Table of Contents

Discrete Design of Pitch Controller

```
%Plant
clear
G=tf(37.2021,[1 0.2830 2.7452])

zeta=0.7;
wn=1;

Ts=0.3; % Because t_r = 3 sec therefore  Ts < t_r/6

G0=c2d(G,Ts)
% z=tf('z')
% Ka= .0693*((z-.8433)/(z-0.8827))
% rlocus(Ka*G0)
pole(G0)
zero(G0)
rlocus(G0);
zgrid(zeta,wn*Ts);
```

G =

```
         37.2
  --------------------
   s^2 + 0.283 s + 2.745
```

Continuous-time transfer function.

G0 =

```
     1.595 z + 1.55
  ----------------------
   z^2 - 1.687 z + 0.9186
```

Sample time: 0.3 seconds
Discrete-time transfer function.

ans =

```
   0.8433 + 0.4555i
   0.8433 - 0.4555i
```

```
ans =

    -0.9719
```

Root Locus
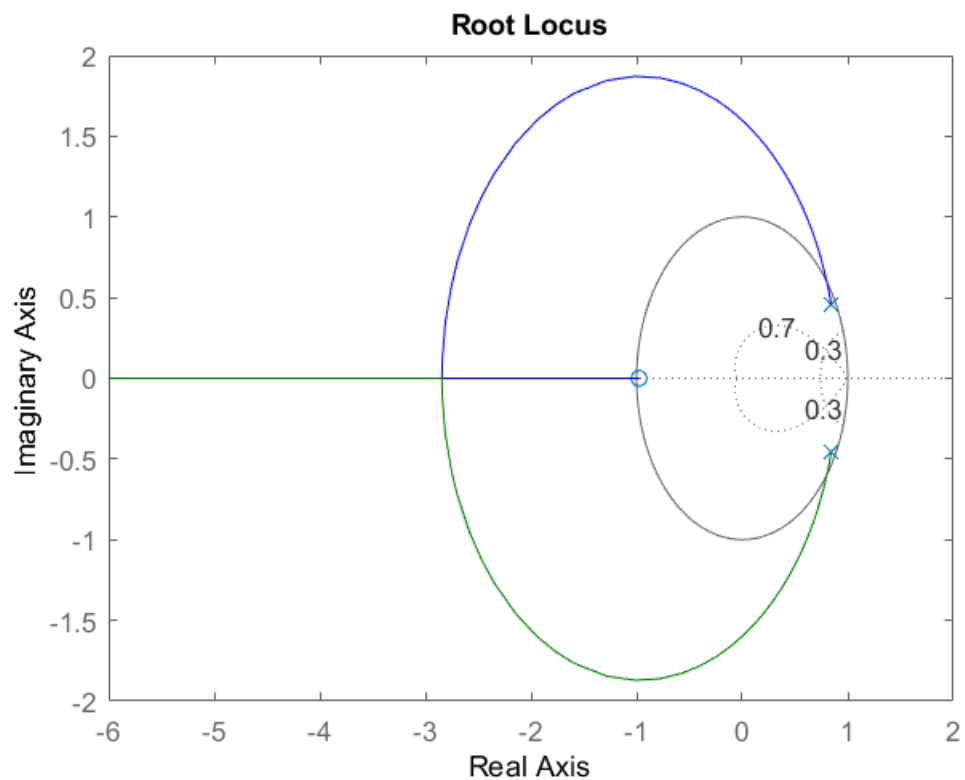
ContolleR

```
K1=tf([1 -1.687 .9186],[1 -1.6208 .6208],Ts)
K=0.0227*K1
G1=series(G0,K)
rlocus(G1)

zgrid(zeta,wn*Ts);
Gcl = feedback(G1,1)

%Step response
step(Gcl)
stepinfo(Gcl)


K1 =

  z^2 - 1.687 z + 0.9186
  ----------------------
  z^2 - 1.621 z + 0.6208
```

```
Sample time: 0.3 seconds
Discrete-time transfer function.


K =

  0.0227 z^2 - 0.03829 z + 0.02085
  ------------------------------
      z^2 - 1.621 z + 0.6208

Sample time: 0.3 seconds
Discrete-time transfer function.


G1 =

  0.0362 z^3 - 0.02589 z^2 - 0.0261 z + 0.03232
  ---------------------------------------------
  z^4 - 3.307 z^3 + 4.273 z^2 - 2.536 z + 0.5703

Sample time: 0.3 seconds
Discrete-time transfer function.


Gcl =

  0.0362 z^3 - 0.02589 z^2 - 0.0261 z + 0.03232
  ---------------------------------------------
  z^4 - 3.271 z^3 + 4.247 z^2 - 2.562 z + 0.6026

Sample time: 0.3 seconds
Discrete-time transfer function.


ans =

        RiseTime: 2.4000
    SettlingTime: 6.3000
     SettlingMin: 0.9510
     SettlingMax: 1.0420
       Overshoot: 4.1961
      Undershoot: 0
            Peak: 1.0420
        PeakTime: 4.5000
```
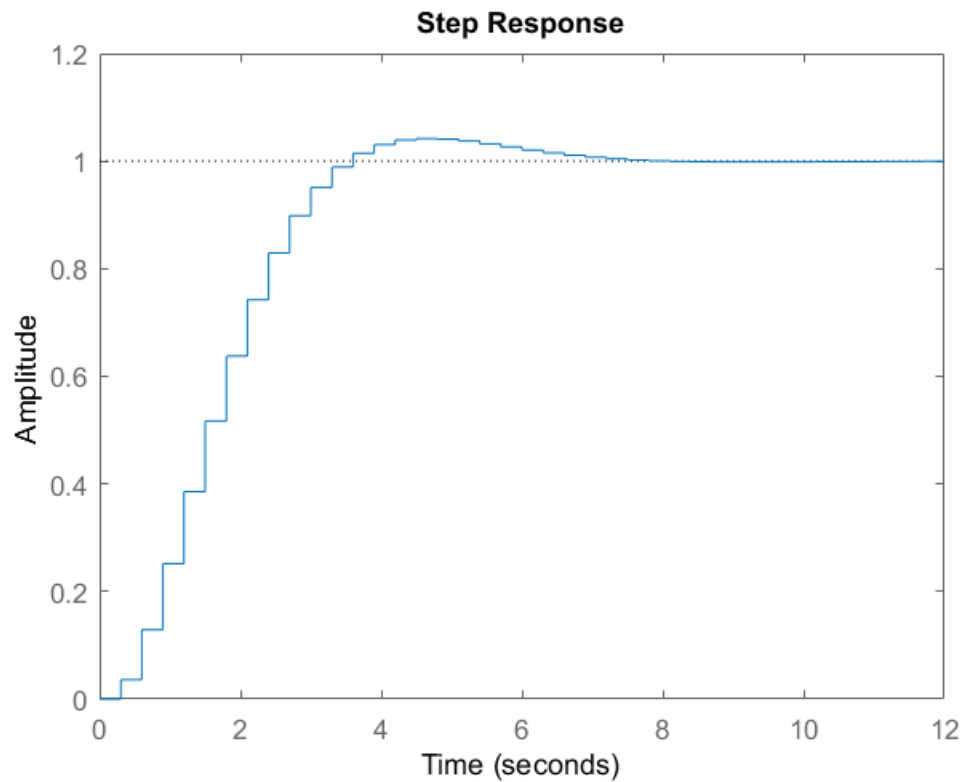
Step Response

