Ricardo Jimenez

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MAE 476, Sec 3

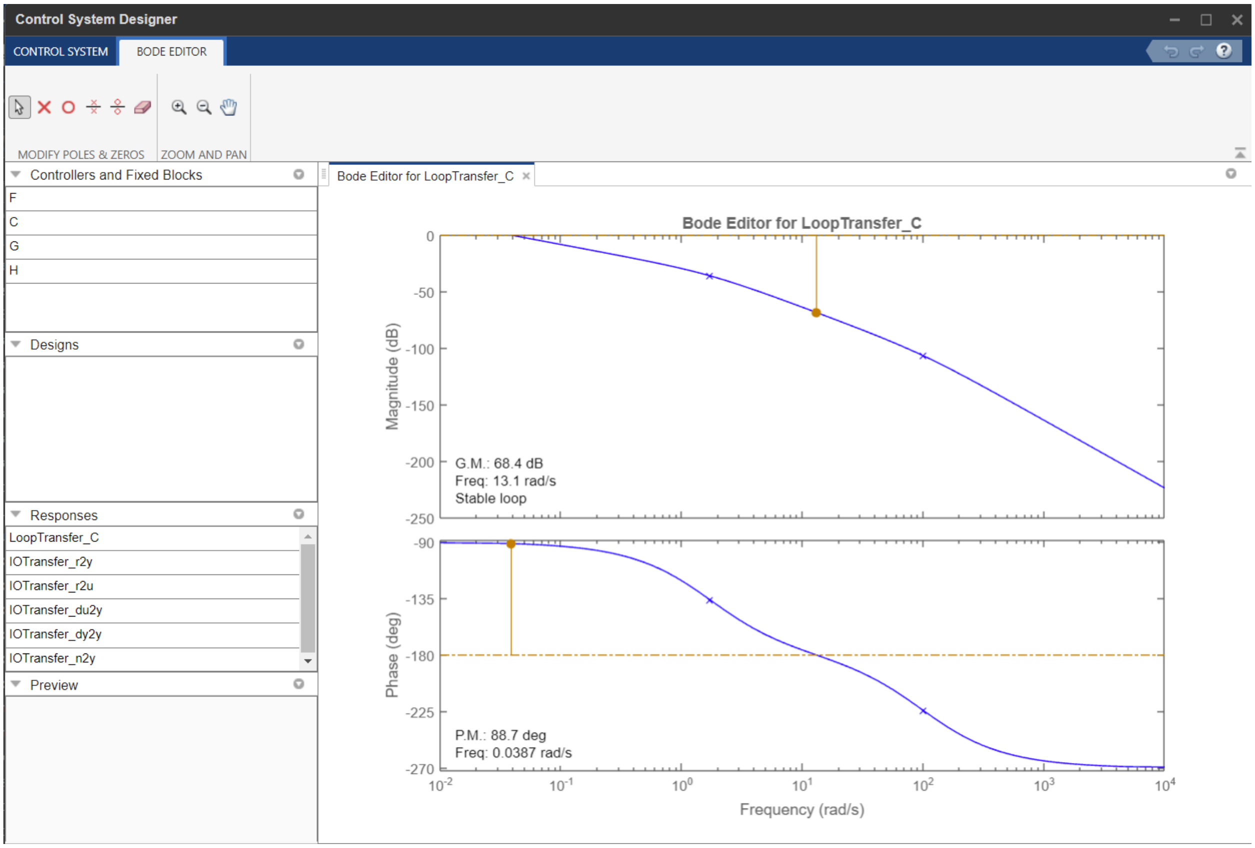
Project 3

Part I:

```
G = zpk([],[0, -1.71, -100], [0.318*100*2.083*0.1])
controlSystemDesigner(G)
```

```
G =

        6.6239
  -----------------
  s (s+1.71) (s+100)

Continuous-time zero/pole/gain model.
Model Properties
```

