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20245360 - Homework #1
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① We have $${}^{B}_{A}T = \left[\begin{array}{c|c} {}^{B}_{A}R & {}^{B}P_{A\_ORG} \\ \hline 0\,0\,0 & 1 \end{array}\right]$$

$$\Rightarrow \quad {}^{A}_{B}T = \left({}^{B}_{A}T\right)^{-1} = \left[\begin{array}{c|c} \left({}^{B}_{A}R\right)^{-1} & -\left({}^{B}_{A}R\right)^{-1}\,{}^{B}P_{A\_ORG} \\ \hline 0\,0\,0 & 1 \end{array}\right]$$

- $$\left({}^{B}_{A}R\right)^{-1} = \left({}^{B}_{A}R\right)^{T} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0.6 & -0.8 \\ 0 & 0.8 & 0.6 \end{bmatrix}$$

- $$-\left({}^{B}_{A}R\right)^{-1}\,{}^{B}P_{A\_ORG} = -\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0.6 & -0.8 \\ 0 & 0.8 & 0.6 \end{bmatrix}\begin{bmatrix} 3 \\ -1 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} -3 \\ 1.4 \\ 0.2 \end{bmatrix}$$

$$\Rightarrow \quad {}^{A}_{B}T = \left[\begin{array}{ccc|c} 1 & 0 & 0 & -3 \\ 0 & 0.6 & -0.8 & 1.4 \\ 0 & 0.8 & 0.6 & 0.2 \\ \hline 0 & 0 & 0 & 1 \end{array}\right]$$

$${}^{A}P = {}^{A}_{B}T\,{}^{B}P = \begin{bmatrix} -2 \\ -3.6 \\ 10.2 \end{bmatrix}$$

(2) a) • $R^T = \begin{bmatrix} 0 & 1/\sqrt{2} & -1/\sqrt{2} \\ 1/\sqrt{2} & 1/2 & 1/2 \\ 1/\sqrt{2} & -1/2 & -1/2 \end{bmatrix} = R^{-1}$

and • $\det R = 1$

$\Rightarrow$ R is a rotation matrix

b) The equivalent rotation axis is $(0.5774, 0.8165, 0)$ and the angle is 2.0944 radians $\sim 120°$

d) Z-X-Z Euler angles : $(0.9553, 2.0944, -0.9553)$ radians

$\sim (54.73, 120, -54.73)$ degree

e) Euler parameters (or Quaternion) : $(0.5, 0.5, 0.7071, 0)$

0.5 → scalar number, 0.5 → x, 0.7071 → y, 0 → z

c) Z-Y-X Fixed angles : $(1.5707, 0.7853, 2.3561)$ radians

(Z, Y, X)

$\sim (90, 44.99, 135)$ degree