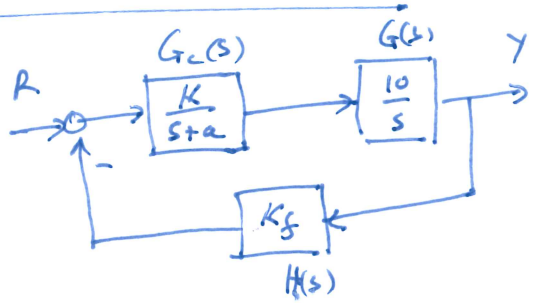
BASIC FEEDBACK DESIGN EXAMPLE

CONSIDER THE SYSTEM: $G(s) = \frac{10}{s}$.

PROBLEM: DESIGN A FEEDBACK SYSTEM USING A LAG COMPENSATOR WITH TF: $G_c(s) = \frac{K}{s+a}$, WHERE K and a ARE PARAMETERS TO BE DESIGNED; YOUR CLOSED LOOP SYSTEM HAS THE FOLLOWING PERFORMANCE REQUIREMENTS:

1) DC GAIN = 2
2) A 2% SETTLING TIME OF 16ms TO A STEP INPUT
3) A 16% OVERSHOOT TO A STEP INPUT.

SOLUTION: CLOSED LOOP CONFIGURATION:



$$\frac{Y}{R} = \frac{\frac{10K}{s(s+a)}}{1+\frac{10KK_f}{s(s+a)}} = \underbrace{\frac{10K}{s^2+as+10KK_f}}_{\text{2nd order system}}$$

$$\Rightarrow 2\zeta\omega_n = a \quad \text{AND} \quad \omega_n^2 = 10KK_f$$

$$\Rightarrow \zeta = \frac{a}{2\omega_n}$$

SETTLING TIME:

$$T_s = \frac{4}{\zeta\omega_n} = \frac{4}{\frac{a}{2\omega_n}\omega_n} = \frac{8}{a}$$

$T_s = 16ms \Rightarrow a = \frac{8}{16\times10^{-3}} = 500$

16% OVERSHOOT $\Rightarrow \zeta = 0.5$

$$\omega_n = \frac{a}{2\zeta} = \frac{500}{2\times0.5} = 500$$

$\Rightarrow 10KK_f = 500^2$

$\Rightarrow K = \frac{500^2}{10K_f}$.

DC GAIN OF 2 $\Rightarrow K_f = 0.5$

$\Rightarrow K = 5\times10^4$

SUMMARY OF DESIGN

$K_f = 0.5$

$a = 500$

$K = 50{,}000$

```
clear
close all

s = tf('s')
g = 10/s

Kf = 0.5

K = 5e4
a = 500
gc = K/(s+a)

g_cl = gc*g/(1+Kf*gc*g)

step(g_cl)

stepinfo(g_cl)
```

Command Window

New to MATLAB? See resources for Getting

```
ans =
  struct with fields:

        RiseTime: 0.0032781
    SettlingTime: 0.016152
     SettlingMin: 1.863
     SettlingMax: 2.3259
       Overshoot: 16.293
      Undershoot: 0
            Peak: 2.3259
        PeakTime: 0.0071841
```