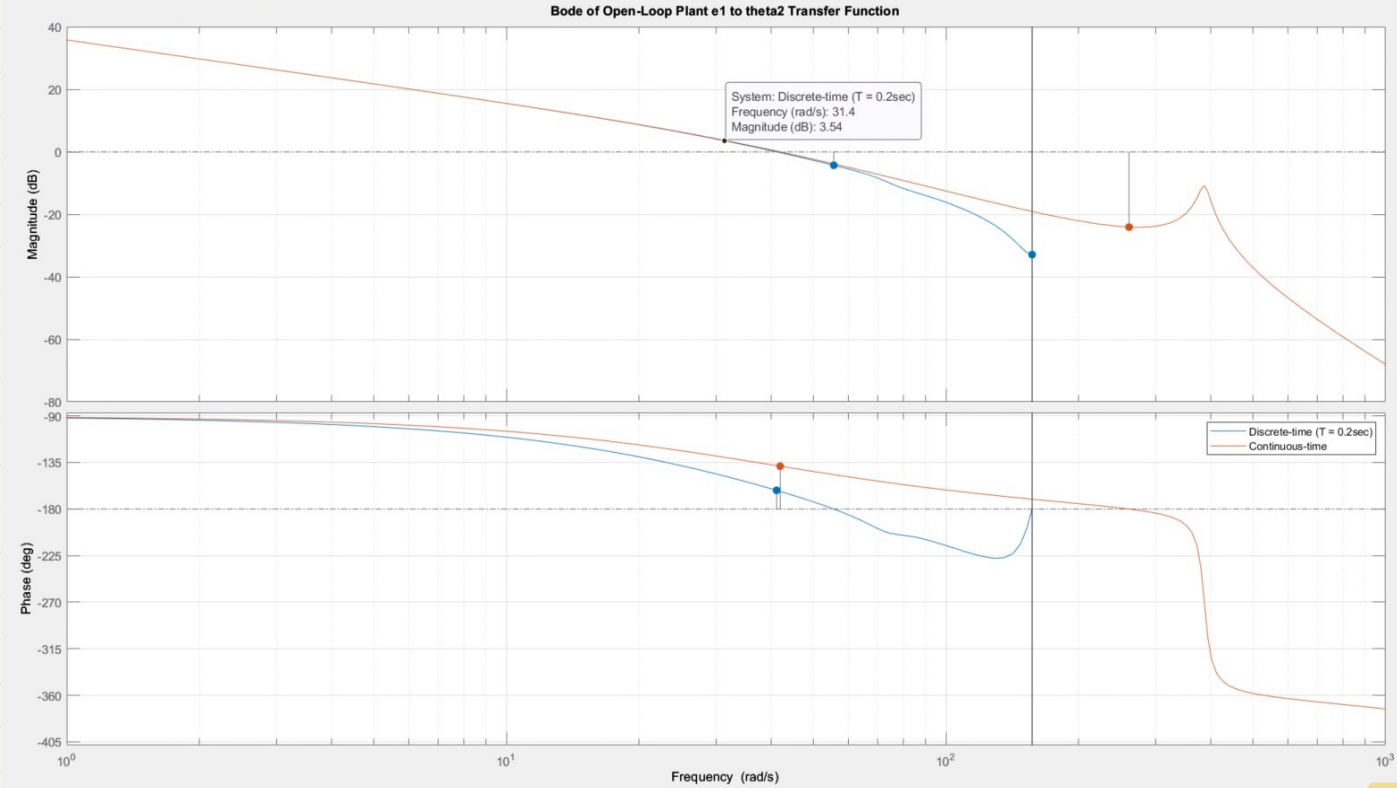
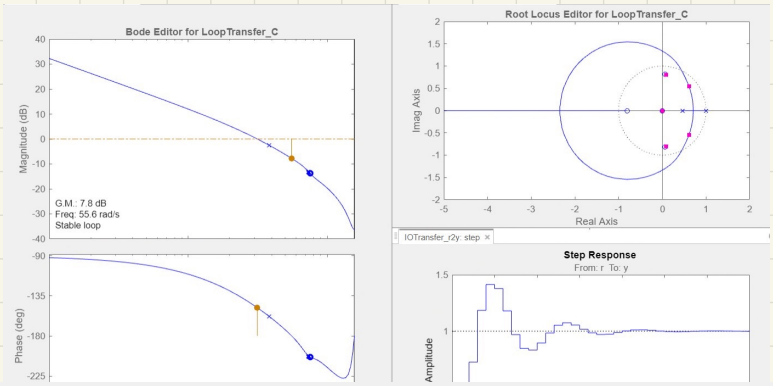
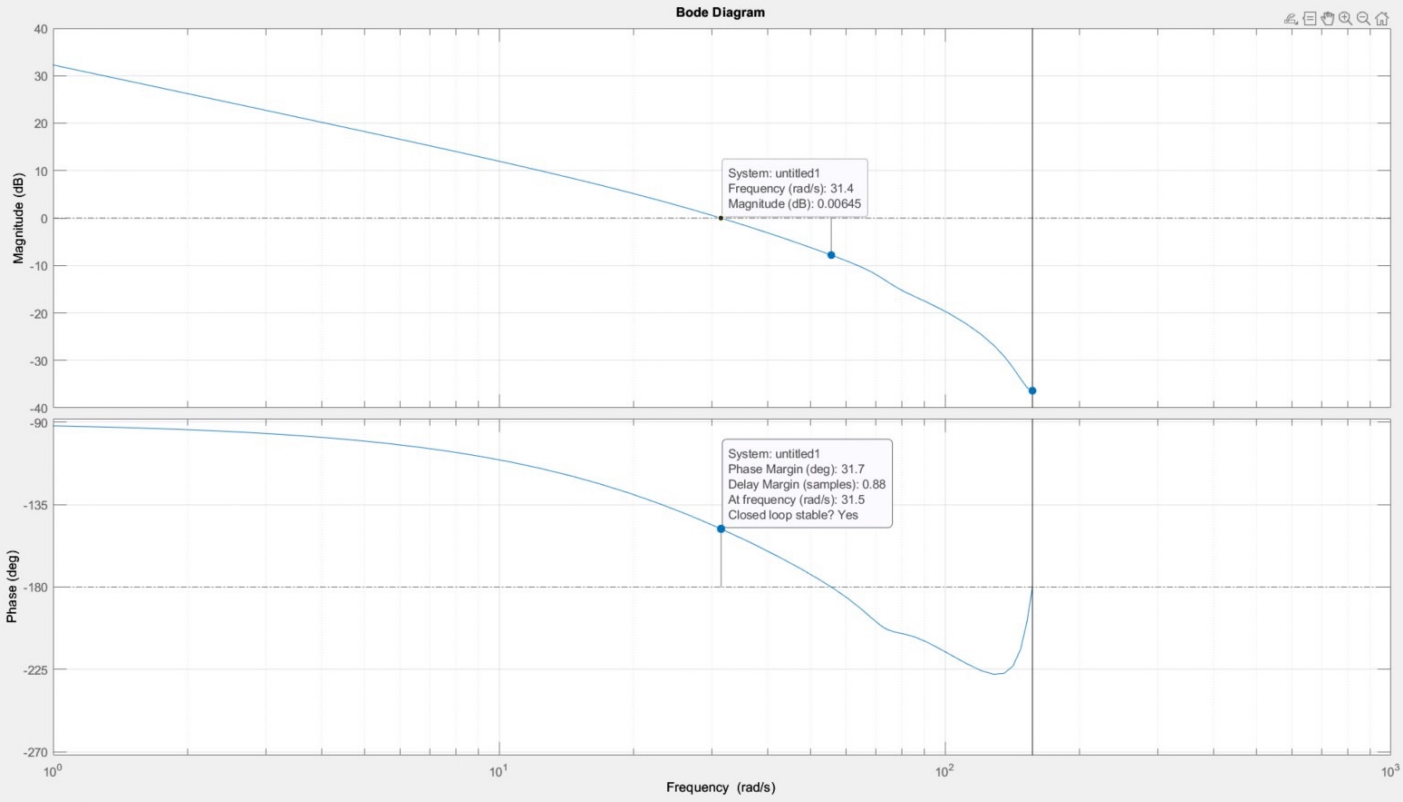


Closed-Loop bandwidth = twice