
```

sys_open = tf([1],[1 2 1 0]);
sys_closed = feedback(sys_open,1,-1)
figure(1)
margin(sys_open)
[Gm,Pm,Wcg,Wcp] = margin(sys_open)
figure(2)
step(sys_closed)
S = stepinfo(sys_closed)

```

```
sys_closed =
```

$$\frac{1}{s^3 + 2s^2 + s + 1}$$

Continuous-time transfer function.

```
Gm =
```

2

```
Pm =
```

21.3877

```
Wcg =
```

1

```
Wcp =
```

0.6823

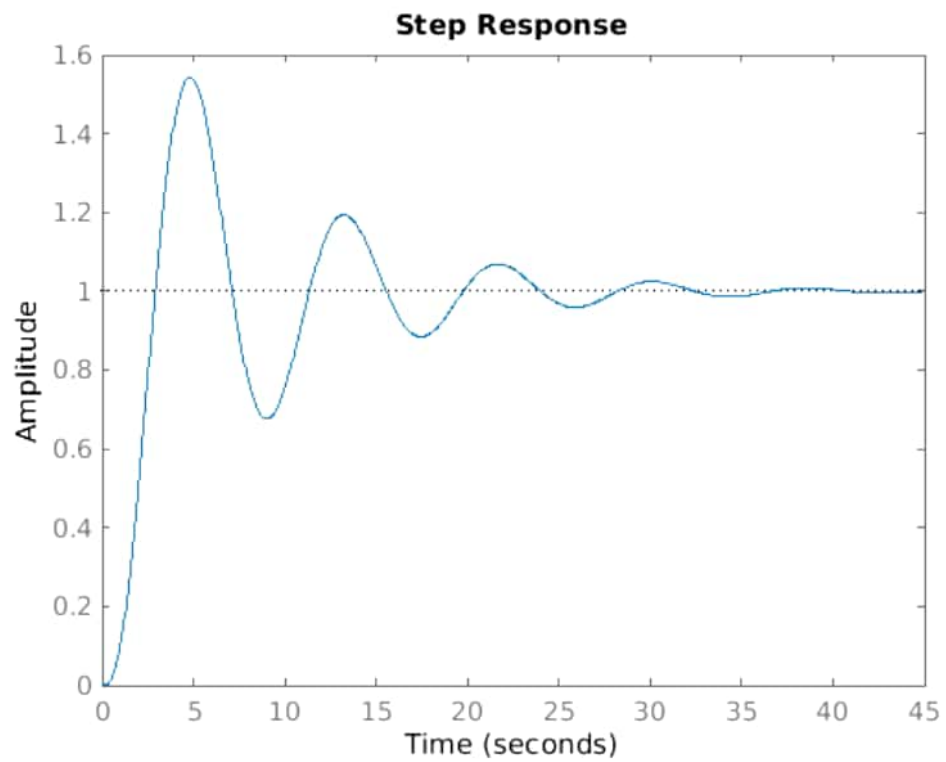
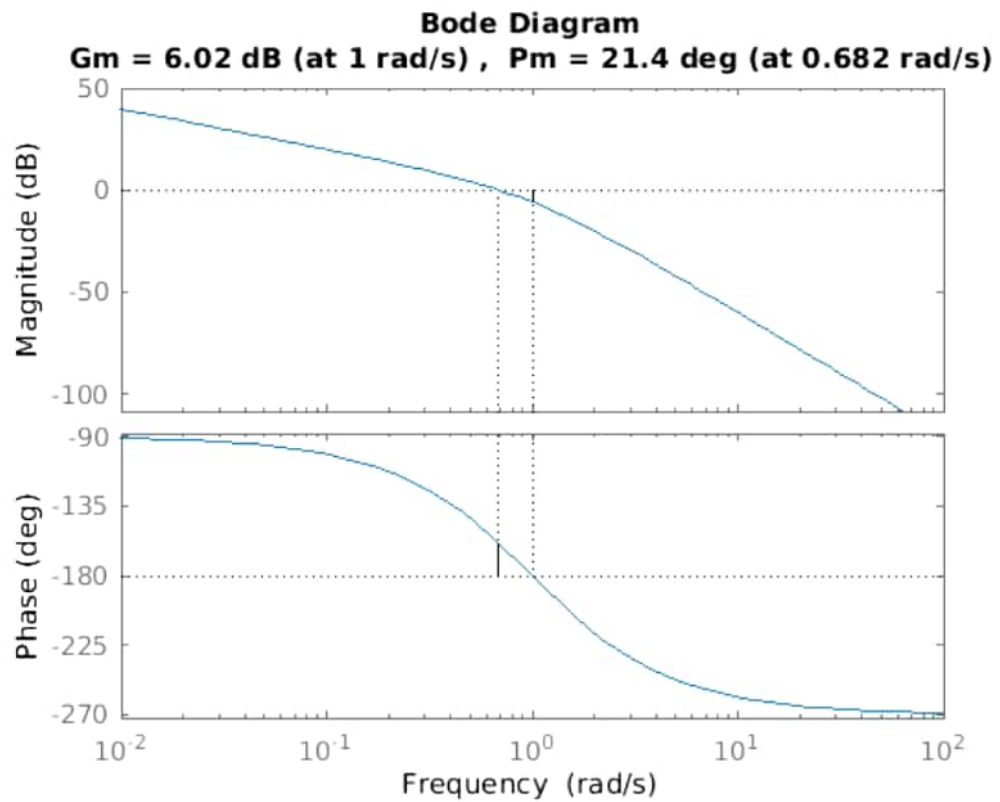
```
S =
```

```
struct with fields:
```

```

    RiseTime: 1.7271
    SettlingTime: 30.9388
    SettlingMin: 0.6759
    SettlingMax: 1.5435
    Overshoot: 54.3517
    Undershoot: 0
        Peak: 1.5435
    PeakTime: 4.7761

