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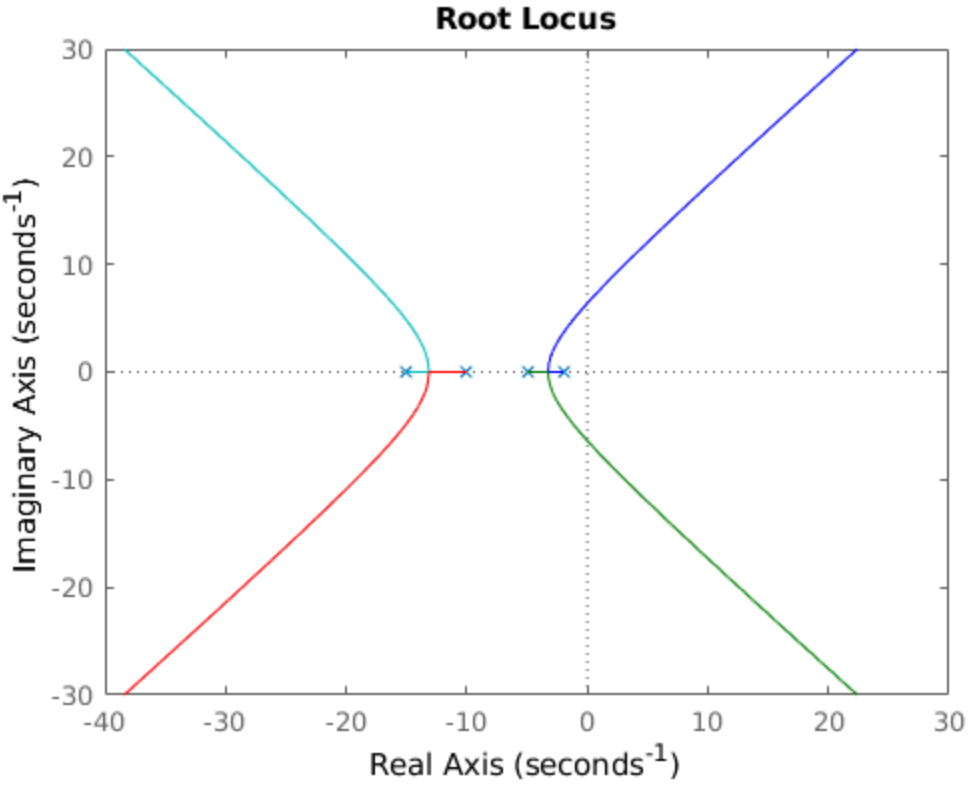
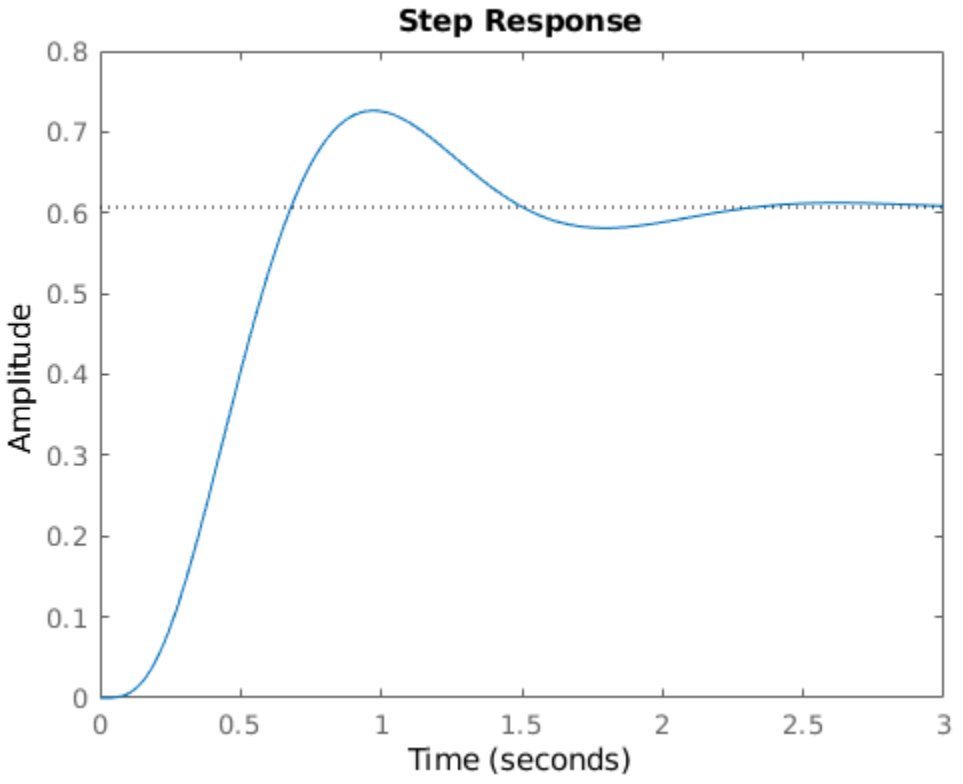
Control Systems Homework 8 Problem 1

```
G = zpk([],[-2 -5 -10 -15],[200]);
rlocus(G);
X1 = evalfr(G, -1.8686 + 3.8160j)
k1 = -1/X1

Gcl1 = minreal(G*abs(k1) / (1+G*abs(k1)))
roots([1 3.737 18.05])
figure;
step(Gcl1)
```

