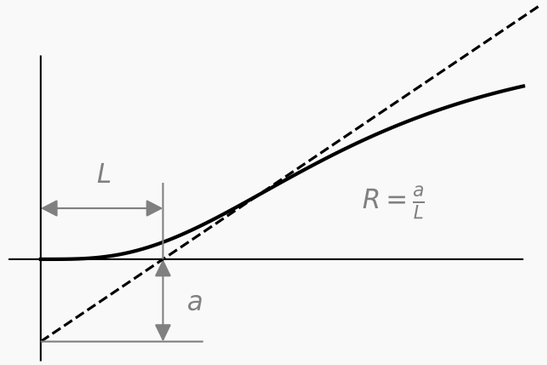
Empirisches Vorgehen

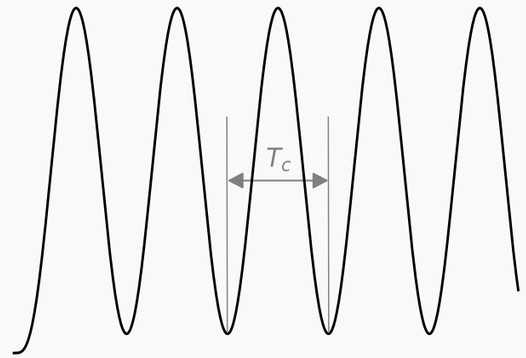
Offener Regelkreis (Sprungantwort)

Sprungantwort
$Y(s) = G(S)U_{step} => y(t)$
Wendetagente (max. Steigung)
Totzeit (Lag)
L
Steigung (Reaction Curve)
$R = \frac{a}{L}$



Geschlossener Regelkreis (Schwingversuch)

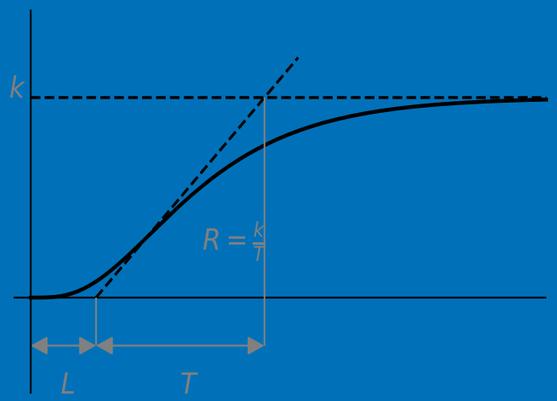
Offener Kreis
$L(s) = K_c G(s)$
Geschlossener Kreis
$T(s) = \frac{L(s)}{1+L(s)}$
Erhöhung der Konstante K_c
$Y(s) = T(s) \cdot U_{const} => y(t)$



Modellbasiertes Vorgehen

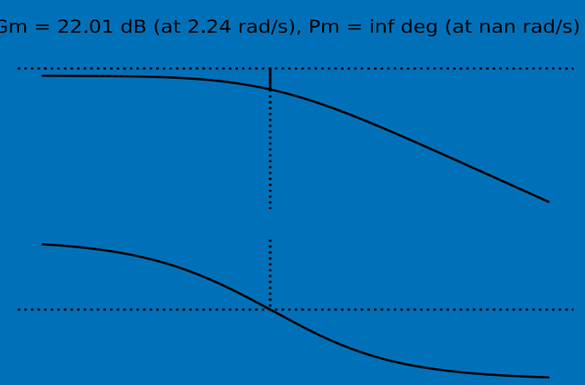
$$G(s) = \frac{b_m s^m + b_{m-1} s^{m-1} + b_0}{a_n s^n + a_{n-1} s^{n-1} + a_0}$$

Modellreduktion
$G_{red}(s) = \frac{k}{1+sT} e^{-sL}$
Umrechung
$a = RL = kL/T$



$$G(s) = \frac{b_m s^m + b_{m-1} s^{m-1} + b_0}{a_n s^n + a_{n-1} s^{n-1} + a_0}$$

Stabilitäsreserven
$G_M, P_M, \omega_{gc}, \omega_{pc} = control.margin(G)$
Kritische Werte
$K_c = G_M \infty, \omega_c = \omega_{gc}$
Offener Kreis
$L(j\omega_c) = K_c \cdot G(j\omega_c) = -1$
Kritische Periode
$T_c = 2\pi/\omega_c$



Einstellregeln

$L, a =>$

Reglertyp	K_p	T_i	T_d
P	$1/a$	-	-
PI	$0.9/a$	$3L$	-
PID	$1.2/a$	$4L$	$L/2$

$K_c, T_c =>$

Reglertyp	K_p	T_i	T_d
P	$0.5K_c$	-	-
PI	$0.4K_c$	$0.8T_c$	-
PID	$0.6K_c$	$0.5T_c$	$0.12T_c$