servo motor block diagram and transfer function

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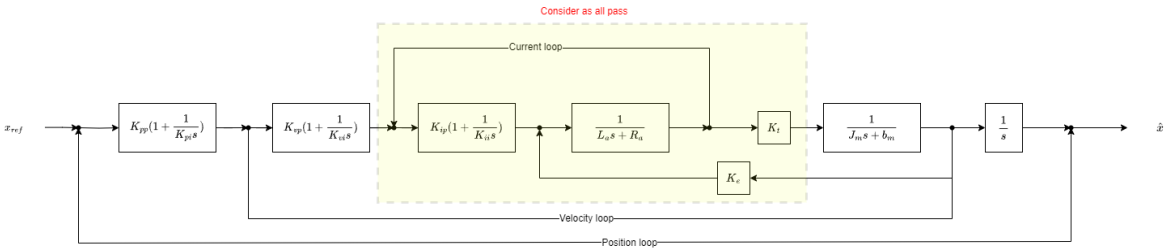

Figure 1: block diagram

1 transfer function

let

$$\begin{cases} G_p = K_{pp}(1+\frac{1}{K_{pi}s}) \\ G_v = K_{vp}(1+\frac{1}{K_{vi}s}) \end{cases}$$

$$velocity-loop = \frac{G_v(\frac{1}{J_m s+b_m})}{1+G_v(\frac{1}{J_m s+b_m})} = \frac{G_v}{(J_m s+b_m)+G_v}$$

$$position-loop = \frac{G_p(\frac{G_v}{(J_m s+b_m)+G_v})}{1+G_p(\frac{G_v}{(J_m s+b_m)+G_v})} = \frac{G_v G_p}{J_m s+b_m+G_v+G_v G_p}$$

$$\text{for } G_v G_p = \frac{K_{pp}K_{vp}(K_{pi}K_{vi}s^2+(K_{pi}+K_{vi})s+1)}{K_{pi}K_{vi}s^2}$$

$$\text{let } J_m s+b_m+G_v+G_v G_p = \frac{as^3+bs^2+c^s+d}{K_{pi}K_{vi}s^2}$$

$$\begin{cases} a = K_{pi}K_{vi}J_m, \\ b = K_{vp}K_{pi}K_{vi}+K_{pi}K_{vi}b_m+K_{pp}K_{vp}K_{pi}K_{vi}, \\ c = K_{pi}K_{vp}+K_{pp}K_{vp}(K_{pi}+K_{vi}), \\ d = K_{pp}K_{vp} \end{cases}$$

$$\frac{\hat{x}}{x_{ref}} = \frac{K_{pp}K_{vp}(K_{pi}K_{vi}s^2 + (K_{pi} + K_{vi})s + 1)}{as^3 + bs^2 + c^s + d}$$