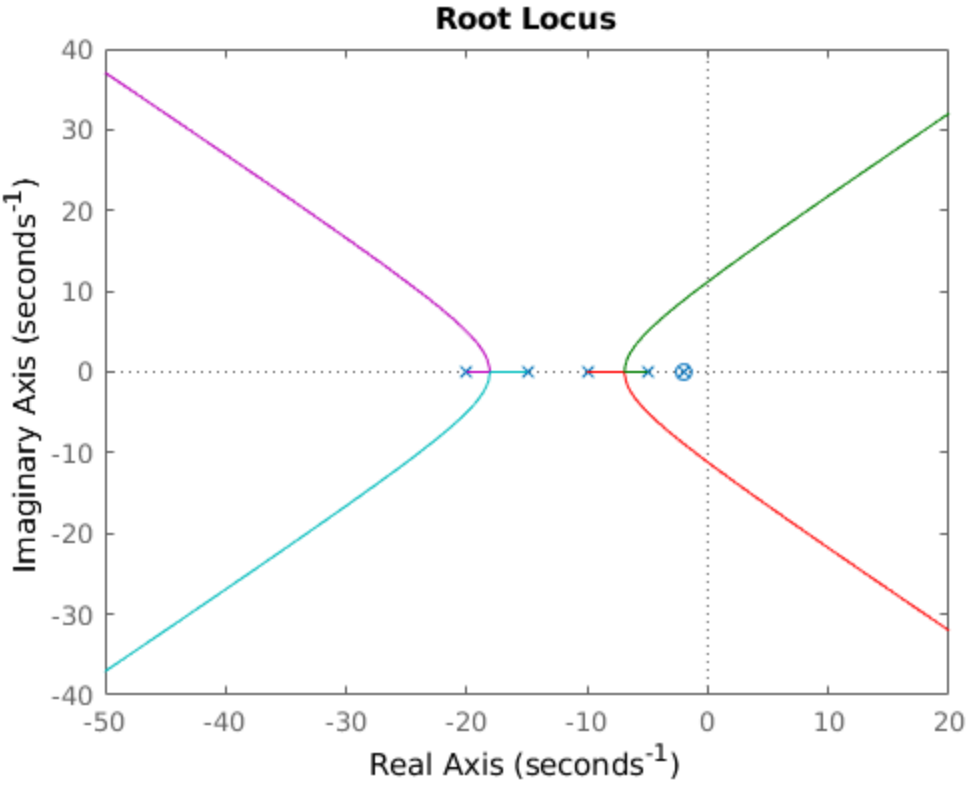
```
X1 =

  -0.0864 - 0.0000i


k1 =

  11.5756 - 0.0000i


Gcl1 =

                    2315.1
  ---------------------------------------------
  (s^2 + 28.26s + 211.3) (s^2 + 3.737s + 18.05)

Continuous-time zero/pole/gain model.


ans =

  -1.8685 + 3.8156i
  -1.8685 - 3.8156i
```

