Regelungs- und Systemtechnik 1

Sommer 10

Überblick Standardübertragungsglieder

Elementare Übertragungsglieder

Bezeichnung	Diffentialgleichung	Übertragungsfkt	Bemerkung
P-Glied	$y(t) = K_P\, u(t)$	$G(s) = K_P$	Proportionalglied
I-Glied	$y(t) = K_I \int_0^t u(\tau) d\tau$	$G(s) = \frac{K_I}{s}$	Integrierglied
D-Glied	$y(t) = K_D\, \dot{u}(t)$	$G(s) = K_D s$	Differenzierglied (nicht realisierbar)
T_1-Glied	$T_1 \dot{y}(t) + y(t) = u(t)$	$G(s) = \frac{1}{T_1 s+1}$	Verzögerungsglied 1. Ordnung
T_τ-Glied	$y(t) = u(t-\tau)$	$G(s) = e^{-\tau s}$	Totzeitglied

Einfache Reihenschaltungen

D-T_1-Glied	$T_1 \dot{y}(t) + y(t) = K_D T_1 \dot{u}(t)$	$G(s) = K_D \frac{T_1 s}{T_1 s+1}$
P-T_1-Glied	$T_1 \dot{y}(t) + y(t) = K_P u(t)$	$G(s) = K_P \frac{1}{T_1 s+1}$

Standardregler (Parallelschaltungen)[1]

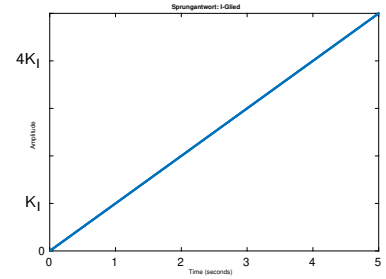
PI-Regler	$u(t) = K_P \left(e(t) + K_I \int_0^t e(\tau) d\tau \right)$	$C(s) = K_P \left(1 + \frac{K_I}{s} \right)$
PD-Regler*	$u(t) = K_P \left(e(t) + K_D \dot{e}(t) \right)$	$C(s) = K_P \left(1 + K_D s \right)$
PID-Regler*	$u(t) = K_P \left(e(t) + K_I \int_0^t e(\tau) d\tau + K_D \dot{e}(t) \right)$	$C(s) = K_P \left(1 + \frac{K_I}{s} + K_D s \right)$

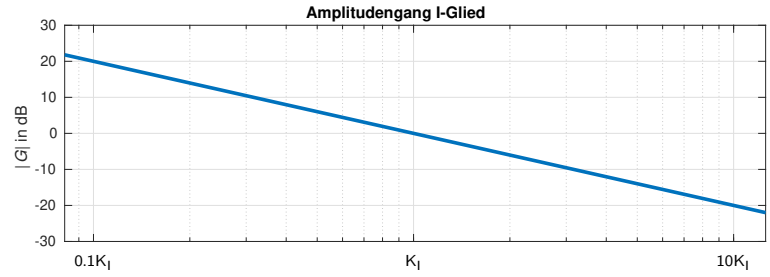
*) nicht ideal realisierbar

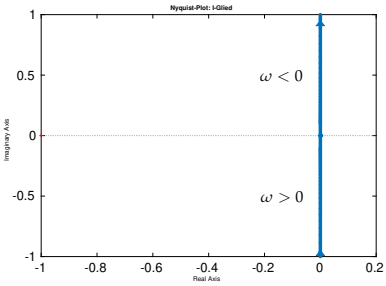
[1] Achtung: Häufig wird wie hier die proportionale Verstärkung K_P ausgeklammert, d. h. K_I und K_D entsprechen nicht denen des reinen Integrierers bzw. Differenzierers wie oben.

