CS 6360 HW 2

Brett Fotheringham, Tyrell Turley

September 30th, 2019

1. In one sentence, explain what the following homogeneous transformation accomplishes when applied to point (x,y,z) in terms of yaw, pitch, roll, and translation.

   Answer

   It is a forty five degree rotation around the z-axis and then a negative 1 translation in the x and a positive 2 translation in the y.

2. $\mathbf{T}_2 =$

$$\left(\begin{bmatrix} 1 & 0 & 0 & 3 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix}\right)\left(\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \frac{1}{\sqrt{2}} & \frac{-1}{\sqrt{2}} & 0 \\ 0 & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}\right)$$

3. $(\mathbf{T_2 T_1})^{-\mathbf{1}} =$

$$\begin{bmatrix} \frac{1}{\sqrt{2}} & \frac{1}{2} & \frac{1}{2} & -2\sqrt{2} \\ \frac{-1}{\sqrt{2}} & \frac{1}{2} & \frac{1}{2} & 0 \\ 0 & \frac{-1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & -2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

4. Find $\mathbf{q}_1$, $\mathbf{q}_2$, and their product $\mathbf{q_1} \circ \mathbf{q_2}$

$$\mathbf{q_1} = (w_1, x_1, y_1, z_1)$$
$$w_1 = \frac{\sqrt{1 + \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}} + 1}}{2} = \frac{\sqrt{2+\sqrt{2}}}{2}$$
$$x_1 = \frac{(0-0)}{w_1} = 0$$
$$y_1 = \frac{(0-0)}{w_1} = 0$$
$$z_1 = \frac{\frac{1}{\sqrt{2}} - \frac{-1}{\sqrt{2}}}{w_1} = \frac{2\sqrt{2}}{\sqrt{2+\sqrt{2}}}$$
$$\mathbf{q_1} = (\frac{\sqrt{2+\sqrt{2}}}{2},\ 0,\ 0,\ \frac{2\sqrt{2}}{\sqrt{2+\sqrt{2}}})$$

$$\mathbf{q_2} = (w_2, x_2, y_2, z_2)$$
$$w_2 = \frac{\sqrt{1 + 1 + \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}}}{2} = \frac{\sqrt{2+\sqrt{2}}}{2}$$
$$x_2 = \frac{\frac{1}{\sqrt{2}} - \frac{-1}{\sqrt{2}}}{w_1} = \frac{2\sqrt{2}}{\sqrt{2+\sqrt{2}}}$$
$$y_2 = \frac{(0-0)}{w_1} = 0$$
$$z_2 = \frac{(0-0)}{w_1} = 0$$
$$\mathbf{q_2} = (\frac{\sqrt{2+\sqrt{2}}}{2},\ \frac{2\sqrt{2}}{\sqrt{2+\sqrt{2}}},\ 0,\ 0)$$

$$\mathbf{q_1} \circ \mathbf{q_2} = (w, x, y, z)$$
$$w = (\frac{1}{2} + \frac{\sqrt{2}}{4}) - 0 - 0 - 0 = \frac{1}{2} + \frac{\sqrt{2}}{4}$$
$$x = \sqrt{2} + 0 + 0 - 0 = \sqrt{2}$$
$$y = 0 + 0 + \frac{8}{2\sqrt{2}} - 0 = \frac{8}{2\sqrt{2}}$$
$$z = 0 + \sqrt{2} + 0 - 0 = \sqrt{2}$$
$$\mathbf{q_1} \circ \mathbf{q_2} = (\frac{1}{2} + \frac{\sqrt{2}}{4},\ \sqrt{2},\ \frac{8}{2\sqrt{2}},\ \sqrt{2})$$