```



```
% Effect of addition on closed loop poles
```

```
sys = tf([1], [1 3 6])
```

```
p = [-1 -5 -10 -20]
```

```
for i=1:4
```

```
    sys_new = tf([1], [1 -p(i)])*sys
```

```
    subplot(2, 2, i)
```

```
    step(sys_new)
```

```
    stepinfo(sys_new)
```

```
end
```

```
sys =
```

```
      1
-----
s^2 + 3 s + 6
```

```
Continuous-time transfer function.
```

```
p =
```

```
    -1    -5   -10   -20
```

```
sys_new =
```

```
      1
-----
s^3 + 4 s^2 + 9 s + 6
```

```
Continuous-time transfer function.
```

```
ans =
```

```
struct with fields:
```

```
    RiseTime: 2.0388
    SettlingTime: 4.3619
    SettlingMin: 0.1503
    SettlingMax: 0.1667
    Overshoot: 0
    Undershoot: 0
    Peak: 0.1667
    PeakTime: 12.8484
```

```
sys_new =
```

```
      1
-----
```

```
s^3 + 8 s^2 + 21 s + 30  
Continuous-time transfer function.
```

```
ans =
```

```
struct with fields:  
  
    RiseTime: 0.8705  
    SettlingTime: 2.6518  
    SettlingMin: 0.0301  
    SettlingMax: 0.0358  
    Overshoot: 7.4106  
    Undershoot: 0  
        Peak: 0.0358  
    PeakTime: 1.8789
```

```
sys_new =
```

```
          1  
-----  
s^3 + 13 s^2 + 36 s + 60  
Continuous-time transfer function.
```

```
ans =
```

```
struct with fields:  
  
    RiseTime: 0.7990  
    SettlingTime: 2.5417  
    SettlingMin: 0.0152  
    SettlingMax: 0.0181  
    Overshoot: 8.4569  
    Undershoot: 0  
        Peak: 0.0181  
    PeakTime: 1.7500
```

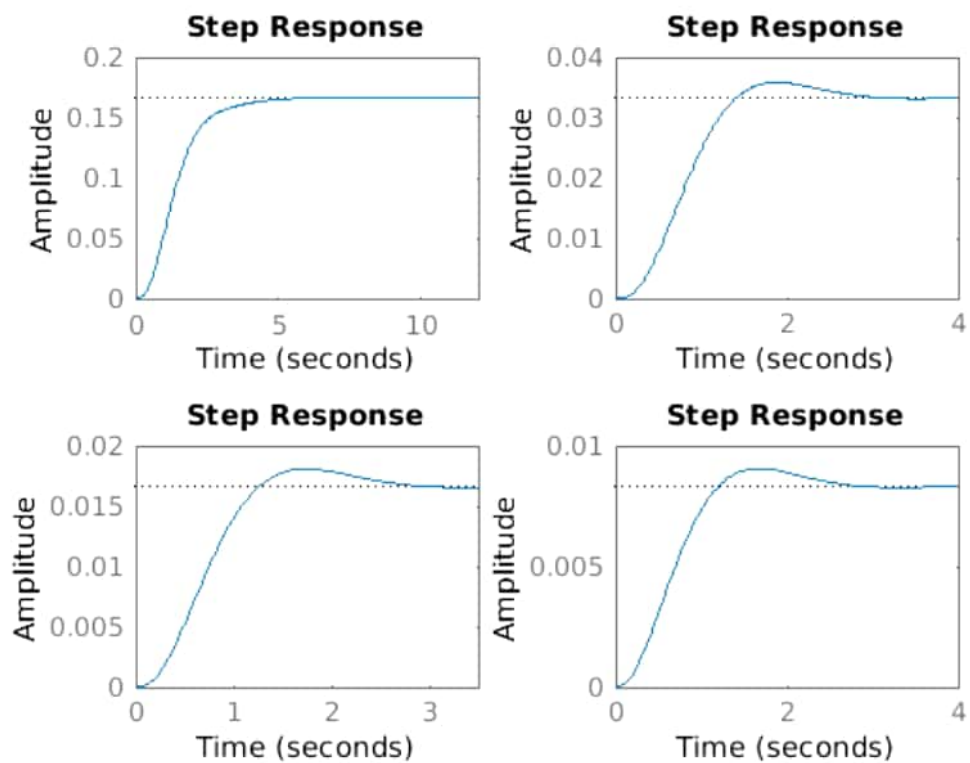
```
sys_new =
```

```
          1  
-----  
s^3 + 23 s^2 + 66 s + 120  
Continuous-time transfer function.
```

```
ans =
```

```
struct with fields:
```