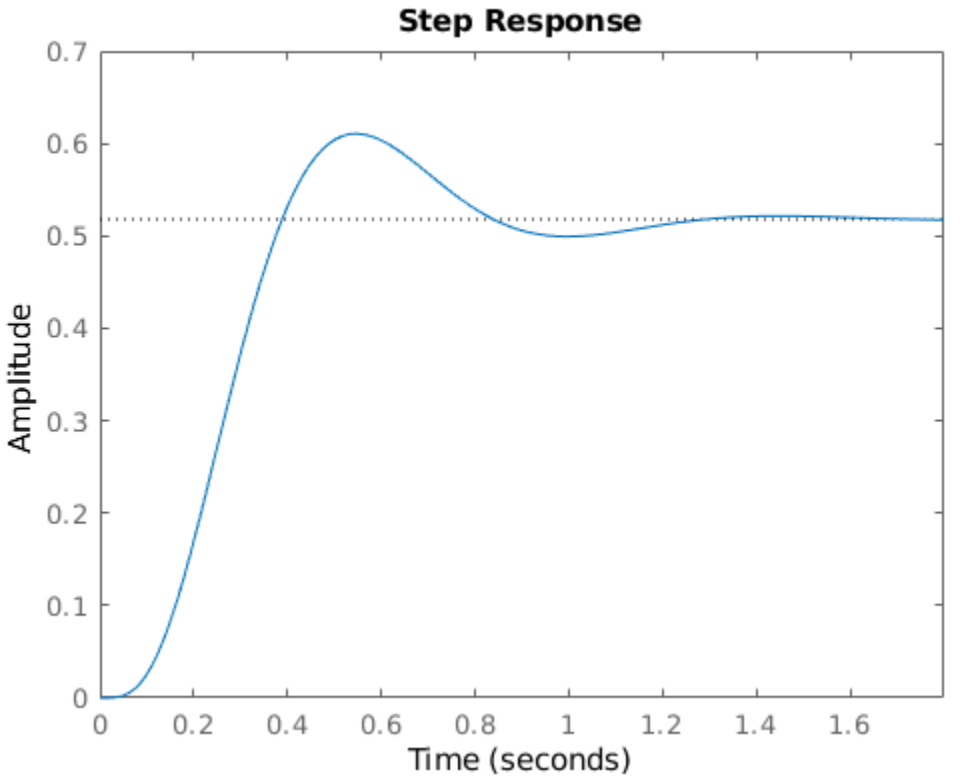

Root Locus
Imaginary Axis (seconds-1)
Real Axis (seconds-1)
30
20
10
0
-10
-20
-30
-40
-30
-20
-10
0
10
20
30


Step Response
Amplitude
Time (seconds)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.5
1
1.5
2
2.5
3

Control Systems Homework 8 Problem 2

```
GK2 = zpk([-2],[-2 -5 -10 -15 -20], [200])
figure;
rlocus(GK2)
X2 = evalfr(GK2, -3.5679 + 6.9665i)
K2 = -1/X2

Gcl2 = minreal(GK2*abs(K2) / (1 + GK2*abs(K2)))
roots([1 7.136 61.26])
figure;
step(Gcl2)


GK2 =

             200 (s+2)
  --------------------------------
  (s+2) (s+5) (s+10) (s+15) (s+20)

Continuous-time zero/pole/gain model.


X2 =

  -0.0124 - 0.0000i


K2 =

  80.5652 - 0.0004i


Gcl2 =

                      16113
  ---------------------------------------------
  (s^2 + 7.136s + 61.26) (s^2 + 42.86s + 507.9)

Continuous-time zero/pole/gain model.


ans =

  -3.5680 + 6.9663i
  -3.5680 - 6.9663i
```