the loop transfer function crossover frequency(10Pi)




```
Tunable Block
Name: C
Sample Time: 0.02
Value:
  0.66861
```



Phase ⇒ 60° - 31.7° = 28.3° (Need More

Lead Compensator ⇒ Z = -18.765 P = -52.596

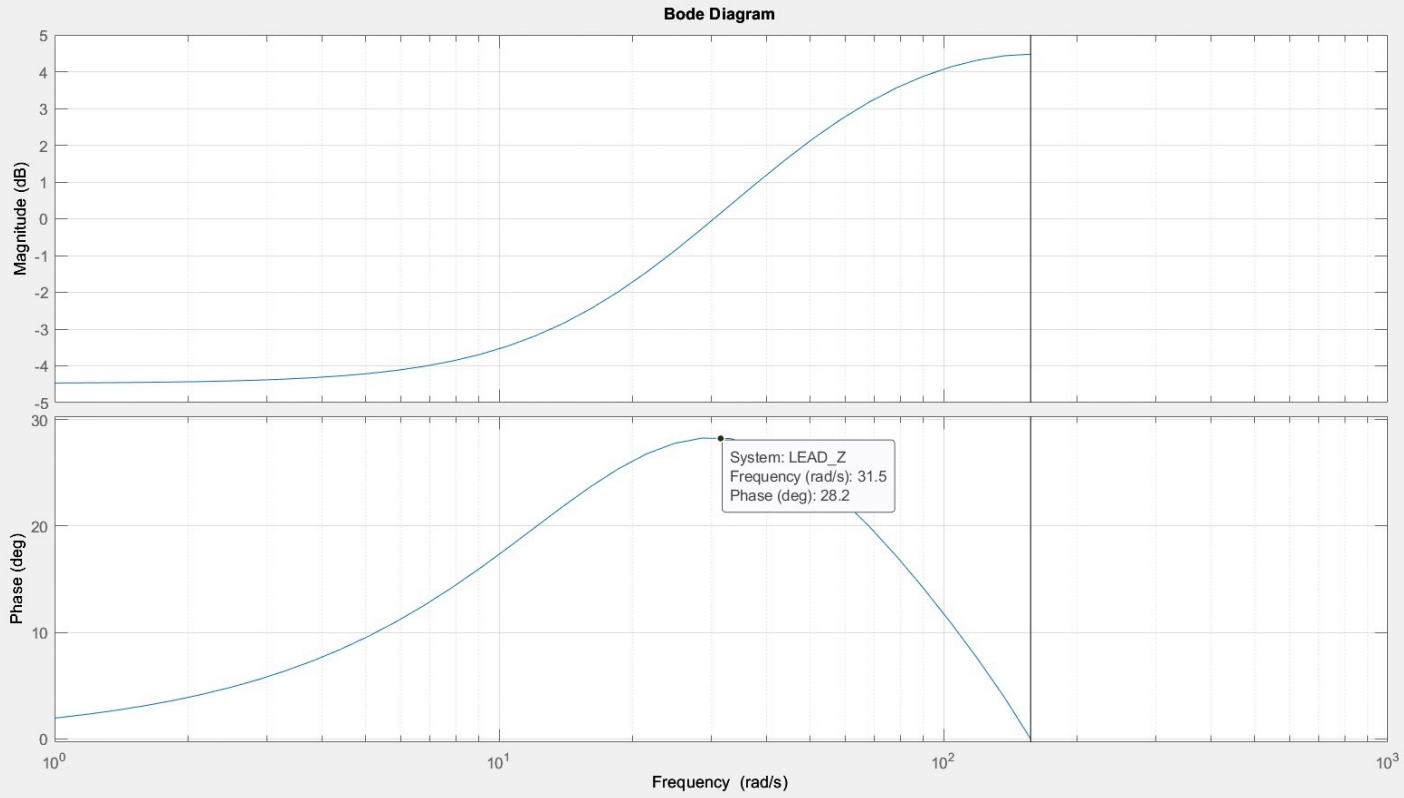
Dynamics

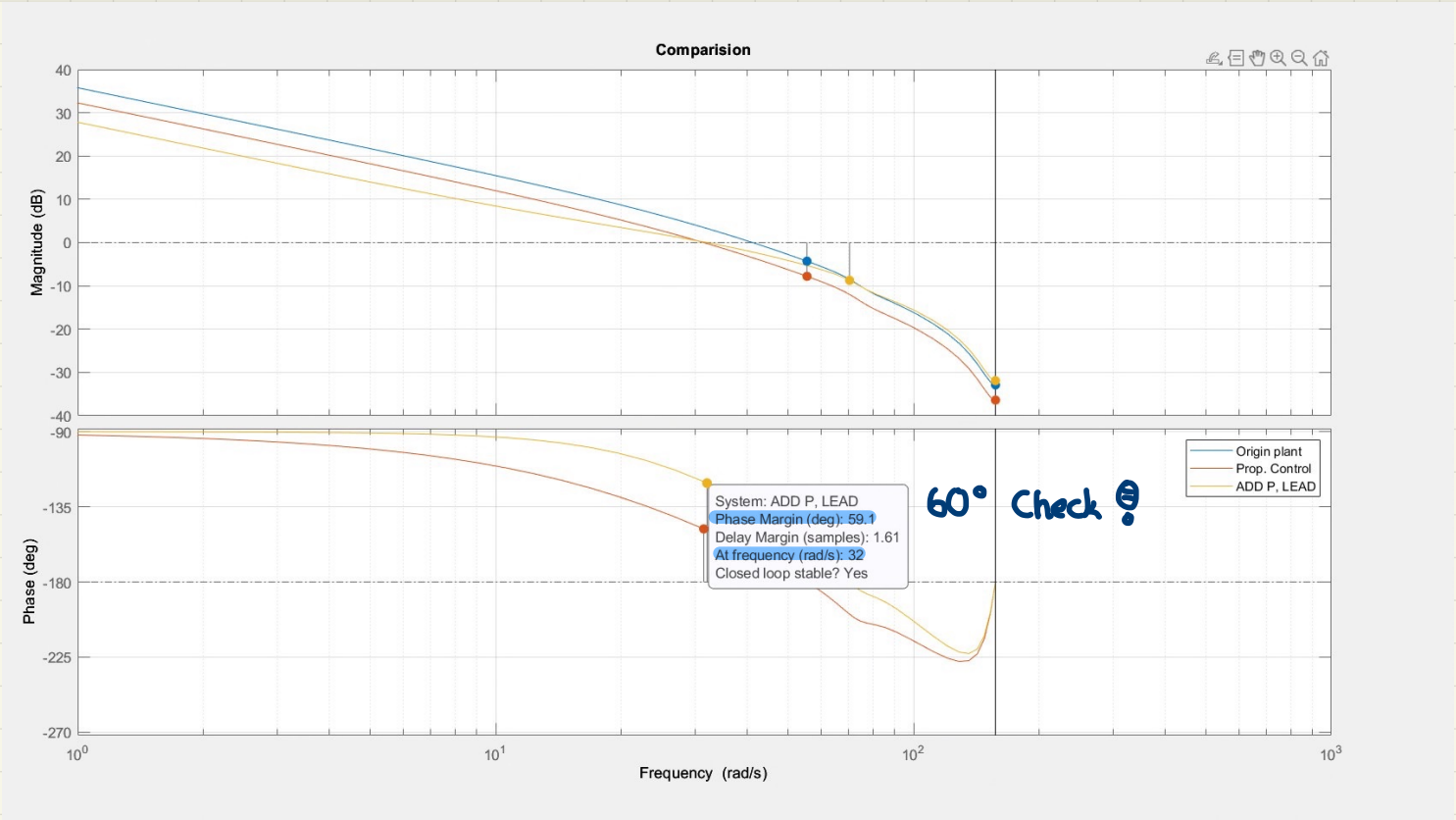
