

Assignment 6 – ECE4560

Brett Erickson

1. 5 hours
2. Completed the survey.

3a) $\mathbf{g}_q = \begin{bmatrix} 1 & 0 & 0 & 5 \\ 0 & 0 & -1 & 6 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$R_{\text{QUADCOPTER}} = R_x(\frac{\pi}{2}) \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{bmatrix} \quad \theta = \frac{\pi}{2}$

$\mathbf{g}_c = \begin{bmatrix} 0 & 0 & -1 & 4 \\ 0 & 1 & 0 & 3 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$\mathbf{g}_m = \begin{bmatrix} 0 & -\sqrt{2}/2 & -\sqrt{2}/2 & 6 \\ 0 & \sqrt{2}/2 & -\sqrt{2}/2 & 3 \\ 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$R_{MC} = R_{\text{chassis}}$

$R_{MX} = R_x(\frac{\pi}{4}) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{bmatrix} \quad \theta = \frac{\pi}{4}$

$\Delta y = d_3 - d_2 = 6 - 3 = 3$

$\Delta x = d_4 - d_1 = 5 - 4 = 1$

$\Delta z = d_5 = 3$

$\mathbf{p}_{cm}^1 = [-1, 3, 3]^T$

3b) $R_z(\frac{\pi}{2}) = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ -1 & 0 & 0 \end{bmatrix}$

$\Delta x = -3$

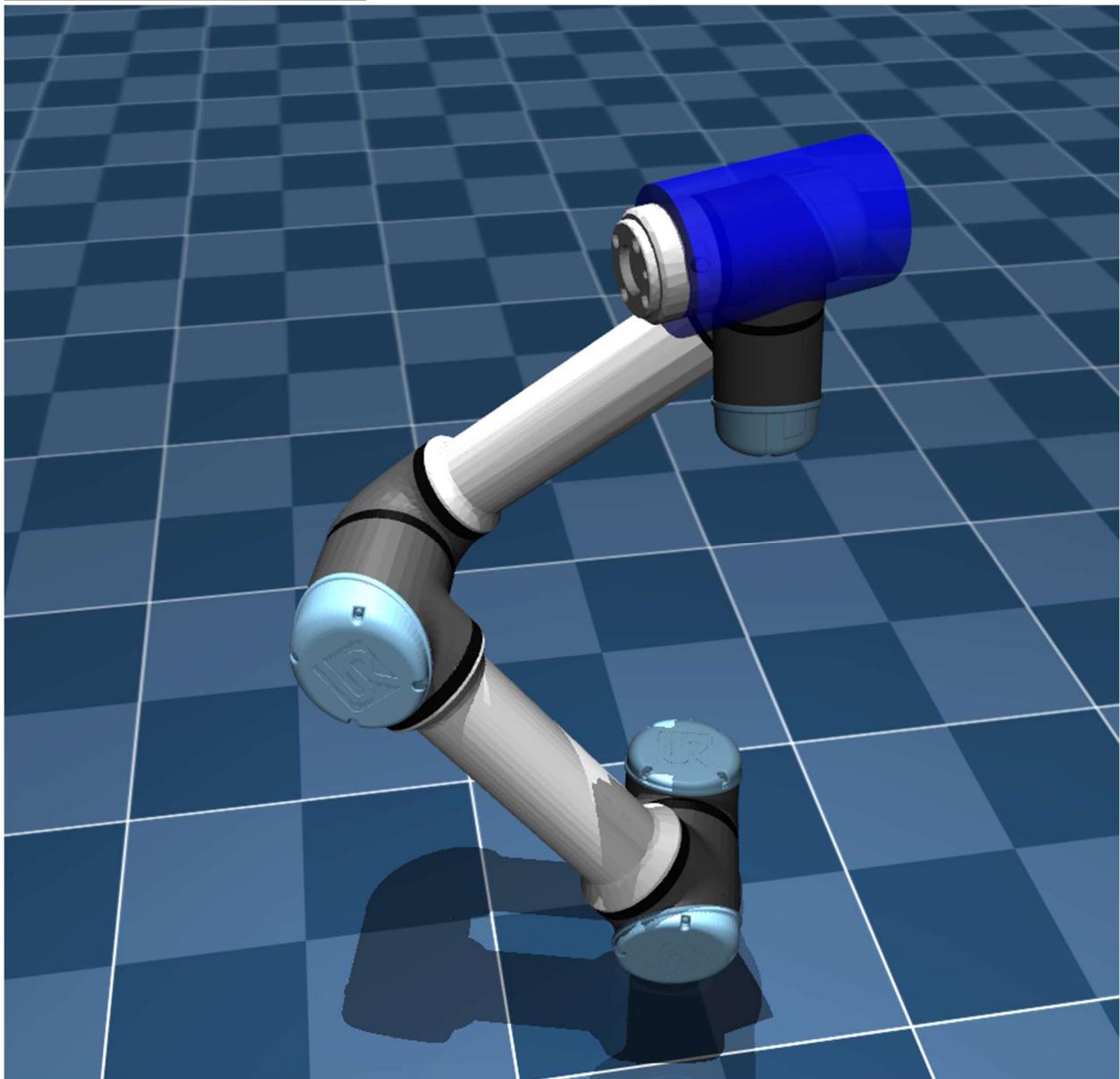
$\Delta y = 1 \quad \Delta p = [3, 1, 0]^T$

$\mathbf{g} = \begin{bmatrix} 0 & 0 & 1 & -3 \\ 0 & 1 & 0 & 1 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

4.

```
# Obtain all Rotation Matrices
R1 = rot_z(theta1) # This rotation is in
R2 = rot_y(theta2)
R3 = rot_y(theta3)
R4 = rot_y(theta4)
R5 = rot_z(-theta5)
R6 = rot_y(theta6)

# Obtain all Displacement Vectors
d1 = np.array([[0], [0], [0.163]]) # This
d2 = np.array([[0], [0.138], [0]])
d3 = np.array([[0.425], [-0.131], [0]])
d4 = np.array([[0.392], [0], [0]])
d5 = np.array([[0], [0.127], [0]])
d6 = np.array([[0], [0], [-0.1]])
# dt = np.array([[0], [0.1], [0]])
```



5. Rodrigo went to perform the checkoff for our group.

Finishing the robotic arm code was relatively straightforward, all we had to do was write the get_xx() functions to gain the transformation matrices based on the robot definition of each frame for each DOF.