Input transfer function and plot using controlSystemDesigner

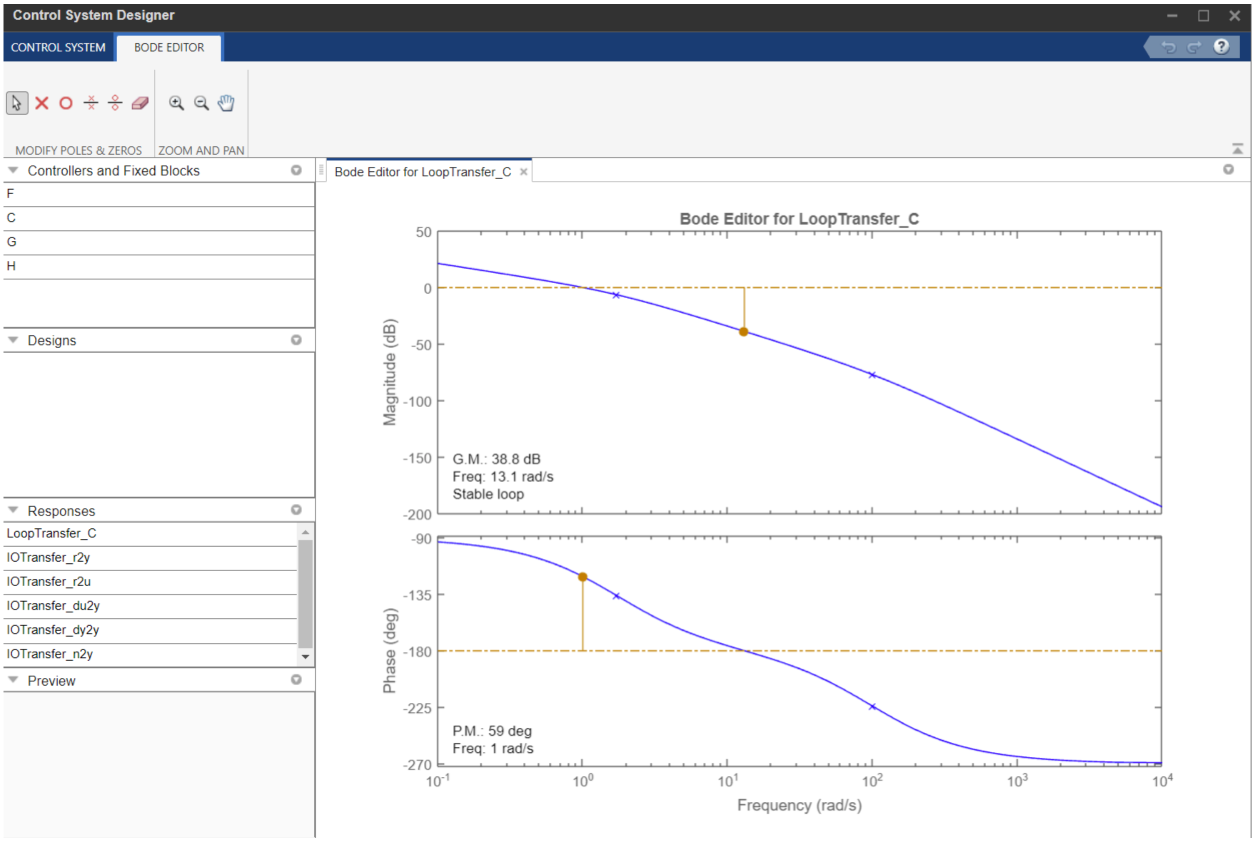


(a) Looking at the Bode plot, the gain margin is given as 68.4 dB

20logK = 68.4

K = $10^{68.4/20}$

K = 2630



(b) Set preamplifier gain to 30 and plot again

The phase margin is given as 59

```
clear; clc;
G = zpk([],[0, -1.71, -100], [0.318*100*2.083*0.1*30])
controlSystemDesigner(G)
syms z
Z = double(solve(59 == atand(2*z/(sqrt(-2*z^2+sqrt(1+4*z^4)))),z))
syms pos
pos = double(solve(Z == -log(pos/100)/sqrt(pi^2+(log(pos/100))^2),pos))
```