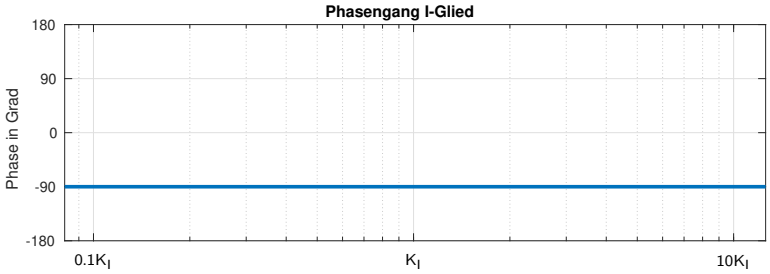
Sprungantwort, Ortskurve und Bode-Diagramm der Standardübertragungsglieder

I-Glied Frequenzgang: $G(j\omega) = \frac{K_I}{j\omega}, \quad \mathrm{Re}\{G(j\omega)\} = 0, \quad \mathrm{Im}\{G(j\omega)\} = \frac{-K_I}{\omega}$

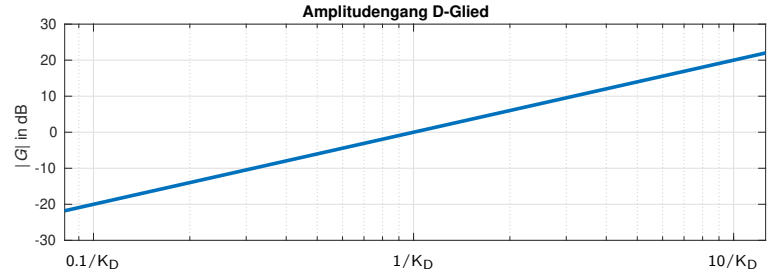


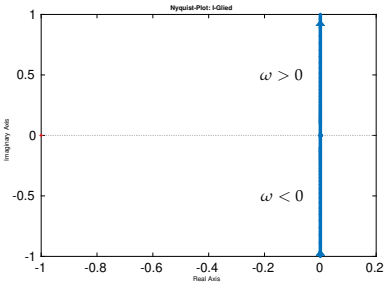


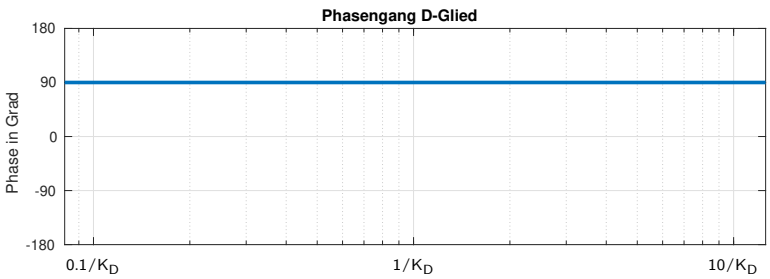




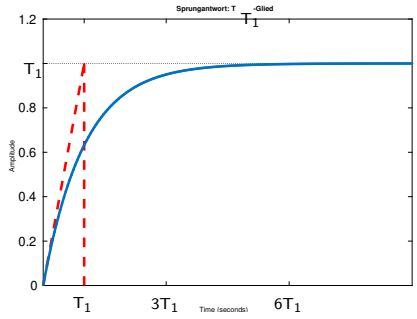
D-Glied Frequenzgang: $G(j\omega) = jK_D\omega, \quad \mathrm{Re}\{G(j\omega)\} = 0, \quad \mathrm{Im}\{G(j\omega)\} = K_D\omega$