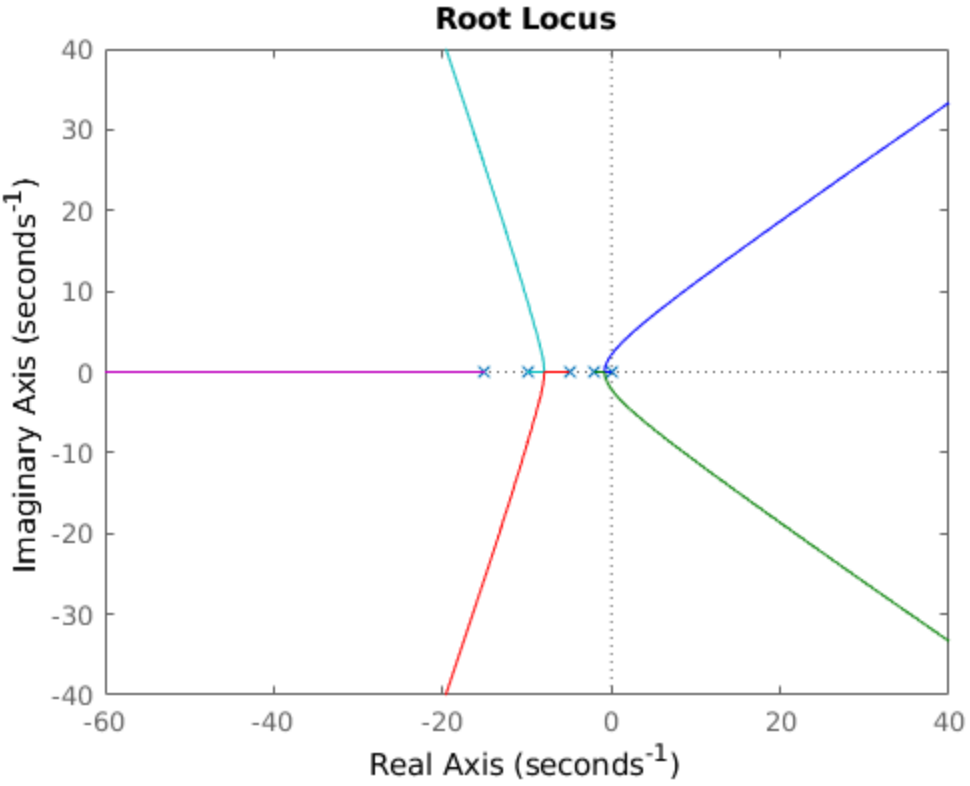

Root Locus
Imaginary Axis (seconds-1)
Real Axis (seconds-1)
40
30
20
10
0
-10
-20
-30
-40
-50
-40
-30
-20
-10
0
10
20

