

$$\begin{bmatrix} W_0 \\ G_1 \end{bmatrix} T = \begin{bmatrix} W_0 \\ B \\ 0 \end{bmatrix} T \begin{bmatrix} 0 \\ 6 \end{bmatrix} T \begin{bmatrix} 6 \\ G_1 \end{bmatrix} T$$

$$\begin{bmatrix} 0 \\ 6 \end{bmatrix} T = \begin{bmatrix} W_0 \\ 0 \end{bmatrix} T^{-1} \begin{bmatrix} W_0 \\ G_1 \end{bmatrix} T \begin{bmatrix} 6 \\ G_1 \end{bmatrix} T^{-1}$$

$$\begin{Bmatrix} {}^0P_6 \end{Bmatrix} = \begin{Bmatrix} {}^0P_4 \end{Bmatrix} = \begin{Bmatrix} {}^0X_4 \\ {}^0Y_4 \\ {}^0Z_4 \end{Bmatrix}$$

$$\theta_1 = \text{atan2}({}^0Y_4, {}^0X_4)$$

$$C_1 = \cos \theta_1$$



$$E = 2L_h \left(L_1 - \frac{{}^0X_4}{C_1} \right); \quad F = 2L_h {}^0Z_4; \quad G = \frac{{}^0X_4^2}{C_1^2} + L_1^2 + L_h^2 - L_4^2 + {}^0Z_4^2 - 2 \frac{L_1 {}^0X_4}{C_1}$$

$$t_{1,2} = \frac{-F \pm \sqrt{E^2 + F^2 - G^2}}{G - E}$$

$$S_{21,2} = \sin \theta_{21,2}; \quad C_{21,2} = \cos \theta_{21,2}$$



$$\theta_{21,2} = 2 \tan^{-1}(t_{1,2})$$

$$\theta_{41,2} = \text{atan2} \left(-{}^0Z_4 - L_h S_{21,2}, \frac{{}^0X_4}{C_1} - L_1 - L_h C_{21,2} \right) - \theta_{21,2}$$

$$\begin{bmatrix} {}^3R(\theta_5, \theta_6, \theta_7) \end{bmatrix} = \begin{bmatrix} {}^0R(\theta_1, \theta_2, \theta_3) \end{bmatrix}^{-1} \begin{bmatrix} {}^0R \end{bmatrix} = \begin{bmatrix} R_{11} & R_{12} & R_{13} \\ R_{21} & R_{22} & R_{23} \\ R_{31} & R_{32} & R_{33} \end{bmatrix}$$

$$\theta_5 = \text{atan2}(R_{33}, R_{13})$$

$$\theta_7 = \text{atan2}(-R_{22}, R_{21})$$

$$\theta_6 = \text{atan2} \left(\frac{R_{21}}{C_7}, -R_{23} \right)$$

$$\uparrow \\ \cos \theta_7$$