Disturbance

```
Gdy=feedback(G0,K)
tfinal=40;
[yd,t]=step(Gdy,tfinal);

plot(t,yd,'*')
grid
xlabel('time (s)')
title('Response (y(n*Ts)) to step disturbance')
resp_dist=stepinfo(Gdy)


Gdy =

    1.595 z^3 - 1.035 z^2 - 1.522 z + 0.9621
  ---------------------------------------------
  z^4 - 3.271 z^3 + 4.247 z^2 - 2.562 z + 0.6026


Sample time: 0.3 seconds
Discrete-time transfer function.


resp_dist =

      RiseTime: 0
```
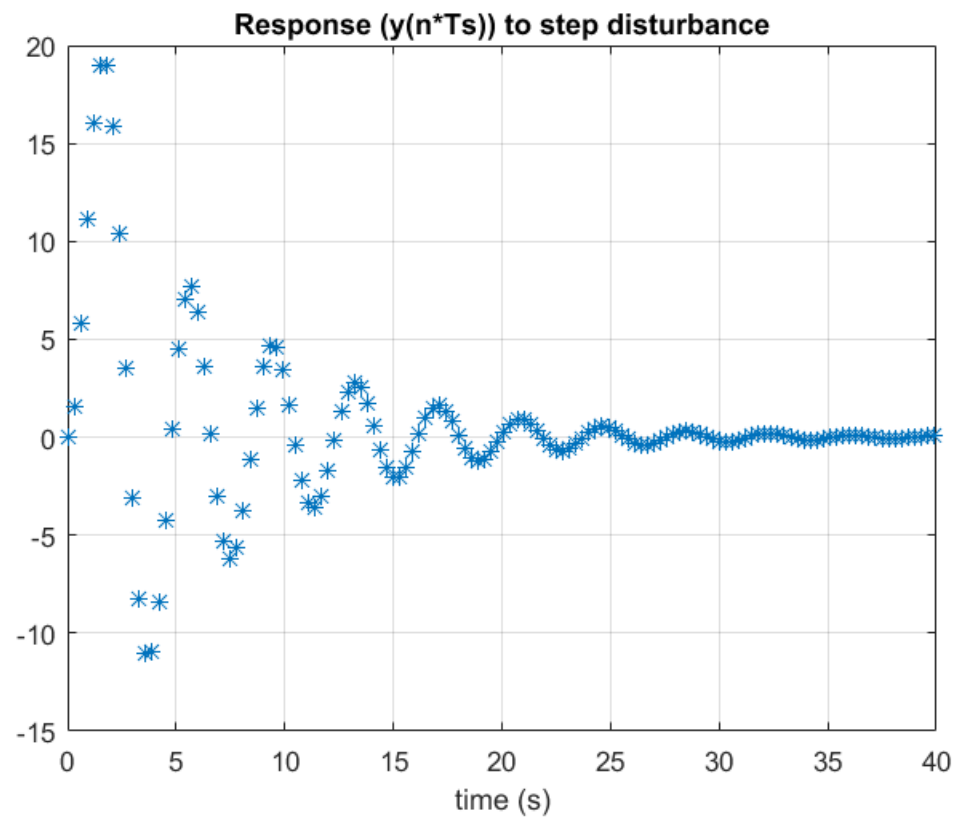
```
SettlingTime: 27
 SettlingMin: -11.0050
 SettlingMax: 18.9749
   Overshoot: 1.4127e+17
  Undershoot: 8.1933e+16
        Peak: 18.9749
    PeakTime: 1.5000
```


Response (y(n*Ts)) to step disturbance

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