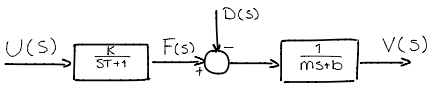
Farthållare

1) $m\frac{dv}{dt} = F(t) - bv(t) - d(t)$ $\quad \mathcal{L}\{1\}: (ms+b)V(s) = F(s) - D(s) \Rightarrow V(s) = \frac{1}{ms+b}(F(s) - D(s))$

2) $\frac{dF}{dt} = -\frac{1}{T}(F(t) - ku(t))$ $\quad \mathcal{L}\{2\}: F(s) = \frac{k}{sT+1}U(s)$

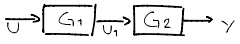


Poler i $s = \frac{-1}{T}$, $s = \frac{-b}{m}$

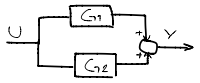
Negativa ⇒ Stabilt system

Blockschemaräkning

Seriekoppling: $Y(s) = G_1(s)G_2(s)U(s)$

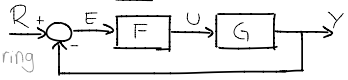


Parallellkoppling: $Y(s) = U(s)(G_1 + G_2)$



Återkoppling: $Y(s) = GF(R-Y)$

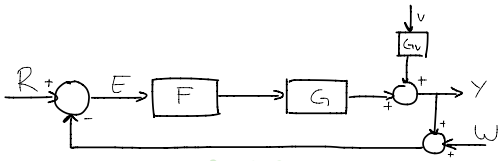
$Y = \frac{GF}{1+GF}R = \frac{L}{1+L}R$ Kretsöverföring



$Y = UG + VG_V$
$U = EF$
$E = R - Y - W$

$\Rightarrow Y = EFG + VG_V \Leftrightarrow Y = (R-Y-W)FG + VG_V \Leftrightarrow Y(1+FG) = (R-W)FG + VG_V \Leftrightarrow$

$Y = \frac{(R-W)FG + VG_V}{1+FG}$



$Y = \frac{GF}{1+GF}R - \frac{GF}{1+GF}W + \frac{G_V}{1+GF}V$

Superpos: $W = V = 0 \Rightarrow Y = \frac{GF}{1+GF}R$

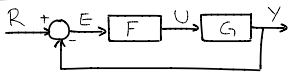
$V = R = 0 \Rightarrow Y = \frac{-GF}{1+GF}W$

$W = R = 0 \Rightarrow Y = Y_1 + G_V V = GU + G_V V = GFE + G_V V$

$= GF(R-Y) + G_V V = -GFY + G_V V$

$Y = \frac{G_V}{1+GF}V$

Kvarstående fel



Kom ihåg felet vid simuleringen av farthållaren. $E(s) = R(s) - Y(s) = R(s) - \frac{GF}{1+GF}R(s) = (1 - \frac{L}{1+L})R(s) = (\frac{1}{1+L})R(s)$ går även med $\frac{från}{1+krets} = \frac{1}{1+FG} = \frac{1}{1+L}$

Slutvärdessatsen

$t \to \infty$!

$\lim_{t\to\infty} e(t) = \lim_{s\to 0} sE(s)$

$r(t)$: enhetssteg $\Rightarrow R(s) = \frac{1}{s}$ $\quad \lim_{t\to\infty} e(t) = \lim_{s\to 0} sE(s) = \lim_{s\to 0} s\frac{1}{1+L(s)}\frac{1}{s} = \lim_{s\to 0}\frac{1}{1+L(s)} = \frac{1}{1+L(0)}$

Ex Farthållare

$G(s) = \frac{k}{(ms+b)(sT+1)}$

P: $F(s) = K_p$

PI: $F(s) = K_p + \frac{1}{s}K_i$

P: $u(t) = K_p e(t)$

PI: $u(t) = K_p e(t) + K_i \int_0^t e(\tau)d\tau = P + I$

PID: $K_p e(t) + K_i \int_0^t e(\tau)d\tau + K_d \frac{de(t)}{dt} = P + I + D$

P: $L = FG = \frac{K_p k}{(ms+b)(sT+1)}$

$\lim_{t\to\infty} e(t) = \lim_{s\to 0} sE(s) = \frac{1}{1+L(0)} = \frac{1}{1+\frac{K_p k}{b}} = \frac{b}{b+K_p k}$, K_p stor → e litet men aldrig 0.

PI: $L = FG = \frac{(K_p\frac{k_i}{s})k}{(ms+b)(sT+1)} = \frac{(K_p s + K_i)k}{s(ms+b)(sT+1)}$

$\lim_{t\to\infty} e(t) = \ldots = \frac{1}{1+L(0)} = \frac{1}{1+\infty} \to 0$ "bättre valet"