

HOMEWORK 5 ECE 4560

1. a) $\mathbf{g}_{ab} = (d_1 + R(\theta_1)d_2, R(\theta_1)R(\theta_2))$

b)

$$\begin{bmatrix} R(\theta_1) & d \\ 0 & 1 \end{bmatrix}$$

c) $\mathbf{g}^{-1} = (-R^T d_1, R^T) = \begin{bmatrix} R^T & -R^T d \\ 0 & 1 \end{bmatrix}$

d) $R(\theta) = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$

e) $\begin{bmatrix} \hat{\mathbf{x}}_s \\ \hat{\mathbf{y}}_b \end{bmatrix} = \mathbf{g}_{sb} \mathbf{g}_{sb}^{-1}$
 $= \mathbf{g}_{sb}^{-1} \hat{\mathbf{y}}_{sb}$

2) a) $\mathbf{g}_e(\vec{\alpha}) = g_{wa} \mathbf{g}_{ab} \mathbf{g}_{bc} \mathbf{g}_{ce}$

$$= \begin{bmatrix} R(\alpha_1) & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} R(\alpha_2) & \alpha_2 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} R(\alpha_3) & \alpha_3 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} R(\alpha_4) & \alpha_4 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} R(\alpha_5) & \alpha_5 \\ 0 & 1 \end{bmatrix}$$

WHERE $R(\theta) = \begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix}$

c) $\mathbf{g}_e(\vec{\alpha}_1)^{-1} \mathbf{g}_e(\vec{\alpha}_2)$

d) $h^{-1} \mathbf{g}_e(\vec{\alpha}_1)^{-1} \mathbf{g}_e(\vec{\alpha}_2) h$

3) a) TO SIMPLIFY, TAKING $-z_c \rightarrow -\hat{y}_{LEG}$ & $y_c \rightarrow \hat{x}_c$

$$\Rightarrow \mathbf{g}_f = \underbrace{\begin{bmatrix} R(\theta_1) & 0 \\ -L & 1 \end{bmatrix}}_{\mathbf{R}_1} \cdot \underbrace{\begin{bmatrix} R(\theta_2) & 0 \\ 0 & 1 \end{bmatrix}}_{\mathbf{R}_2} \cdot \underbrace{\begin{bmatrix} R(\theta_3) & w \\ 0 & 1 \end{bmatrix}}_{\mathbf{R}_3}$$

a) $-v -v$