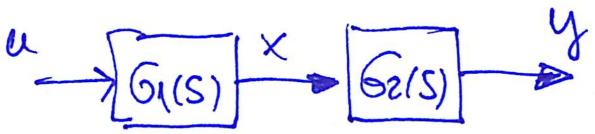
Aufgabe 1 – Kompensation dynamischer Fehler



$\omega_{gm} = 2\pi \left[\frac{rad}{s}\right]$

$K_m = 1 \left[\frac{V}{K}\right]$

$G_1(s) = \frac{K_m}{1 + s \cdot T_m}$

$\omega e_{max} = 2\pi \left[\frac{rad}{s}\right]$

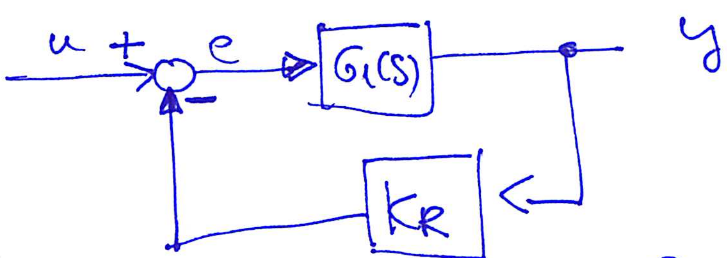
Bestimmen Sie die Elemente (T_{K1} und T_{K2}) des Kompensators

$G_2(s) = K_K \cdot \frac{(1 + s \cdot T_{K1})}{1 + s \cdot T_{K2}} = K_K \frac{1 + \frac{s}{\omega_{K1}}}{1 + \frac{s}{\omega_{K2}}}$ so das

$\omega_g = 20 \cdot \pi \left[\frac{rad}{s}\right]$ (Grenzfrequenz des Gesamtsystems).

Bestimmen Sie K_K, so das $K = 2 \left[\frac{V}{K}\right]$ (Gesamtverstärkung)

Aufgabe 2 Kompensation durch Rückführung



Bestimmen Sie

$G(s) = \frac{Y(s)}{U(s)}$

$G_1(s) = \frac{K_m}{1 + s \cdot T_m}$

$G_K(s) = K_R$

- wie ändert sich die Grenzfrequenz in abhängigkeit von K_R?
- wie viel ist die Gesamtverstärkung wenn $K_R \gg K_m$?

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Aufgabe

Dynamischer Fehler → Kompensator

$$u \rightarrow \boxed{G_1(s)} \xrightarrow{x} \boxed{G_2(s)} \rightarrow y$$

$$G_1(s) = \frac{K_m}{1+s\cdot T_m} = K_m \cdot \frac{1}{1+\frac{s}{\omega_{gm}}}$$

$$G_2(s) = \frac{K_K\cdot(1+sT_{K1})}{1+s\cdot T_{K2}} = K_K \cdot \frac{1+\frac{s}{\omega_{K1}}}{1+\frac{s}{\omega_{K2}}}$$

$\omega_{gm} = 2\pi \left[\frac{rad}{s}\right]$

$K_m = 1 \left[V/K\right]$

$\omega_{e\,max} = 2\pi \left[\frac{rad}{s}\right]$

Kompensator $G_2(s)$, so dass $\omega_g \approx 10 \cdot \omega_{e\,max}$

$\omega_g = 20\cdot\pi \left[\frac{rad}{s}\right]$

$$\left.\begin{matrix}(f_g = 10\,Hz)\\ K = 2\left[V/K\right]\end{matrix}\right\} \text{Verstärker}$$

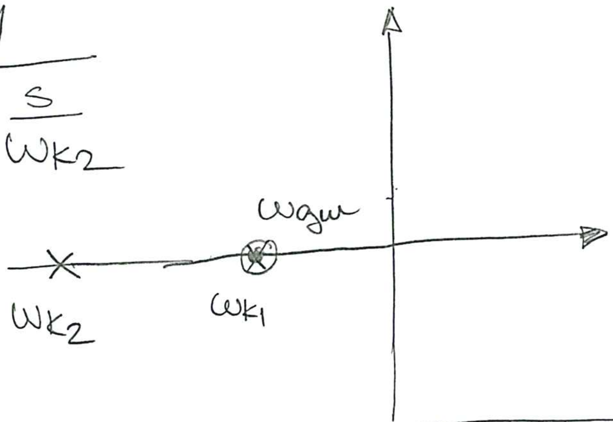
$$G_1(s)\cdot G_2(s) = K_m \cdot \frac{1}{\cancel{1+s\cdot\frac{1}{\omega_{gm}}}} \cdot K_K \cdot \frac{\cancel{1+\frac{s}{\omega_{K1}}}}{1+\frac{s}{\omega_{K2}}}$$

