin{bmatrix} c_1 & s_1 & 0 \\ 0 & 0 & -1 \\ -s_1 & c_1 & 0 \end{bmatrix} \Rightarrow$$

$$R_6^3 = \begin{bmatrix} c_1 & s_1 & 0 \\ 0 & 0 & -1 \\ -s_1 & c_1 & 0 \end{bmatrix} \cdot \begin{bmatrix} r_{11} & r_{12} & r_{13} \\ r_{21} & r_{22} & r_{23} \\ r_{31} & r_{32} & r_{33} \end{bmatrix} =$$

$$\begin{bmatrix} c_1 \cdot r_{11} + s_1 r_{21} & c_1 r_{12} + s_1 r_{22} & c_1 r_{13} + s_1 r_{23} \\ - r_{31} & - r_{32} & - r_{33} \\ c_1 r_{21} - s_1 r_{11} & c_1 r_{22} - s_1 r_{12} & c_1 r_{23} - s_1 r_{13} \end{bmatrix}$$

$$= \begin{bmatrix} k_{11} & k_{12} & k_{13} \\ k_{21} & k_{22} & k_{23} \\ k_{31} & k_{32} & k_{33} \end{bmatrix}$$

$$\theta_5 = A\tan2\left(k_{33} \pm \sqrt{1-k_{33}^2}\right)$$

Hvis θ_5 er positiv $\Rightarrow$

$$\theta_4 = A\tan2\left(k_{13}, k_{23}\right)$$

$$\theta_6 = A\tan2\left(-k_{31}, k_{32}\right)$$

Hvis θ_5 er negativ $\Rightarrow$

$$\theta_4 = A\tan2\left(-k_{13}, -k_{23}\right)$$

$$\theta_6 = A\tan2\left(k_{31}, -k_{32}\right)$$