Type	Location	Damping	Frequency
Lead	-18.8, -52.6	1	18.8, 52.6

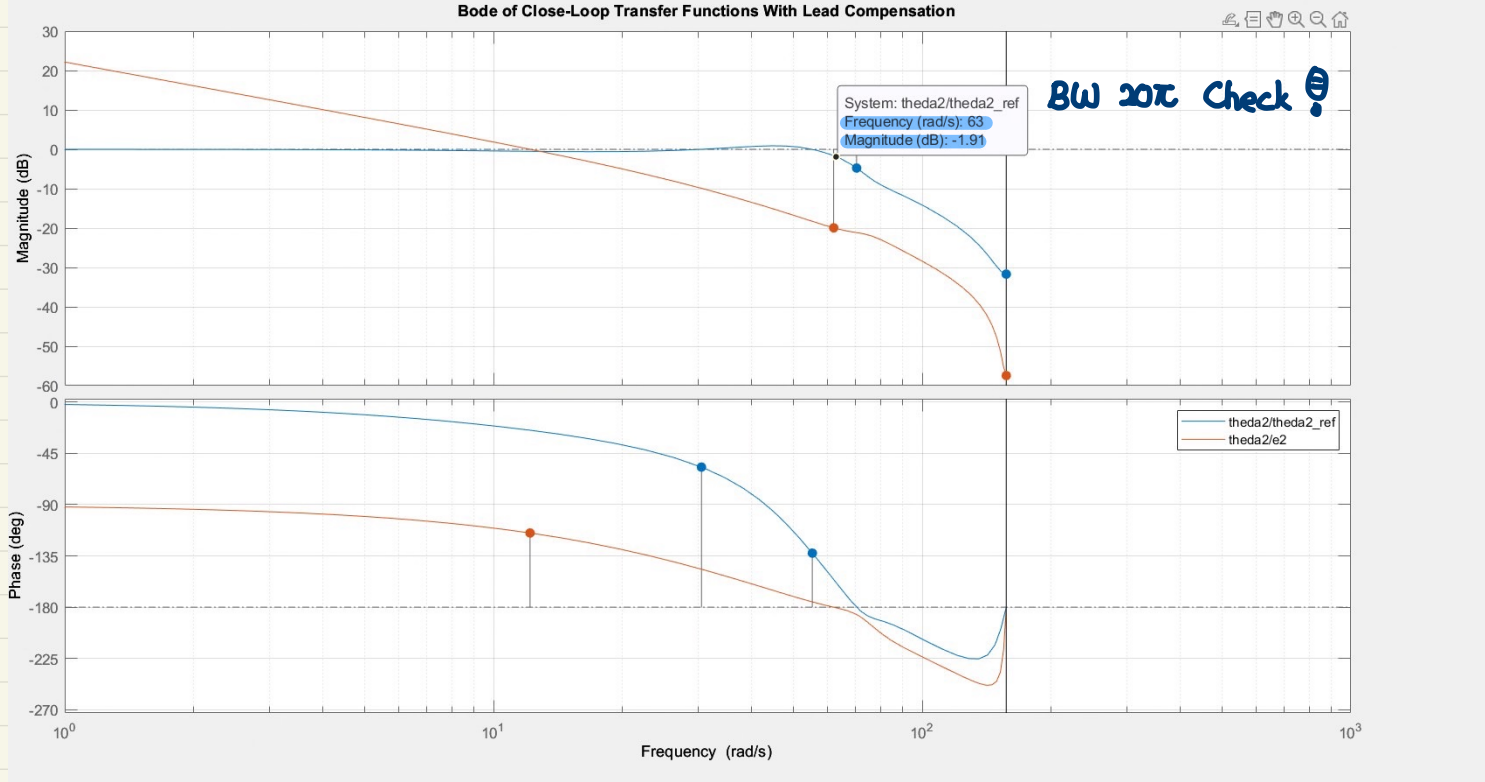
Right-click to add or delete poles/zeros

