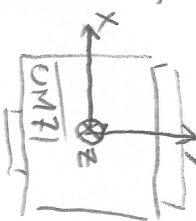


Convention

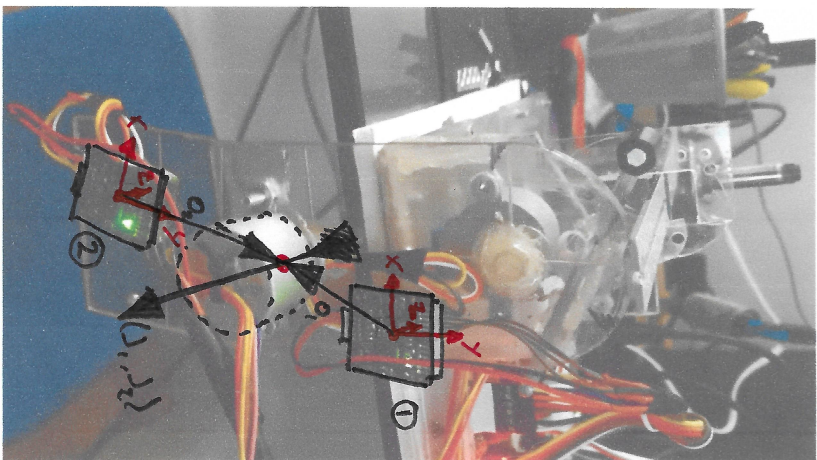


$$\begin{cases} j_1 = (-0.1, 0, -1) \\ j_2 = (0, 0, -1) \end{cases}$$

QUANTITATIVE

$$x = (\theta_1, \phi_1, \theta_2, \phi_2)$$

$$s_1 = \sin(x_1) \text{ etc.}$$



j-vectors

$$\frac{de}{dx} = \frac{de}{dj} \cdot \frac{dj}{dx}$$

O-vectors

$$\frac{de}{dx} = \frac{de}{do} \cdot \frac{do}{dx}$$

$$\begin{bmatrix} \frac{(g_1 \times j_1) \times g_1}{\|g_1 \times j_1\|_2} \\ \frac{(g_2 \times j_2) \times g_2}{\|g_2 \times j_2\|_2} \end{bmatrix}_k$$

6x1

$$\begin{bmatrix} \frac{dj_1}{d\theta_1} & \frac{dj_1}{d\phi_1} & \frac{dj_2}{d\theta_2} & \frac{dj_2}{d\phi_2} \\ -s_1 c_1 & -c_1 s_1 & 0 & 0 \\ c_1 c_2 & -s_1 s_2 & 0 & 0 \\ 0 & c_2 & 0 & 0 \\ 0 & 0 & -s_3 c_4 & -c_3 s_4 \\ 0 & 0 & c_3 c_4 & -s_3 s_4 \\ 0 & 0 & 0 & c_4 \end{bmatrix}_k$$

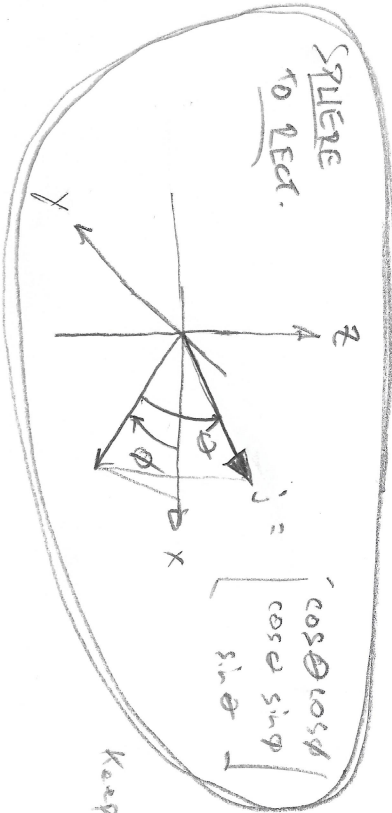
Error Vectors

$$\begin{cases} e_j = \|j_1 \times g_1\|_2 - \|j_2 \times g_2\|_2 \\ e_0 = \|a_1 - T_{g_1}^T(o_1)\|_2 - \|a_2 - T_{g_2}^T(o_2)\|_2 \end{cases}$$

$$\begin{bmatrix} \frac{T_{g_1}^T(a_1 - T_{g_1}^T(o_1))}{\|a_1 - T_{g_1}^T(o_1)\|_2} \\ \frac{T_{g_2}^T(a_2 - T_{g_2}^T(o_2))}{\|a_2 - T_{g_2}^T(o_2)\|_2} \end{bmatrix}_k$$

$$\begin{bmatrix} \cdot \\ \cdot \\ \cdot \end{bmatrix}$$

SQUARE TO RECT.



Keep angle  $< 2\pi$ .

QUANTITATIVE

$$\begin{cases} o_1 = (1, -1, 0) \\ o_2 = (0, 1, 0) \end{cases}$$

(Direction only, not unit vectors)

$$T_{g_1}^T(o_1) = g_1 \times (g_1 \times o_1) + \dot{g}_1 \times o_1$$