Lab 6 Notes

I. Scaling DSA TF to desired form.

The desired form of the TF is given in Eq 6.2.

$$\frac{V_{tach}}{V_i}(s) = K_c \, K \cdot K_{tach} \cdot K_{amp} \cdot \frac{(1+\tau_z s)}{(1+\tau_p s)(1+\tau_m s)}$$

This is in gain-phase form. The DSA data is given as Eq 6.4:

$$K \cdot \frac{(s+z)}{(s+p_1)(s+p_2)}$$

This can be misleading because the roots are given in Hertz.

To see what this means, we must analyze the variable 's'.

$s = j\omega$ lets call $\bar{s} = jf \longrightarrow \bar{s} = j\frac{\omega}{2\pi}$

Then the DSA actually gives us

$$K \cdot \frac{(\bar{s}+z)}{(\bar{s}+p_1)(\bar{s}+p_2)} = K \frac{(\frac{s}{2\pi}+z)}{(\frac{s}{2\pi}+p_1)(\frac{s}{2\pi}+p_2)}$$

Putting this into gain-phase form, we get

$$\frac{K \cdot z}{p_1 \cdot p_2} \cdot \frac{(\frac{s}{2\pi z}+1)}{(\frac{s}{2\pi p_1}+1)(\frac{s}{2\pi p_2}+1)}$$

Now we can equate the gain and roots to equation 6.2 to determine the motor parameters.

II. Generating mag/phase data from a related TF's mag/phase data

Let's say we have a known TF $G(s)$ with mag/phase data given.

Let $H(s) = \frac{KG(s)}{s}$. We want to find the mag/phase data for $H(s)$.

if our data is: $\omega = [.1 \quad 1 \quad 10 \; \ldots]$ rad/s

$|G| = [20 \quad 0 \quad -20 \; \ldots]$ dB $= [10 \quad 1 \quad 0.1 \; \ldots]$

$\angle G = [-90 \quad -90 \quad -90 \; \ldots]$ degrees

we know: $|H| = \frac{|K| \cdot |G|}{|j\omega|} = \frac{|K| \cdot |G|}{|\omega|}$

and $\angle H = \angle K + \angle G - \angle j\omega = \angle G - 90°$

so we get: $|H| = \left[\frac{|K| \cdot 10}{0.1} \quad \frac{|K| \cdot 1}{1} \quad \frac{|K| \cdot 0.1}{10} \; \ldots \right] = [100|K| \quad |K| \quad 0.01|K|]$

$\angle H = [-180 \quad -180 \quad -180 \; \ldots]$ degrees.

This concept can be applied to any relationship between G and H.