I. Scaling DSA TF to desired form.

The desired form of the TF is given as Eq 6.2:

\[
\frac{V_{\text{ref}}}{V_i} = K_0 K \cdot \frac{K_{\text{inv}} K_{\text{amp}}}{(1 + T_p s)(1 + T_{\text{inv}} s)}.
\]

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

\[
K \cdot \frac{\frac{s + 2}{s + 3}}{(s + p)(s + p^2)}.
\]

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

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

\[s = jw \quad \text{let's call } 3 + jf \quad \Rightarrow s = j\frac{3f}{2}
\]

Then the DSA actually gives us:

\[
K \cdot \frac{\frac{s + 2}{s + 3}}{(s + p)(s + p^2)} = K \cdot \frac{\frac{\frac{3f}{2} + 2}{\frac{3f}{2} + 3}}{(\frac{3f}{2} + p)(\frac{3f}{2} + p^2)}.
\]

Putting this into gain-phase form, we get:

\[
K' \cdot \frac{\frac{s}{2s + 1}}{p_1 \cdot p_2} = \frac{\frac{\frac{3f}{2} + 2}{\frac{3f}{2} + 3}}{(\frac{3f}{2} + p_1)(\frac{3f}{2} + p_2)}.
\]

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

If our data is: \(w = [1 \quad 10 \quad ...] \text{ rad/s}\)

\(\angle G = [20 \quad 0 \quad -20 \quad ...] \text{ degrees}\)

\(\angle G = [-90 \quad -90 \quad -90 \quad ...] \text{ degrees}\)

We know: \(\angle H = \frac{\angle G - \angle G}{\angle G} = \frac{\angle G}{\angle G}\)

And \(\angle H = 2K + \angle G - 2\angle w = 2G - 90^\circ\)

So we get: \(\angle H = \begin{bmatrix} 100 & 1 \end{bmatrix} \begin{bmatrix} 1 \end{bmatrix} = \begin{bmatrix} 100k \end{bmatrix}\)

\(\angle H = [-180 \quad -180 \quad -180 \quad ...] \text{ degrees}\).

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