Edit Selected Dynamics

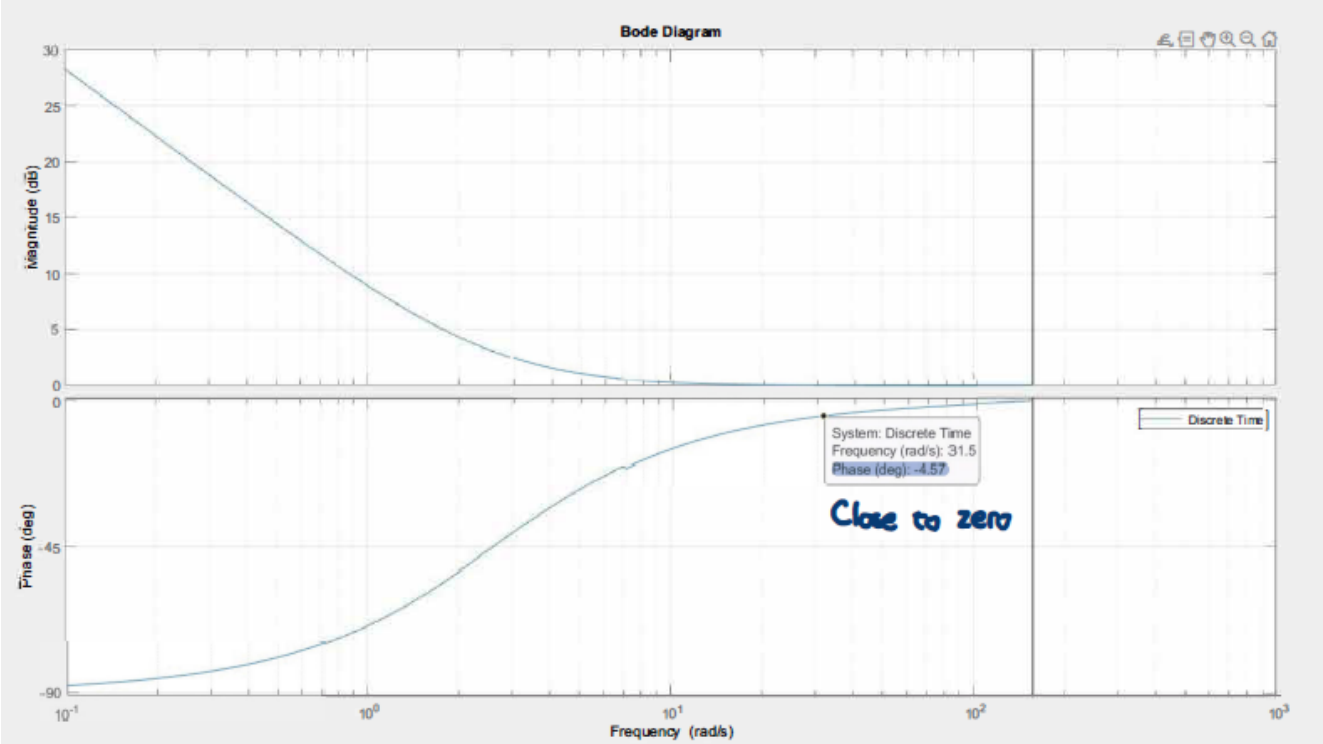
Real Zero	-18.765
Real Pole	-52.596
Max Delta Phase (deg)	28.3
at Frequency	31.416

