

$$P_{oe}(0,0,0) =$$

$$x_{p_{oe}} = a_1$$

$$y_{p_{oe}} = -(d_2 + a_3) \cos \alpha$$

$$z_{p_{oe}} = (d_2 + a_3) \sin \alpha + d_1$$

$$M_{i-1,i} = \text{Tras}(z, d_i) \text{Rot}(z, \vartheta_i) \text{Rot}(x, \varphi_i) \text{Tras}(x, a_i) = \quad (6.1.1)$$

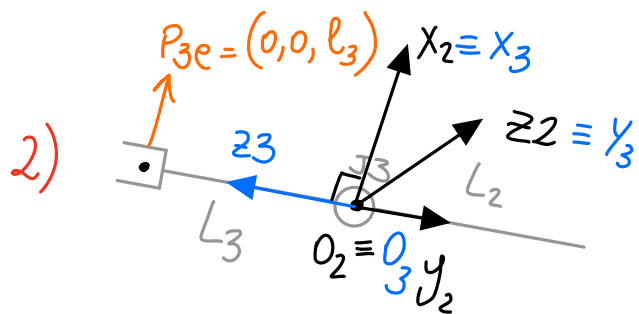
$$= \begin{bmatrix} c\vartheta_i & -s\vartheta_i c\varphi_i & s\vartheta_i s\varphi_i & a_i c\vartheta_i \\ s\vartheta_i & c\vartheta_i c\varphi_i & -c\vartheta_i s\varphi_i & a_i s\vartheta_i \\ 0 & s\varphi_i & c\varphi_i & d_i \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} X_x & Y_x & Z_x & X \\ X_y & Y_y & Z_y & Y \\ X_z & Y_z & Z_z & Z \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (6.1.2)$$

$$c\vartheta_i = \cos(\vartheta_i) \quad s\vartheta_i = \sin(\vartheta_i)$$

$$c\varphi_i = \cos(\varphi_i) \quad s\varphi_i = \sin(\varphi_i)$$

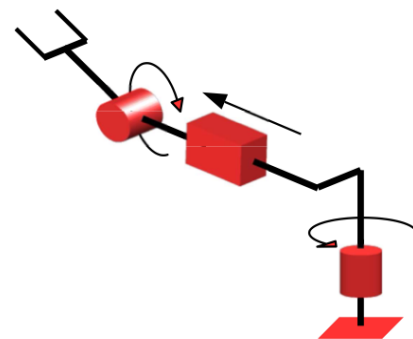
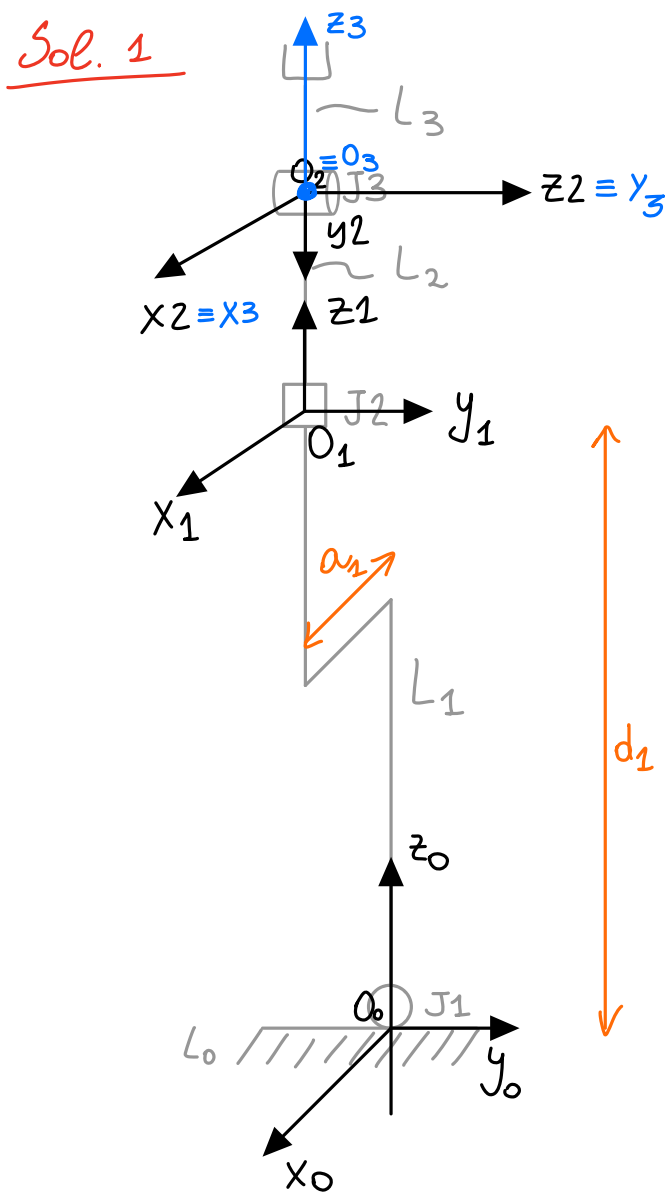
$$\vartheta_i = h_i q_i + \vartheta_{0i}$$

