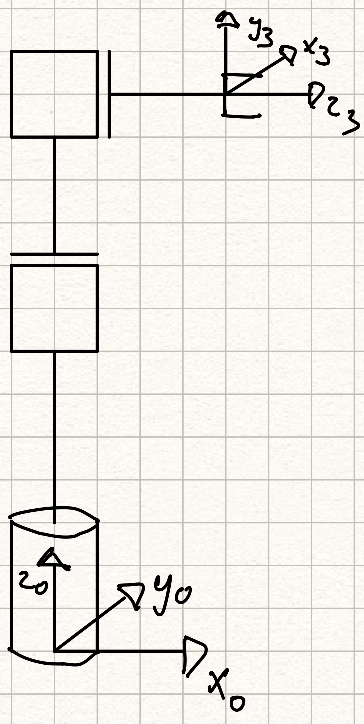


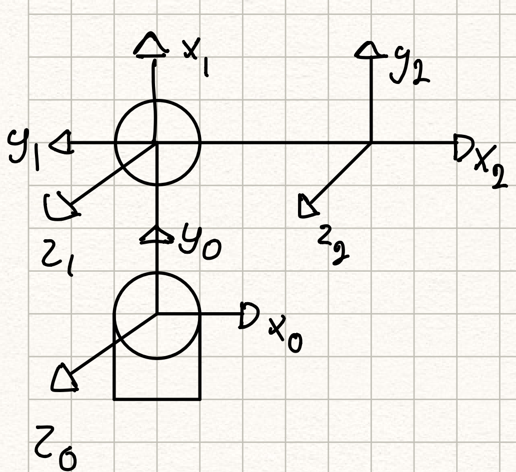
$$H_3^0 = \begin{bmatrix} -s_1 & 0 & c_1 & c_1 d_3^* \\ c_1 & 0 & s_1 & s_1 d_3^* \\ 0 & 1 & 0 & d_1 + d_2^* \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\left.\begin{aligned} x &= c_1 d_3^* \\ y &= s_1 d_3^* \end{aligned}\right\} \quad \frac{y}{x} = \frac{s_1 d_3^*}{c_1 d_3^*} = \tan\theta_1 \rightarrow \operatorname{atan2}\left(\frac{y}{x}\right)$$

$$z = d_1 + d_2^* \longrightarrow d_2^* = z - d_1$$

$$x^2 + y^2 = c_1^2 d_3^{*2} + s_1^2 d_3^{*2} = d_3^{*2} \overbrace{(s_1^2 + c_1^2)}^{1}$$

$$d_3^* = \sqrt{x^2 + y^2}$$



Link	θ	d	a	α
1	$\theta_1^* + 90^\circ$	0	a_1	0
2	$\theta_2^* - 90^\circ$	0	a_2	0

$$\sin(\theta \pm 90) = s_1 c_{90} \pm c_1 s_{90} = \pm c_1$$
$$\cos(\theta \pm 90) = c_1 c_{90} \mp s_1 s_{90} = \mp s_1$$

$$H_2^0 = \begin{bmatrix} c_1c_2 - s_1s_2 & -c_1s_2 - s_1c_2 & 0 & -a_1s_1 - a_2s_1s_2 + a_2c_1c_2 \\ c_1s_2 + s_1c_2 & c_1c_2 - s_1s_2 & 0 & a_1c_1 + a_2s_1c_2 + a_2c_1s_2 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$x = -a_1s_1 \overbrace{-a_2s_1s_2 + a_2c_1c_2}^{a_2c_{12}}$$
$$y = a_1c_1 \underbrace{+a_2s_1c_2 + a_2c_1s_2}_{a_2s_{12}}$$
$$z = 0$$

$$x^2 = a_1^2s_1^2 - 2a_1a_2s_1c_{12} + a_2^2c_{12}^2$$
$$y^2 = a_1^2c_1^2 + 2a_1a_2c_1s_{12} + a_2^2s_{12}^2$$

θ_2:

$$x^2 + y^2 = a_1^2\overbrace{(s_1^2 + c_1^2)}^{1} + a_2^2\overbrace{(s_{12}^2 + c_{12}^2)}^{1} \quad / \text{ledd med } \sin^2 + \cos^2$$
$$+ 2a_1a_2c_1s_{12} - 2a_1a_2s_1c_{12}$$

$$= a_1^2 + a_2^2 + 2a_1c_1(a_2s_1c_2 + a_2c_1s_2)$$
$$- 2a_1s_1(a_2c_1c_2 - a_2s_1s_2)$$

skrevet ut s_{12} og c_{12}

$$= a_1^2 + a_2^2 + 2a_1a_2s_1c_1c_2 + 2a_1a_2c_1^2s_2$$
$$+ 2a_1a_2s_1^2s_2 - 2a_1a_2s_1c_1c_2$$

$$= a_1^2 + a_2^2 + 2a_1a_2c_1^2s_2 + 2a_1a_2s_1^2s_2$$

$$= a_1^2 + a_2^2 + 2a_1a_2s_2\underbrace{(c_1^2 + s_1^2)}_{1}$$

$$x^2 + y^2 = a_1^2 + a_2^2 + 2a_1a_2s_2$$

$\downarrow$

$$s_2 = \frac{x^2 + y^2 - a_1^2 - a_2^2}{2a_1a_2} := D$$

$1 = \sin^2 + \cos^2$

$\hookrightarrow \cos = \pm\sqrt{1 - \sin^2}$

$$\theta_2 = \operatorname{atan2}\left(\frac{D}{\pm\sqrt{1-D^2}}\right)$$

θ_1:

$$y = a_1 c_1 + a_2 s_1 c_2 + a_2 c_1 s_2$$
$$= c_1 (a_1 + a_2 s_2) + a_2 s_1 c_2 \quad \text{/ trekker ut } c_1$$

$$a \cos\theta + b \sin\theta = c$$
$$\Updownarrow$$
$$\theta = \operatorname{atan2}\left(\frac{b}{a}\right) \pm \operatorname{atan2}\left(\frac{\sqrt{a^2+b^2+c^2}}{c}\right)$$

$$a = a_1 + a_2 s_2$$
$$b = a_2 c_2$$
$$c = y$$

$$\theta_1 = \operatorname{atan2}\left(\frac{a_2 c_2}{a_1 + a_2 s_2}\right) \pm \operatorname{atan2}\left(\frac{\sqrt{a_1^2 + a_2^2 + y^2 + 2 s_2 a_1 a_2}}{y^2}\right)$$