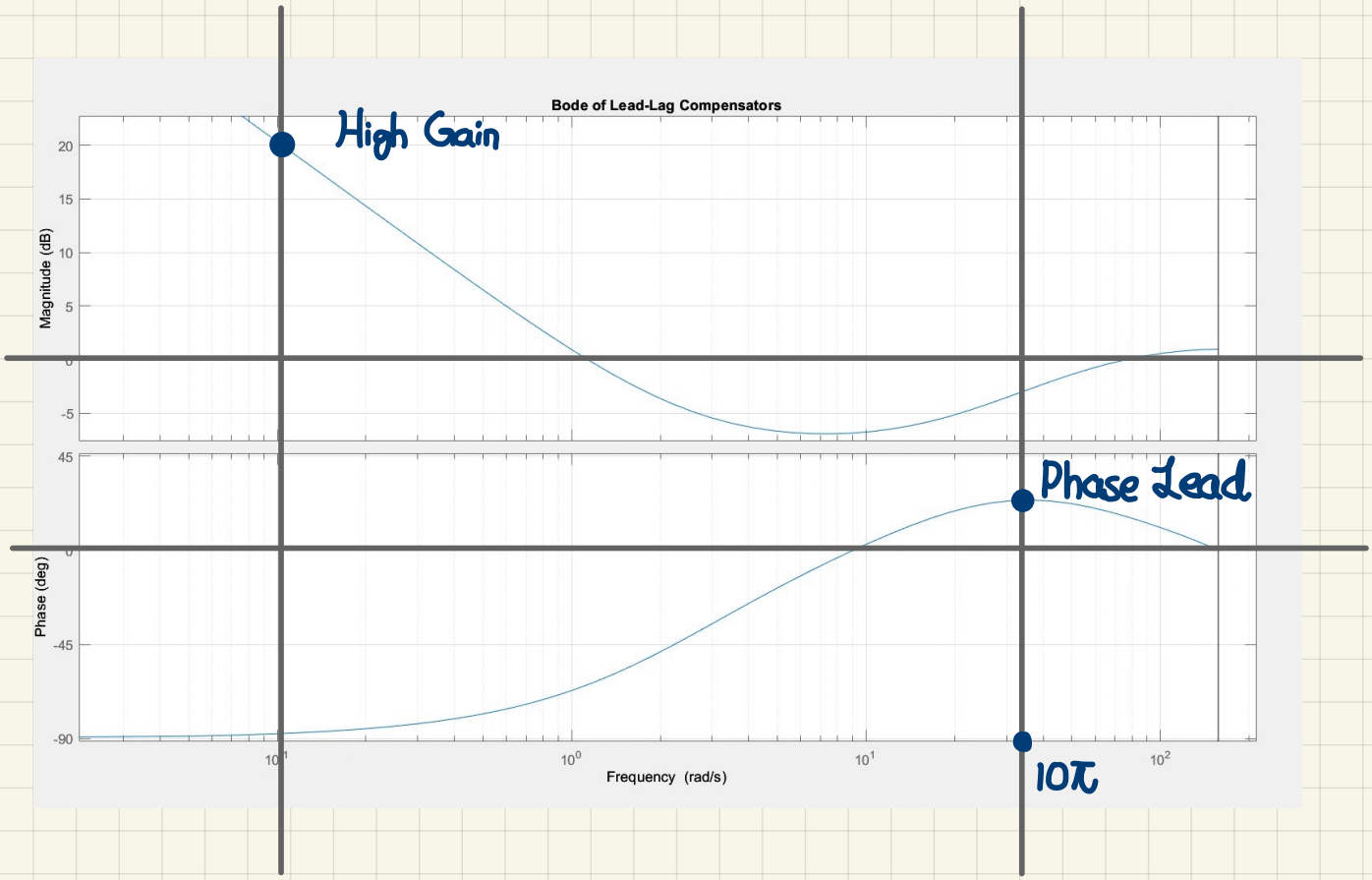


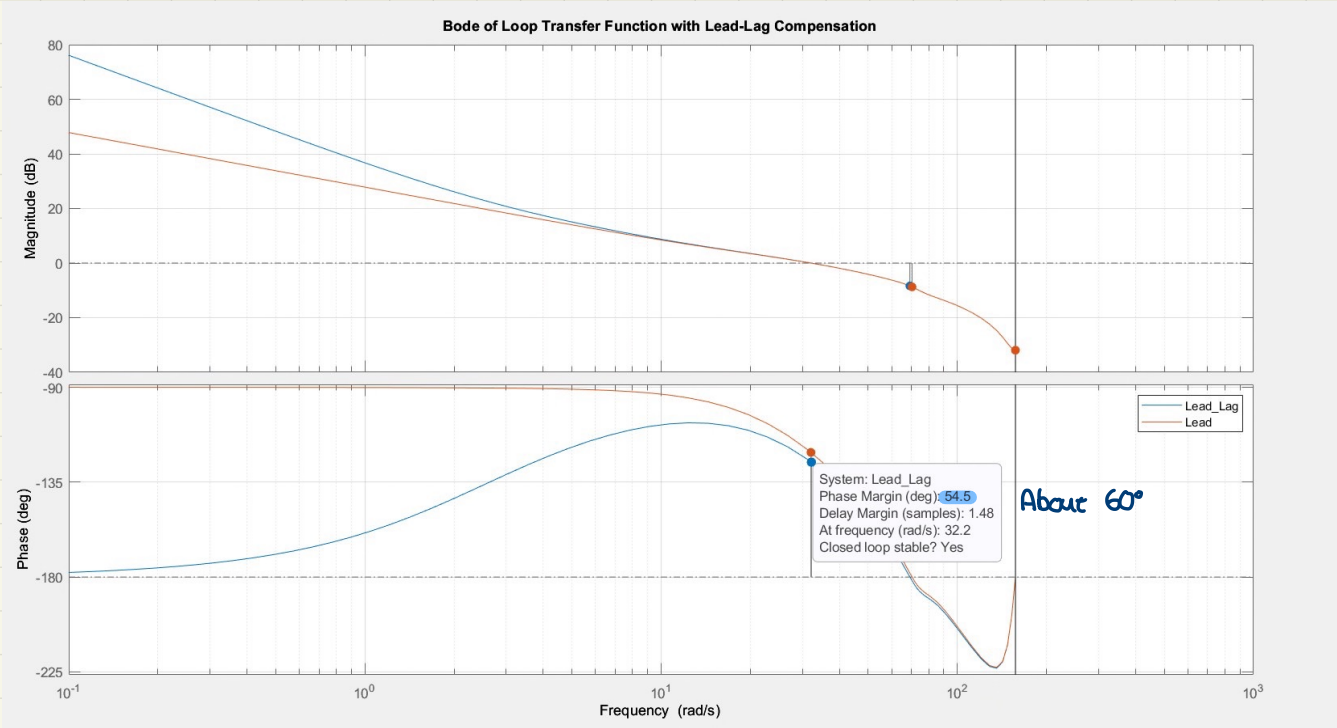

Comparision
Magnitude (dB)
Phase (deg)
Frequency (rad/s)
Origin plant
Prop. Control
ADD P, LEAD
System: ADD P, LEAD
Phase Margin (deg): 59.1
Delay Margin (samples): 1.61
At frequency (rad/s): 32
Closed loop stable? Yes
60° Check !

