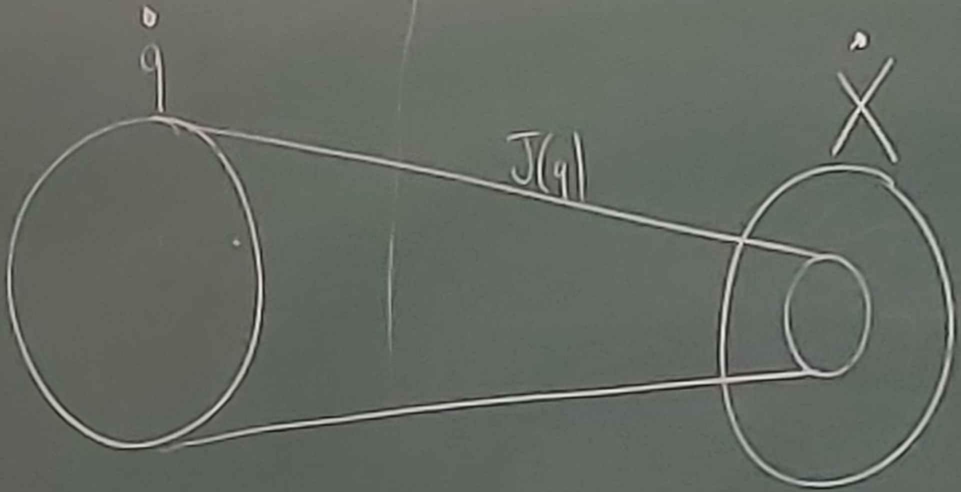
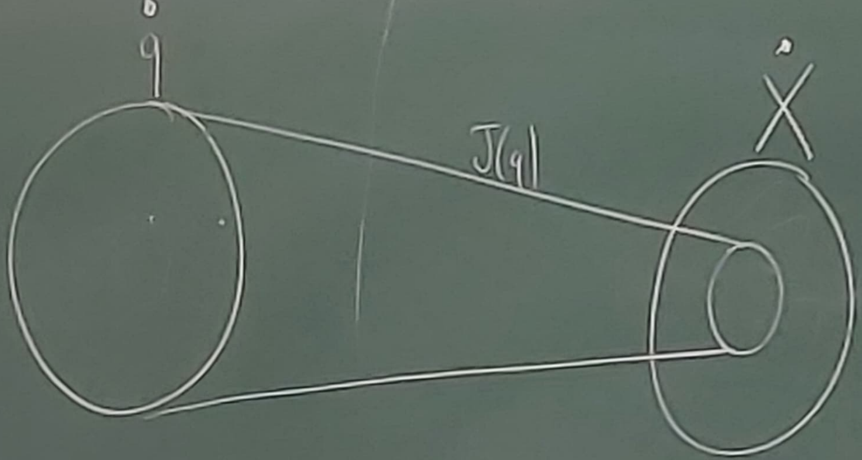
$J(q)$



$$\dot{X} = J(q)\,\dot{q}$$

$$X = \left(\quad \right) \qquad \begin{pmatrix} \dot{q}_1 \\ \vdots \\ \dot{q}_n \end{pmatrix}$$

$J(q)$



$$\underbrace{q \longrightarrow T_{0n}(q)}_{\text{robot}} \longrightarrow \underbrace{X}_{\text{tâche}}$$

$$\overbrace{\dot q \longrightarrow \begin{matrix} dp \\ d\varphi \end{matrix}}^{} \longrightarrow \overbrace{\dot X}^{}$$

$$\dot X = J(q)\,\dot q$$

$$dX = J(q)\,dq$$

$$\dot X = ($$

$$\begin{pmatrix} \dot q_1 \\ \vdots \\ q_n \end{pmatrix}$$

$$z_{5(4)}$$

$$T_{45} = \left(\begin{array}{ccc|c} c_5 & -s_5 & \boxed{0} & 0 \\ 0 & 0 & \boxed{1} & 0 \\ -s_5 & -c_5 & \boxed{0} & 0 \\ \hline 0 & 0 & 0 & 1 \end{array}\right)$$

$$z_{5(4)} = y_{4(4)}$$

$$\downarrow$$

$$z_{5(3)} = y_{4(3)} = \begin{pmatrix} -s_4 \\ c_4 \\ 0 \end{pmatrix}$$

$$T_{56} = \left(\begin{array}{ccc|c} c_6 & -s_6 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ s_6 & c_6 & 0 & 0 \\ \hline 0 & 0 & 0 & 1 \end{array}\right)$$

$$R_{ij} = \begin{array}{c|ccc} & x_j & y_j & z_j \\ \hline x_i & a & & \\ y_i & b & & \\ z_i & c & & \end{array}$$

