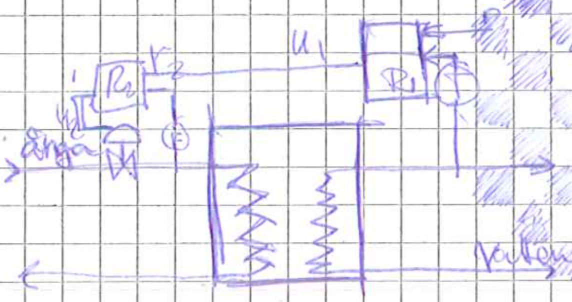
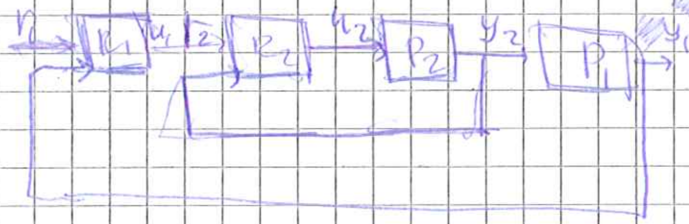
20/1-2012

(13)

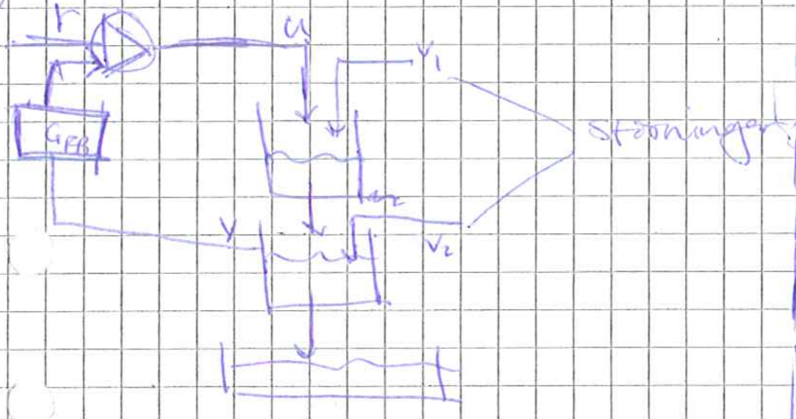
Kaskadreglering

Ex





Framkoppling



1) Störning på övre tanken

$U_{FF} = G_{FF} V_1$

$X_1 = V_1 + U_{FB} + G_{FF} V_1 = (1 + G_{FF}) V_1 + U_{FB}$

$G_{FF} = -1$ => V_1 påverkar ej Y

2) Störning på undre tanken

$X = V_2 + G_{P1}(U_{FB} + G_{FF} V_2)$

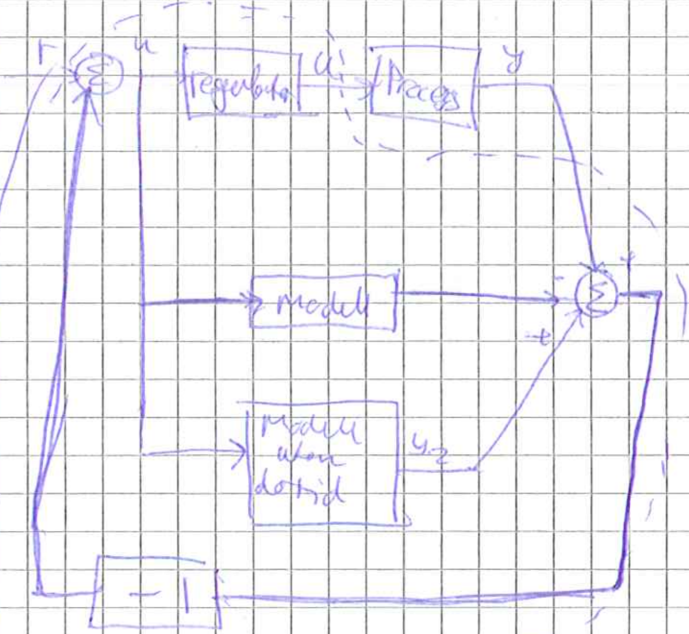
$X = (1 + G_{P1} G_{FF}) V_2 + G_{P1} U_{FB}$

$G_{FF} = -\frac{1}{G_{P1}}$ => V_2 påverkar ej y.

$G_{P1} = \frac{1}{s+a}$ $\quad u_{FF} = -(s+a)V_2$ derivering

$\frac{1}{G_{P1}} = s + a$

Dödtidskompensering



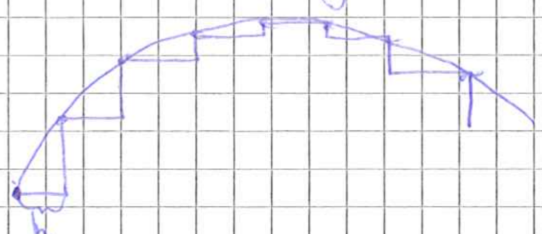
$U = G_{R0}(R - Y_* + Y_1 - Y_2) = G_{R0}(R - Y_2)$

$Y = G_{P0} e^{-sL} U$

$U = G_{R0}(R - G_{P0} U) = \frac{G_{R0}}{1 + G_{P0} G_{R0}} R$

$Y = G_{P0} e^{-sL} U = \frac{G_{P0} G_{R0}}{1 + G_{P0} G_{R0}} e^{-sL} R$

Sampling



Vikningseffekten

Samplingsperiod: h

Samplingsfrekvens: $\omega_s = \frac{2\pi}{h}$

Vi kan se frekvenser upp till $\omega_n = \frac{\omega_s}{2}$

Högre frekvenser uppfattas som lägre

1) Sampla tillräckligt ofta
2) Högre frekvenser måste filtreras bort

Diskretisering av PID-regulatorn

$$U = K\left[(bR - Y) + \frac{1}{sT_i}E - \frac{sT_d}{1+sT_d/N}Y\right]$$

$$u(kh) = P(kh) + I(kh) + D(kh)$$

P-delen:

$$u_p(t) = K(b \cdot r(t) - y(t))$$

$$P(kh) = K(br(kh) - y(kh))$$

I-delen:

$$u_I(t) = \frac{K}{T_i}\int e(t)dt$$

$$I(kh) = \frac{K}{T_i} h \sum_{k=0}^{k} e(ih) = I(kh-h) + \frac{Kh}{T_i}e(kh)$$

D-delen:

$$U_D = -\frac{sKT_d}{1+sT_d/N}Y$$

$$\left(1 + s\frac{T_d}{N}\right)U_D = -sKT_dY$$

$$u_d(t) + \frac{T_d}{N}\frac{du_d}{dt} = -KT_d\frac{dy}{dt}$$

$$D(kh) + \frac{T_d}{N}\frac{D(kh) - D(kh-h)}{h} = -KT_d\frac{Y(kh) - Y(kh-h)}{h}$$

$$\left(1 + \frac{T_d}{Nh}\right)D(kh) = \frac{T_d}{Nh}D(kh-h) - \frac{KT_d}{h}(y(kh) - Y(kh-h))$$

$$D(kh) = \frac{T_d}{T_d+Nh}D(kh-h) - \frac{KT_dN}{T_d+Nh}(y(kh) - Y(kh-h))$$

$$KT_d\frac{Y(kh) - Y(kh-h)}{h}$$