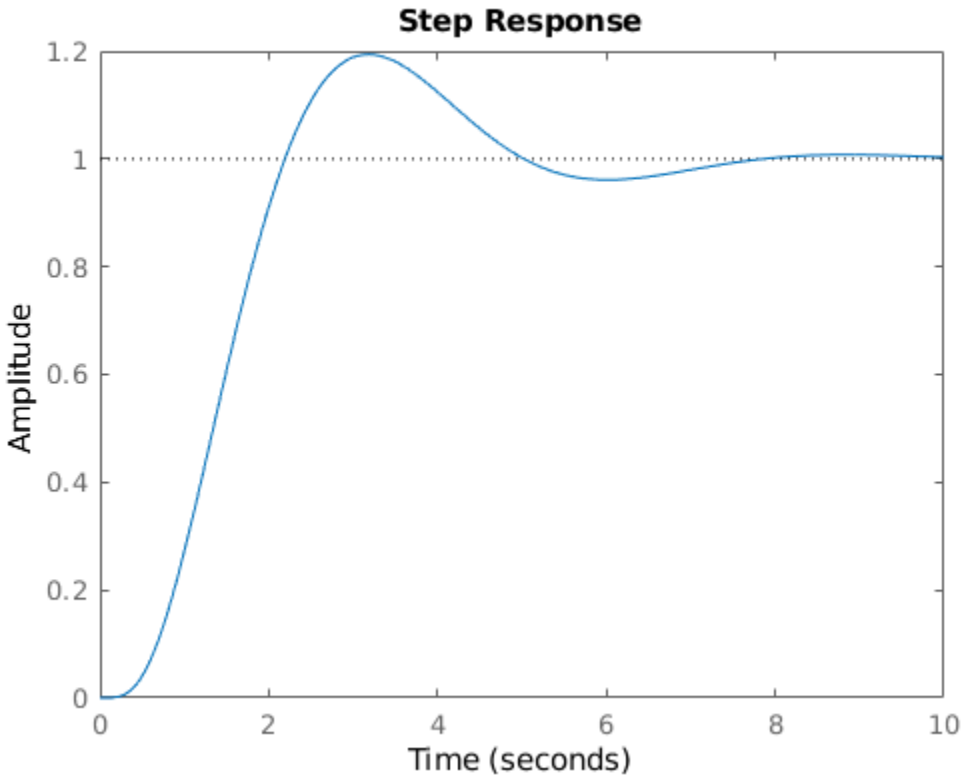

Step Response
Amplitude
Time (seconds)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6

Control Systems Homework 8 Problem 3

```
GK3 = zpk([],[0 -2 -5 -10 -15], [200])
figure;
rlocus(GK3)
X3 = evalfr(GK3, -0.5676 + 1.1091j)
K3 = -1/X3

Gcl3 = minreal(GK3*abs(K3) / (1 + GK3*abs(K3)))
roots([1 1.135 1.552])
figure;
step(Gcl3)
```

```
GK3 =

              200
  ---------------------------
  s (s+2) (s+5) (s+10) (s+15)

Continuous-time zero/pole/gain model.


X3 =

  -0.1411 + 0.0000i


K3 =

   7.0886 + 0.0002i


Gcl3 =

                        1417.7
  ---------------------------------------------------
  (s+15.14) (s+9.09) (s+6.638) (s^2 + 1.135s + 1.552)

Continuous-time zero/pole/gain model.


ans =

  -0.5675 + 1.1090i
  -0.5675 - 1.1090i
```

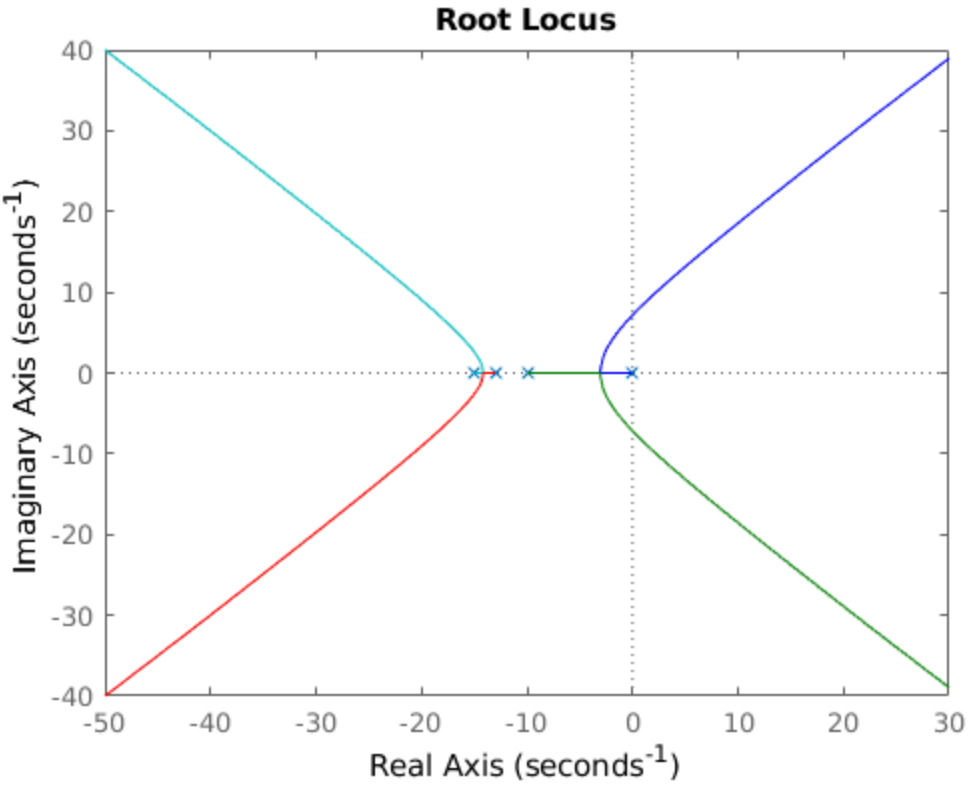

Root Locus
Imaginary Axis (seconds-1)
Real Axis (seconds-1)
40
30
20
10
0
-10
-20
-30
-40
-60
-40
-20
0
20
40