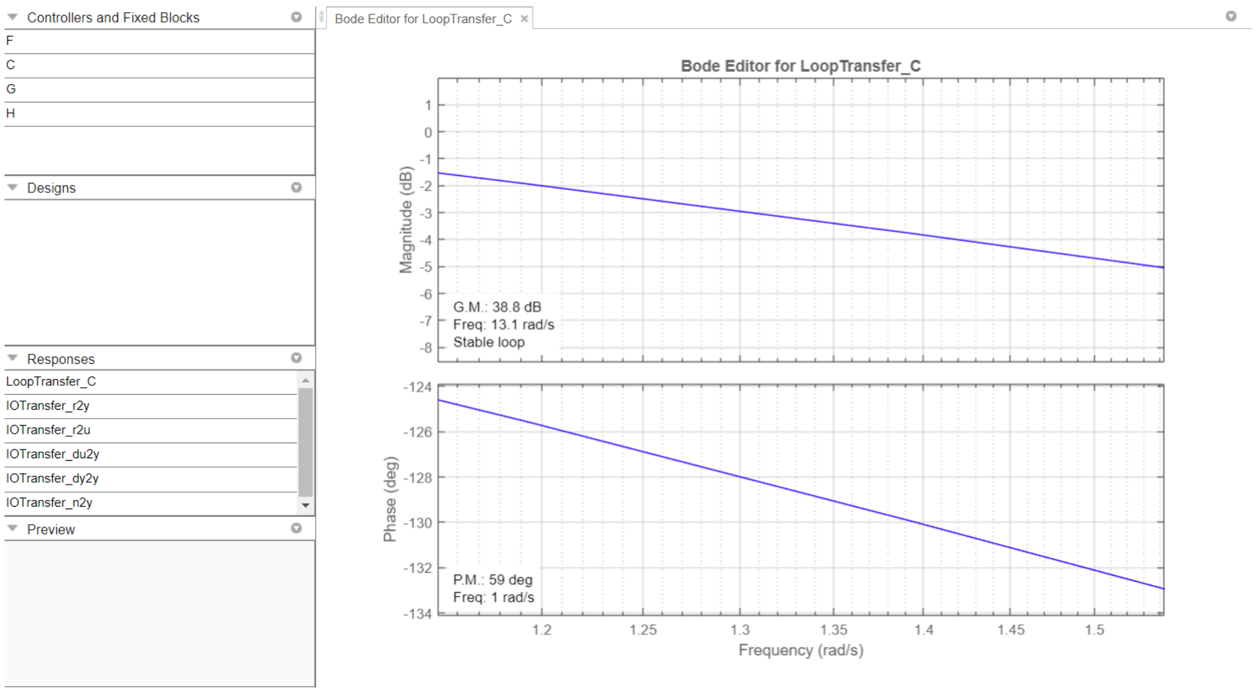
```
G =

        198.72
  ------------------
  s (s+1.71) (s+100)

Continuous-time zero/pole/gain model.
Model Properties
Z = 0.5972
pos = 9.6419
```

Solve for the dampening ratio and then use it to find the percent overshoot

```
[mag,phase,wout] = bode(G);
mag = squeeze(mag);
phase = squeeze(phase);
Wbw = interp1(20*log10(mag), wout, -3)
```

```
Wbw = 1.3073
```

Find the bandwidth by locating the frequency at which the magnitude of the bode diagram is equal to -3dB



The bandwidth is equal to 1.3 rad/s

```
syms Ts Tp
Ts = double(solve(Wbw == (4/Ts*Z)*sqrt((1-2*Z^2)+(4*Z^4-4*Z^2+2)),Ts))
Wn = 4/(Ts*Z)
Tp = double(solve(Wn == pi/(Tp*sqrt(1-Z^2)),Tp))
Tr = (1.76*Z^3-0.417*Z^2+1.039*Z+1)/Wn
```

```
Ts = 2.1378
Wn = 3.1331
Tp = 1.2501
Tr = 0.5894
```

We can then solve for the settling time (2.1378 sec)
Then use that to solve for the natural frequency (3.1331)
Then use that to solve for the peak time (1.2501 sec)
And finally the rise time (0.5894 sec)