$$d_i = p_i q_i + d_{0i}$$



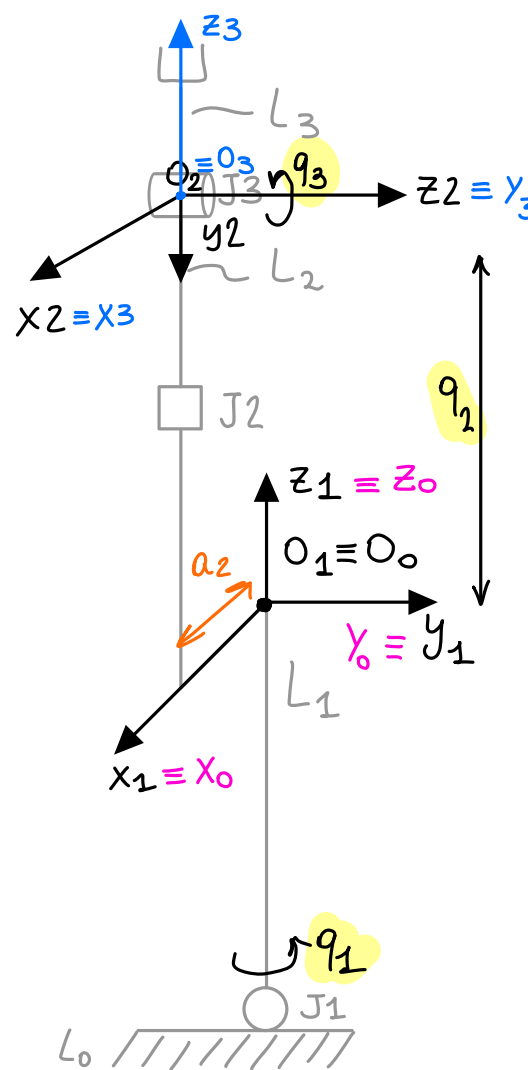
2)

n°	J	θ	d	a	φ
1	R	q_1	d_1	a_1	$+\pi/2$
2	P	$+\pi/2$	q_2+d_2	0	$-\pi/2$
3	R	q_3	0	0	$+\pi/2$



Sol. 2

n° link	type	θ	d	a	φ
1	R	q_1	0	0	0
2	P	0	q_2	a_2	$-\pi/2$
3	R	q_3	0	0	$+\pi/2$



S1

$$M_{01}(q_1) = \left(\begin{array}{ccc|c} c_{q_1} & -s_{q_1} & 0 & a_1 c_{q_1} \\ s_{q_1} & c_{q_1} & 0 & a_1 s_{q_1} \\ 0 & 0 & 1 & d_1 \\ \hline 0 & 0 & 0 & 1 \end{array} \right)$$

dove $c_{q_1} = \cos(q_1)$
e $s_{q_1} = \sin(q_1)$

$$M_{12}(q_2) = \left(\begin{array}{ccc|c} 1 & 0 & 0 & 0 \\ 0 & \cos(-\pi/2) & -\sin(-\pi/2) & 0 \\ 0 & \sin(-\pi/2) & \cos(-\pi/2) & q_2 \\ \hline 0 & 0 & 0 & 1 \end{array} \right) = \left(\begin{array}{ccc|c} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & -1 & 0 & q_2 \\ \hline 0 & 0 & 0 & 1 \end{array} \right)$$

$$M_{23}(q_3) = \left(\begin{array}{ccc|c} c_{q_3} & -s_{q_3} \cdot 0 & s_{q_3} \cdot 1 & 0 \\ s_{q_3} & c_{q_3} \cdot 0 & -c_{q_3} \cdot 1 & 0 \\ 0 & 1 & 0 & 0 \\ \hline 0 & 0 & 0 & 1 \end{array} \right) = \left(\begin{array}{ccc|c} c_{q_3} & 0 & s_{q_3} & 0 \\ s_{q_3} & 0 & -c_{q_3} & 0 \\ 0 & 1 & 0 & 0 \\ \hline 0 & 0 & 0 & 1 \end{array} \right)$$

