Problema
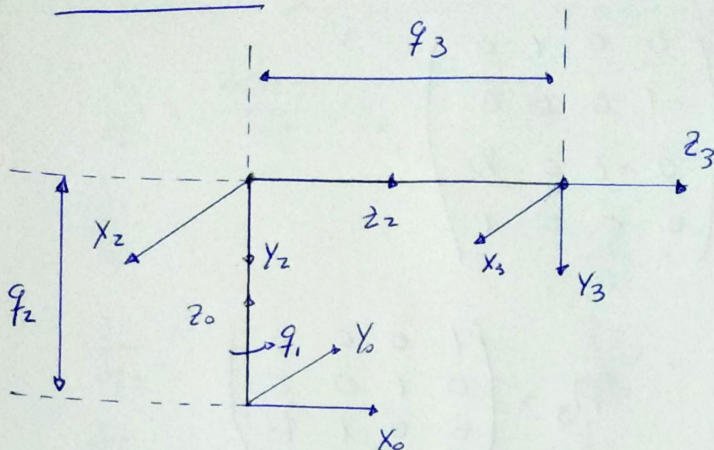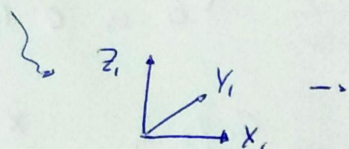

1 articulación rotación

2 articulaciones prismáticas

El sistema 1 está en la misma posición que el sistema 0

- Cinemática directa:

$$
{}^{0}A_{1} = \begin{pmatrix} \cos q_1 & -\sin q_1 & 0 & 0 \\ \sin q_1 & \cos q_1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} C_1 & -S_1 & 0 & 0 \\ S_1 & C_1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}
$$

$$
{}^{1}A_{2} = \begin{pmatrix} \cos(-90) & -\sin(-90) & 0 & 0 \\ \sin(-90) & \cos(-90) & 0 & 0 \\ 0 & 0 & 1 & q_2 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(-90) & -\sin(-90) & 0 \\ 0 & \sin(-90) & \cos(-90) & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} =
$$

$$
= \begin{pmatrix} 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 1 & q_2 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} 0 & 0 & 1 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & q_2 \\ 0 & 0 & 0 & 1 \end{pmatrix}
$$

$$
{}^{2}A_{3} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & q_3 \\ 0 & 0 & 0 & 1 \end{pmatrix}
$$

$$T = {}^{0}A_1 \cdot {}^{1}A_2 \cdot {}^{2}A_3$$

$$
{}^{0}A_1 \cdot {}^{1}A_2 =
\begin{pmatrix}
C_1 & -S_1 & 0 & 0 \\
+S_1 & C_1 & 0 & 0 \\
0 & 0 & 1 & 0 \\
0 & 0 & 0 & 1
\end{pmatrix}
\begin{pmatrix}
0 & 0 & 1 & 0 \\
-1 & 0 & 0 & 0 \\
0 & -1 & 0 & q_2 \\
0 & 0 & 0 & 1
\end{pmatrix}
=
$$

$$
=
\begin{pmatrix}
S_1 & 0 & C_1 & 0 \\
-C_1 & 0 & S_1 & 0 \\
0 & -1 & 0 & q_2 \\
0 & 0 & 0 & 1
\end{pmatrix}
\qquad
{}^{2}A_3 =
\begin{pmatrix}
1 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 \\
0 & 0 & 1 & q_3 \\
0 & 0 & 0 & 1
\end{pmatrix}
$$

$$
T = {}^{0}A_1 \cdot {}^{1}A_2 \cdot {}^{2}A_3 =
\begin{pmatrix}
S_1 & 0 & C_1 & C_1 q_3 \\
-C_1 & 0 & S_1 & S_1 q_3 \\
0 & -1 & 0 & q_2 \\
0 & 0 & 0 & 1
\end{pmatrix}
\qquad
\begin{aligned}
x &= C_1\, q_3 \\
y &= S_1\, q_3 \\
z &= q_2
\end{aligned}
$$

- Cinemática inversa:

$$\boxed{z = q_2}$$

$$x^2 + y^2 = C_1^2\, q_3^2 + S_1^2\, q_3^2 = q_3^2 \underbrace{(C_1^2 + S_1^2)}_{1}$$

$$\boxed{q_3 = \sqrt{x^2 + y^2}}$$

$$
\begin{aligned}
x &= C_1 \cdot q_3 \;\to\; \cos q_1 = \frac{x}{q_3} \\
y &= S_1\, q_3 \;\to\; \operatorname{sen} q_1 = \frac{y}{q_3}
\end{aligned}
\left.\right\}\;
tg\, q_1 = \frac{y/q_3}{x/q_3} = \frac{y}{x}
$$

$$\boxed{q_1 = arctg\left(\frac{y}{x}\right)}$$