```
close all
clear
format compact

s = tf('s')

%%%%%%%%%%

% unstable open loop system

g0 = 1
g = g0/(s-1) % unstable system, pole at s=+1

figure
step(g)

%%%%%%%%%%%%

% the following is improper feedback design

h = 4/3
gf = g/(1+g*h)
gfm = minreal(gf) % for pole zero cancellation

figure
step(gfm)

stepinfo(gfm)

%%%%%%%%%%%%%%%%%

% perturbed system

g0 = 1.1 % perturb the DC gain
g = g0/(s-1)

% step(g)
%
% h = 4/3

gf = g/(1+g*h)
gfm = minreal(gf)
figure
step(gfm)

inf = stepinfo(gfm)

error_pct = (3-inf.Peak)/3 *100  % large error

%%%%%%%%%%%%%%
%%%%%%%%%%%%%%

% Now look at a stable system
% (the following is also improper feedback design)

g0 = 1
```

```
g = g0/(s+1)   % stable system, pole at s=-1

figure
step(g)


h = -2/3  % ==> positive feedback ==> not good
gf = g/(1+g*h)
% gfm = minreal(gf) % for pole zero cancellation
gfm_zpk = minreal(zpk(gf))
% properties(zpk)
pole0 = gfm_zpk.P{1}


figure
step(gfm_zpk)

inf = stepinfo(gfm_zpk)
riseTime0 = inf.RiseTime


%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% perturbed system

g0 = 1.1
g = g0/(s+1)

h = -2/3

gf = g/(1+g*h)
gfm = minreal(gf)
figure
step(gfm)

inf = stepinfo(gfm)

error_pct = (3-inf.Peak)/3 *100  % large error, this highlights the problem

%%%%%%%%%%%%%%%%%%%%%%%%

% the following is proper feedback design approach

Kp = 27 % gives a closed loop DC gain of 2.7 (= 3 - 10% x 3)
gc = Kp      % minimum gain requirement

g0 = 1
g = g0/(s+1)

% figure
% step(g)


h = 1/3

gfp = g*gc/(1+g*gc*h)
```

```
% gfpm = minreal(gfp)
gfpm_zpk = minreal(zpk(gfp))
% properties(zpk)
pole1 = gfpm_zpk.P{1}


figure
step(gfpm_zpk)

% stepinfo(gfp)
inf = stepinfo(gfpm_zpk)

error_pct = (3-inf.Peak)/3 *100
riseTime1 = inf.RiseTime


%%%%

% perturbed system

Kp = 27
gc = Kp

g0 = 1.1   % low frequency gain is perturbed
g = g0/(s+1)

% step(g)

h = 1/3

gfp = g*gc/(1+g*gc*h)
gfpm = minreal(gfp)


figure
step(gfpm)

% stepinfo(gfp)
inf = stepinfo(gfpm)

error_pct = (3-inf.Peak)/3 *100


%%%%%%

% high loop gain

Kp = 1000   % this value greatly increases the loop gain
gc = Kp

g0 = 1   % *******
g = g0/(s+1)

figure
step(g)
```

```
h = 1/3

gfp = g*gc/(1+g*gc*h)
% gfpm = minreal(gfp)
gfpm_zpk = minreal(zpk(gfp))
% properties(zpk)
pole2 = gfpm_zpk.P{1}


figure
step(gfpm_zpk)

% stepinfo(gfp)
inf = stepinfo(gfpm_zpk)

error_pct = (3-inf.Peak)/3 *100
riseTime2 = inf.RiseTime

%%%%%%%%%%%%%%%%%%%%%%%%%%

% perturbed system

Kp = 1000   % *****
gc = Kp

g0 = 1.1   % *******
g = g0/(s+1)

figure
step(g)

h = 1/3

gfp = g*gc/(1+g*gc*h)
gfpm = minreal(gfp)


figure
step(gfpm)

% stepinfo(gfp)
inf = stepinfo(gfpm)

error_pct = (3-inf.Peak)/3 *100

%%%%%%%%%%%%%%%%%%%%
```