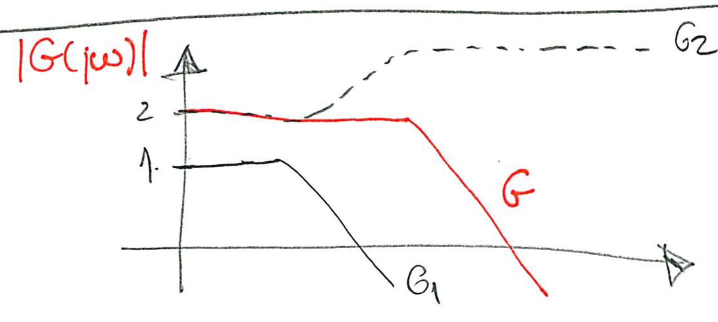
$\omega_{K1} = \omega_{gm}$ → Pol mit ω_{gm} wird gekürzt

$$G(s) = G_1(s)\cdot G_2(s) = K_m \cdot K_K \cdot \frac{1}{1+\frac{s}{\omega_{K2}}}$$

$$\omega_{K2} = \omega_g = 20\,\pi \left[\frac{rad}{s}\right]$$

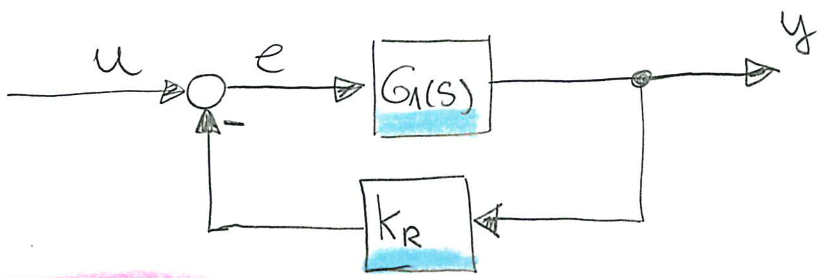
$$K_K = K/K_m = \frac{2[V/K]}{1[V/K]} = 2$$





Matlab!

Kompensation durch Rückführung



$$G(s) = \frac{Y(s)}{U(s)}$$

$$G_1(s) = \frac{K_m}{1+s\cdot T_m}$$

$$\left.\begin{array}{l} e = u - y\cdot K_R \\ y = e\cdot G_1(s) \end{array}\right\} \quad y = (u - y\cdot K_R)\cdot G_1(s)$$

$$Y(s) = U\cdot G_1(s) - Y(s)\cdot K_R\cdot G_1(s)$$

$$Y(s)\left(1 + K_R\cdot G_1(s)\right) = U(s)\cdot G_1(s)$$

$$\frac{Y(s)}{U(s)} = \frac{G_1(s)}{1+K_R\cdot G_1(s)} = \frac{\frac{K_m}{1+s\cdot T_m}}{1+K_R\cdot\frac{K_m}{1+s\cdot T_m}}$$

$$= \frac{\frac{K_m}{\cancel{1+s\cdot T_m}}}{\frac{1+s\cdot T_m + K_R\cdot K_m}{\cancel{1+s\cdot T_m}}} = \frac{K_m}{(1+K_R K_m)+s\cdot T_m} =$$

$$G(s) = \frac{K_m}{1+K_R\cdot K_m}\cdot\frac{1}{1+s\cdot\frac{T_m}{K_R\cdot K_m}}$$

$$\boxed{G(s) = K_e\cdot\frac{1}{1+s\cdot T_e}}$$

$$K_e = \frac{K_m}{1+K_R\cdot K_m} \approx \frac{\cancel{K_m}}{K_R\cdot \cancel{K_m}} = \frac{1}{K_R}$$

$$(K_R\cdot K_m \gg 1)$$

$$T_e = \frac{T_m}{K_R\cdot K_m}$$

$$\omega_e = \omega_m\cdot(K_R\cdot K_m)$$

erhöhter Grenzfrequenz