

* Problem 1

(a) Solved using MATLAB.

Rzyz : $\phi = \frac{-0.5236}{0.7137} \text{ rad}$
 (relative) $\theta = 1.0472 \text{ rad}$
 $\psi = 2.3562 \text{ rad}$

$\phi = \frac{2.6180}{2.4279} \text{ rad}$
 $\theta = -1.0472 \text{ rad}$
 $\psi = -0.7854 \text{ rad}$

(b) Solved using MATLAB

RPY : $\phi = \frac{0.0600}{0.0717} \text{ rad}$
 (absolute) $\theta = \frac{-0.4813}{0.5404} \text{ rad}$
 $\psi = \frac{0.6847}{0.8571} \text{ rad}$

$\phi = \frac{-3.0816}{3.0679} \text{ rad}$
 $\theta = \frac{-2.6603}{2.6012} \text{ rad}$
 $\psi = \frac{-2.4569}{2.2815} \text{ rad}$

(c) ~~Axis~~ Solved using MATLAB

Axis-Angle : $\theta = 2.0310 \text{ rad}$
 (absolute)

$k = \begin{bmatrix} 0.5831 \\ 0.0768 \\ 0.8086 \end{bmatrix}$

0.5834

0.0768

0.8086

* Problem 2

Solved using MATLAB

$$H = \begin{bmatrix} 0.4698 & 0.1107 & 0.8758 & 0.5000 \\ -0.8660 & 0.2500 & 0.4330 & 0.0000 \\ -0.1710 & -0.9619 & 0.2133 & 0.0000 \\ 0.0000 & 0.0000 & 0.0000 & 1.0000 \end{bmatrix}$$

* Problem 3

Solved using MATLAB.

NOTE: The given matrix is NOT a generic rotation matrix.

$$|R| = 2\sin^2\psi \cdot \sin^2\theta - 2\sin^2\theta + 1$$

$$R \cdot R^T = \begin{bmatrix} 1 & 0 & -2\cos^2\psi \cos\theta \\ 0 & 1 & -2\cos\psi \sin\psi \sin\theta \\ -2\cos^2\psi \cos\theta & -2\cos\psi \sin\psi \sin\theta & 1 \end{bmatrix}$$

However, observing closely, we see that if $\theta = n\pi$ for $n = 0, 1, 2, \dots$, $\sin\theta = 0$

$$\therefore |R| = (2\sin^2\psi) \cdot 0 - 2(0) + 1 = 1$$

$$\text{and } R \cdot R^T = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = I$$

Hence in this case, R can be a rotation matrix.

* Problem 4

Solved using MATLAB.

There is no feasible solⁿ to satisfy the conditions of rotation matrix for the given matrix.

NOTE: If the last element (r_{33}) of the given matrix was also unknown, it could have the following possible solⁿs so as to satisfy the conditions of a generic rotation matrix:

$$r_{33} = \{-1/\sqrt{2}, -1, 1\} \leftarrow \text{any of these values satisfies the conditions of a rotation matrix (with given matrix } r_{12} = r_{21} = 0.707 = 1/\sqrt{2}).$$

* Problem 5

Solved using MATLAB.

* Problem 6

Proved using MATLAB.