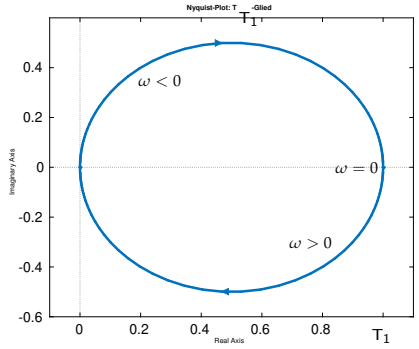


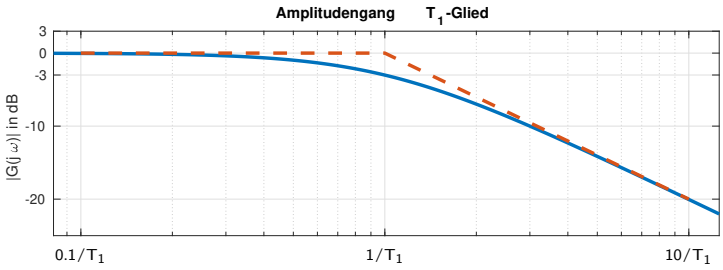


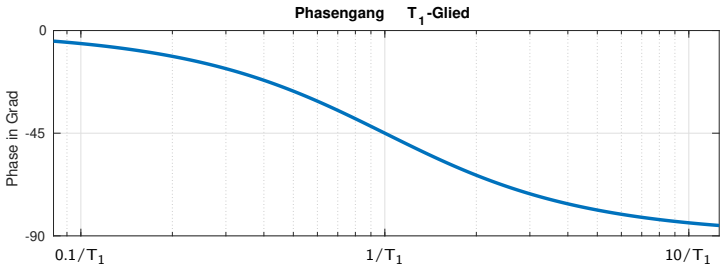


T_1-Glied Frequenzgang: $G(j\omega) = \frac{1}{1+jT_1\omega}$, $\mathrm{Re}\{G(j\omega)\} = \frac{1}{1+T_1^2\omega^2}$, $\mathrm{Im}\{G(j\omega)\} = \frac{-T_1\omega}{1+T_1^2\omega^2}$



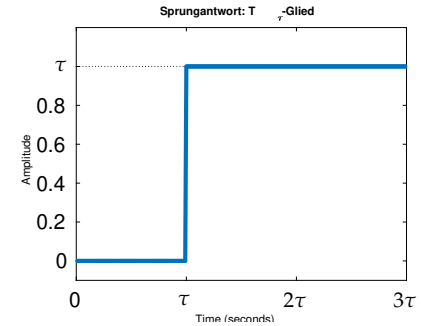


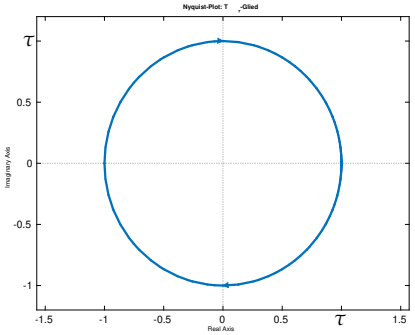


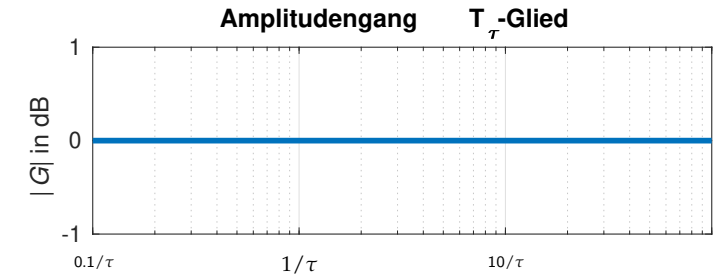


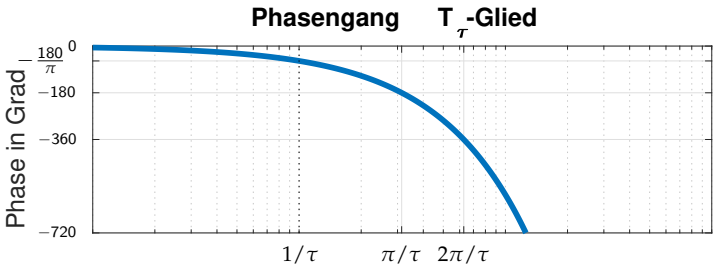
Totzeit-Glied Frequenzgang: $G(j\omega) = e^{-j\tau\omega}$, $\mathrm{Re}\{G(j\omega)\} = \cos\tau\omega$, $\mathrm{Im}\{G(j\omega)\} = -\sin\tau\omega$

Man beachte: Ist ω wie üblich in $[rad/s]$ gegeben, ergibt sich die Phase $\arg_s G(j\omega) = -\tau\omega$ in Radiant.









D-T$_1$-Glied Frequenzgang: $G(j\omega) = \dfrac{jK_DT_1\omega}{1+jT_1\omega}$, $\mathrm{Re}\{G(j\omega)\} = \dfrac{K_DT_1^2\omega^2}{1+T_1^2\omega^2}$, $\mathrm{Im}\{G(j\omega)\} = \dfrac{K_DT_1\omega}{1+T_1^2\omega^2}$