RiseTime: 0.7770
SettlingTime: 2.4869
SettlingMin: 0.0076
SettlingMax: 0.0091
Overshoot: 8.6970
Undershoot: 0
Peak: 0.0091
PeakTime: 1.6886



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```
% Effect of addition on closed loop zeroes
```

```
sys = tf([1], [1 3 6])
```

```
z = [-1 -5 -10 -20]
```

```
for i=1:4
```

```
    sys_new = tf([1 -z(i)], [1])*sys
```

```
    subplot(2, 2, i)
```

```
    step(sys_new)
```

```
    stepinfo(sys_new)
```

```
end
```

```
sys =
```

```
      1
-----
s^2 + 3 s + 6
```

```
Continuous-time transfer function.
```

```
z =
```

```
    -1    -5   -10   -20
```

```
sys_new =
```

```
      s + 1
-----
s^2 + 3 s + 6
```

```
Continuous-time transfer function.
```

```
ans =
```

```
struct with fields:
```

```
    RiseTime: 0.1658
    SettlingTime: 3.0252
    SettlingMin: 0.1508
    SettlingMax: 0.2867
    Overshoot: 72.0403
    Undershoot: 0
    Peak: 0.2867
    PeakTime: 0.6754
```

```
sys_new =
```

```
      s + 5
-----
```

```
s^2 + 3 s + 6

Continuous-time transfer function.
```

```
ans =
```

```
struct with fields:

    RiseTime: 0.6566
    SettlingTime: 2.2140
    SettlingMin: 0.7514
    SettlingMax: 0.9198
    Overshoot: 10.3779
    Undershoot: 0
    Peak: 0.9198
    PeakTime: 1.3508
```

```
sys_new =
```

```
      s + 10
-----
s^2 + 3 s + 6

Continuous-time transfer function.
```

```
ans =
```

```
struct with fields:

    RiseTime: 0.7398
    SettlingTime: 2.3284
    SettlingMin: 1.5323
    SettlingMax: 1.8183
    Overshoot: 9.0973
    Undershoot: 0
    Peak: 1.8183
    PeakTime: 1.5044
```

```
sys_new =
```

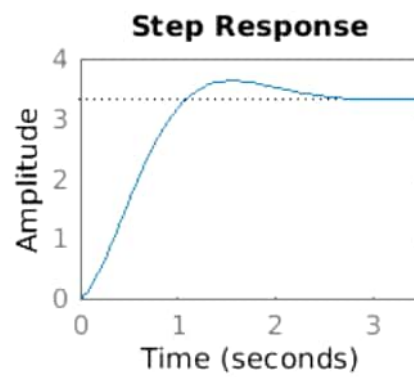
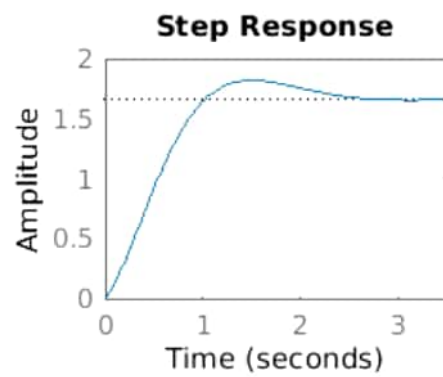
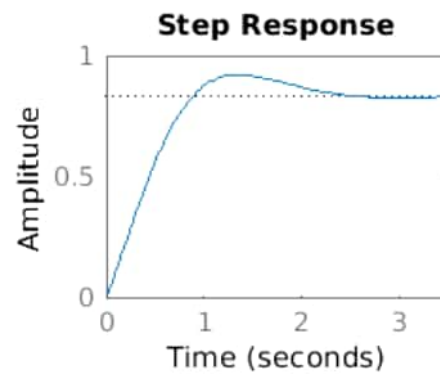
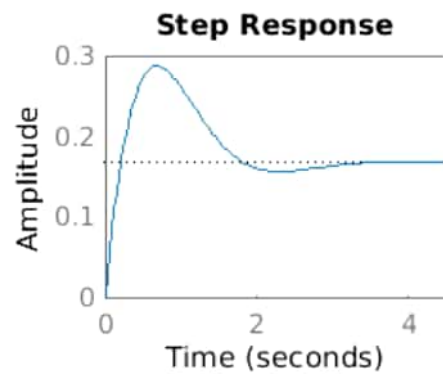
```
      s + 20
-----
s^2 + 3 s + 6

Continuous-time transfer function.
```

```
ans =
```

```
struct with fields:
```

RiseTime: 0.7623
SettlingTime: 2.3834
SettlingMin: 3.0030
SettlingMax: 3.6282
Overshoot: 8.8459
Undershoot: 0
Peak: 3.6282
PeakTime: 1.5658



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