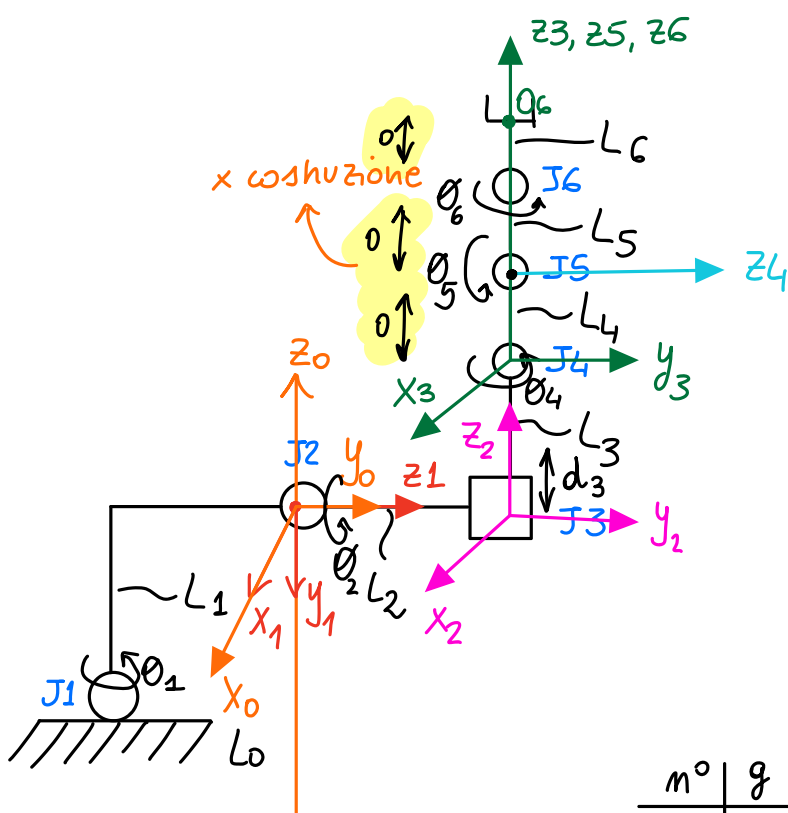
n° link	tipo	θ	d	a	φ
1	R	q_1	d_1	a_1	0
2	P	0	q_2	0	$-\pi/2$
3	R	q_3	0	0	$+\pi/2$

$$M_{0,3}(q_{1,2,3}) = \left(\begin{array}{ccc|c} c_{q_1} & -s_{q_1} & 0 & a_1 c_{q_1} \\ s_{q_1} & c_{q_1} & 0 & a_1 s_{q_1} \\ 0 & 0 & 1 & d_1 \\ \hline 0 & 0 & 0 & 1 \end{array} \right) \left(\begin{array}{ccc|c} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & -1 & 0 & q_2 \\ \hline 0 & 0 & 0 & 1 \end{array} \right) \left(\begin{array}{ccc|c} c_{q_3} & 0 & s_{q_3} & 0 \\ s_{q_3} & 0 & -c_{q_3} & 0 \\ 0 & 1 & 0 & 0 \\ \hline 0 & 0 & 0 & 1 \end{array} \right)$$

$P_{oe} = M_{03} \cdot P_{3e}$

↓

$$\begin{pmatrix} 0 \\ 0 \\ 0 \\ 1 \end{pmatrix}$$



$$\begin{aligned} \varphi_i &= z_{i-1} \text{ e } z_i \\ \theta_i &= x_{i-1} \text{ e } x_i \\ d_i &= O_{i-1} \text{ e } x_i \\ a_i &= O_i \text{ e } z_{i-1} \end{aligned}$$

- giunti prismatici \rightarrow orizzontali
l'asse per avere $a_i = d_{i-1} = 0$
- giunti rot. contigui $\parallel \Rightarrow d_i = 0$

n°	g	θ	d	a	φ
1	R	q_1	0	0	-90°
2	R	q_2	d_2	0	$+90^\circ$
3	P	0	q_3	0	0
4	R	q_4	0	0	-90°
5	R	q_5	0	0	$+90^\circ$
6	R	q_6	0	0	0