$$z_6(5) = -y_5(5)$$

$$z_6(4) = -y_5(4) = \begin{pmatrix} s_5 \\ 0 \\ c_5 \end{pmatrix}$$

$$z_6(3) = s_5 \cdot x_4(3) + c_5\, z_4(3)$$

$$= s_5 \begin{pmatrix} c_4 \\ s_4 \\ 0 \end{pmatrix} + c_5 \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$$

$$\overrightarrow{O_2O_3}_{(2)}$$

$$T_{23} = \begin{array}{l} \\ \vec{y}_{2(3)} \\ \vec{Z}_{2(3)} \\ \\ \end{array} \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & -q_3 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \qquad T_{45} = \begin{pmatrix} c_5 & -s_5 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -s_5 & -c_5 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$\vec{Z}_{4(3)} \quad \overrightarrow{O_3O_4}_{(3)}$$

$$T_{34} = \begin{pmatrix} c_4 & -s_4 & 0 & 0 \\ s_4 & c_4 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{pmatrix} \qquad T_{56} = \begin{pmatrix} c_6 & -s_6 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ s_6 & c_6 & 0 & 0 \end{pmatrix}$$

$$\underline{0}$$

$$\underline{O_1O_4}_{(1)} = \underline{O_1O_2}_{(1)} + \underline{O_2O_4}_{(1)}$$

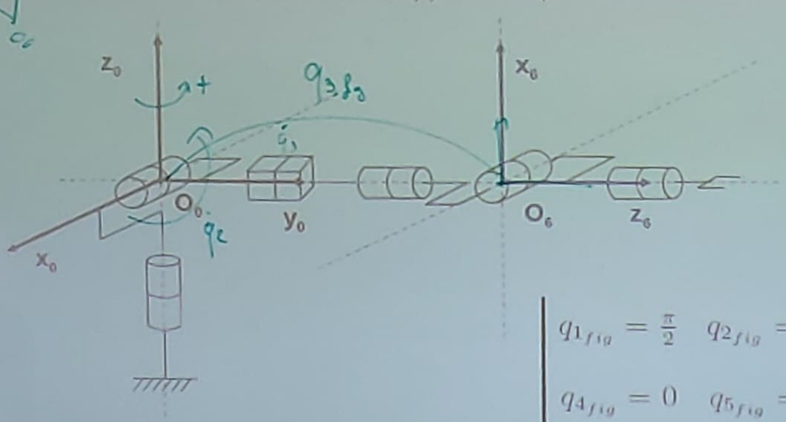
$$= \underbrace{\underline{O_1O_2}_{(1)}}_{=0} + \underline{O_2O_3}_{(1)} + \underbrace{\underline{O_3O_4}_{(1)}}_{=0}$$

$$\underline{O_2O_3}_{(2)} = \begin{pmatrix} 0 \\ -q_3 \\ 0 \end{pmatrix} = -q_3\, y_{2(1)}$$

$$\underline{O_2O_3}_{(1)} = -q_3 \begin{pmatrix} 0 \\ 0 \\ -1 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ q_3 \end{pmatrix}$$

MDD RRPRRR : Validation

- On valide le calcul de $\overrightarrow{dp}_{(0)}$ et $\overrightarrow{d\varphi}_{(0)}$ → Configuration figure



$$q_{1_{fig}} = \frac{\pi}{2} \quad q_{2_{fig}} = \frac{\pi}{2} \quad q_{3_{fig}} = O_2O_3$$

$$q_{4_{fig}} = 0 \quad q_{5_{fig}} = 0 \quad q_{6_{fig}} = 0$$

$$\dot{p} = \begin{pmatrix} -q_{3f} \cdot \dot{q}_1 \\ \dot{q}_3 \\ q_{3f} \cdot \dot{q}_2 \end{pmatrix}$$

$$\dot{\varphi} = \begin{pmatrix} \dot{q}_2 + \dot{q}_5 \\ \dot{q}_4 + \dot{q}_6 \\ \dot{q}_1 \end{pmatrix}$$

$$\begin{pmatrix} d\rho \\ d\varphi \end{pmatrix} \longrightarrow \begin{pmatrix} d\underline{x}_\rho \\ d\underline{x}_R \end{pmatrix}$$

$$\underline{O_0 O_{n+1}} \quad \underline{O_0 O_n} + \underline{O_n O_{n+1}}$$

$$\rho_0 \quad \rho_{0,n}$$

$$d\underline{x}_\rho = d\,\underline{O_0 O_{n+1}} - d\rho_{0,n+1} = d\,\underline{O_0 O_n} + d\,\underline{O_n O_{n+1}}$$

$$= d\rho_{0,n} - d\rho_{0,n+1}$$

$$d\underline{x}_{\rho_{(i)}} = d\rho_{0,n_{(i)}} + d\varphi_{(i)} \wedge \rho_{n,n+(i)} \qquad - d\varphi_1 \wedge \rho_{n,n+1}$$