ECE 141 Homework 4

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Problem 1

We have that

$$\beta = \arctan(\frac{l_r}{l_r + l_f}\tan(u))$$

therefore

$$\tan(\beta) = \frac{l_r}{l_r + l_f}\tan(u)$$

therefore since the range of tan is $-\infty$ to ∞ for any β we can find a u that satisfies the equation.

Problem 2

We have that

$$\frac{d}{dt}y = v\sin(\psi + \beta)$$

$$\frac{d}{dt}\psi = \frac{v}{l_R}\sin(\beta)$$

$$\beta = \arctan(\frac{l_r}{l_r + l_f}\tan(u))$$

Linearizing around $\psi = 0$ $\beta = 0$, we have

$$\frac{d}{dt}y = v(\psi + \beta)$$

$$\frac{d}{dt}\psi = \frac{v}{l_R}\beta$$

$$\beta = \frac{l_r}{l_r + l_f}u$$

therefore taking the laplace transform we have

$$sY = v(\psi + \beta)$$

$$s\psi = \frac{v}{l_r}\beta$$

$$\beta = \frac{l_r}{l_r + l_f}U$$

Therefore we get

$$sY = v(\frac{v + l_r}{l_r + l_f}U)$$

$$\frac{Y}{U} = \frac{v(l_r + v)}{s(l_r + l_f)}$$