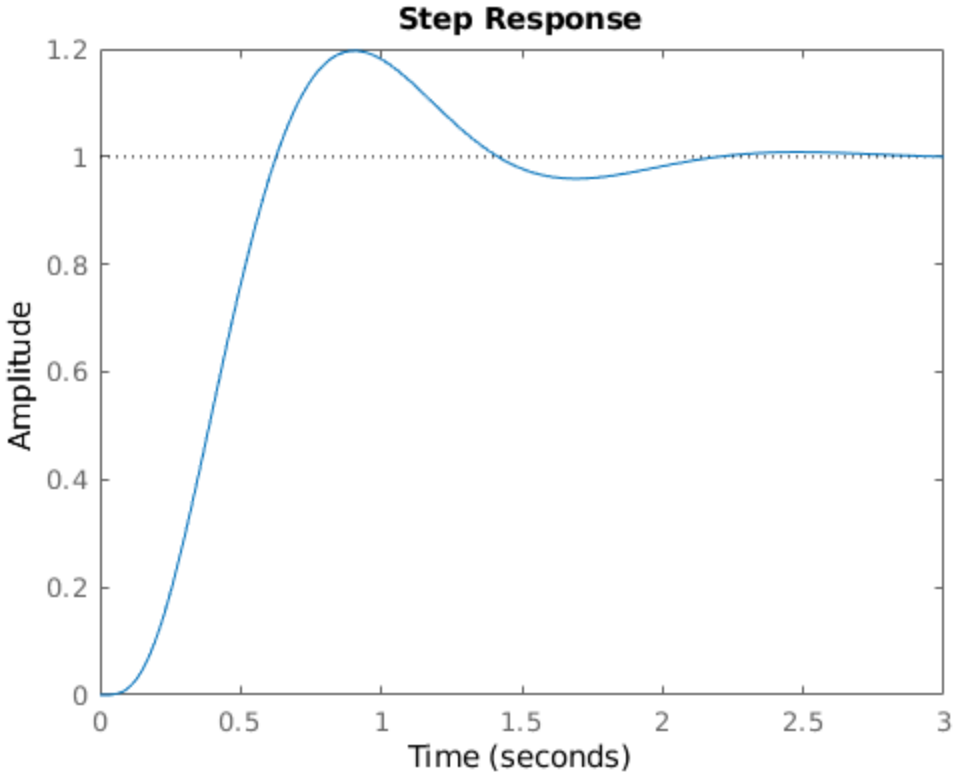

Step Response
Amplitude
Time (seconds)
1.2
1
0.8
0.6
0.4
0.2
0
0
2
4
6
8
10

Control Systems Homework 8 Problem 4

```
GK4 = zpk([],[0 -10 -13 -15],[200])
figure;
rlocus(GK4)
X4 = evalfr(GK4, -1.9937 + 3.9875i)
K4 = -1/X4

Gcl4 = minreal(GK4*abs(K4) / (1 + GK4*abs(K4)))
roots([1 3.987 19.88])
figure;
step(Gcl4)

err4 = evalfr(Gcl4, 1000000)
```

```
GK4 =

           200
  ----------------------
  s (s+10) (s+13) (s+15)

Continuous-time zero/pole/gain model.


X4 =

  -0.0315 - 0.0000i


K4 =

  31.7507 - 0.0003i


Gcl4 =

                     6350.1
  ---------------------------------------------
  (s^2 + 3.987s + 19.88) (s^2 + 34.01s + 319.5)

Continuous-time zero/pole/gain model.


ans =

  -1.9935 + 3.9882i
  -1.9935 - 3.9882i


err4 =

   6.3499e-21
```


Root Locus
Imaginary Axis (seconds-1)
Real Axis (seconds-1)
40
30
20
10
0
-10
-20
-30
-40
-50
-40
-30
-20
-10
0
10
20
30



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