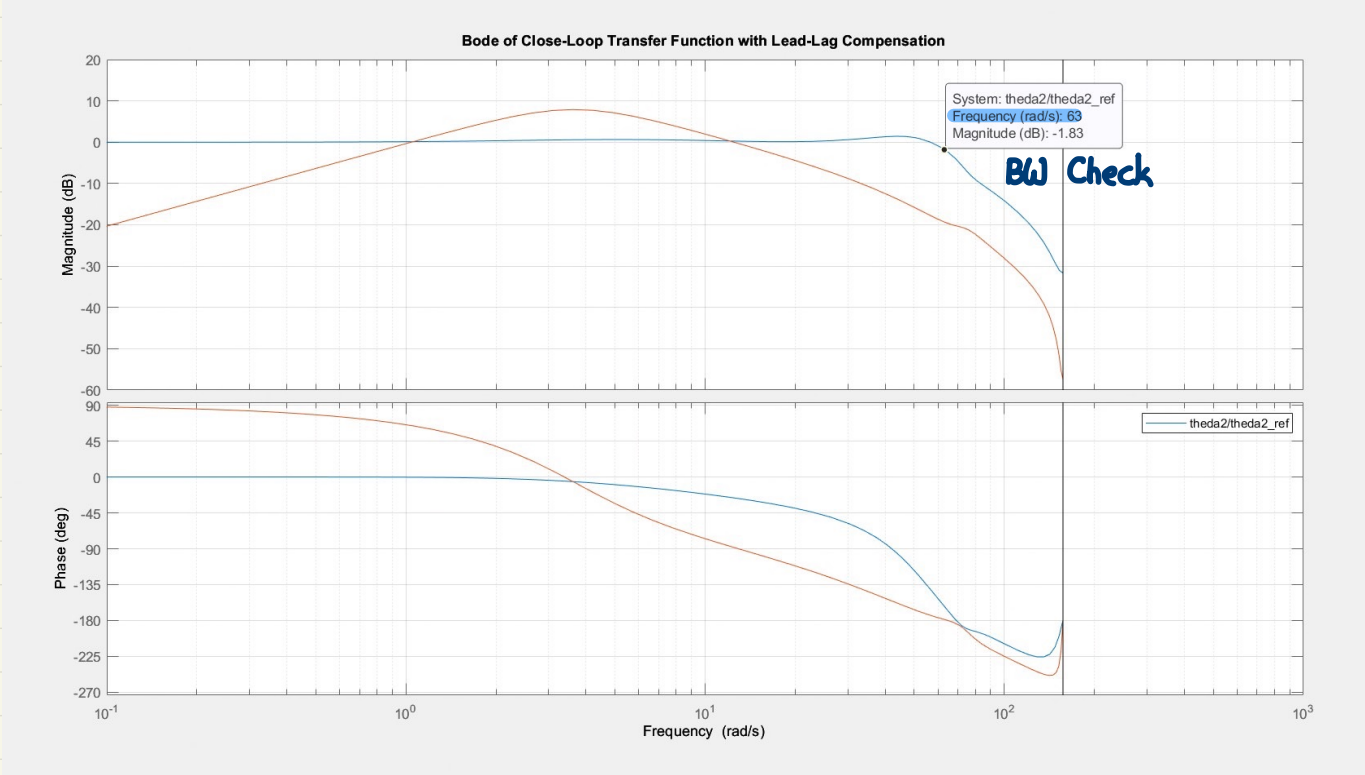

Bode of Close-Loop Transfer Functions With Lead Compensation
Magnitude (dB)
Phase (deg)
Frequency (rad/s)
theda2/theda2_ref
theda2/e2
System: theda2/theda2_ref
Frequency (rad/s): 63
Magnitude (dB): -1.91
BW 20π Check !

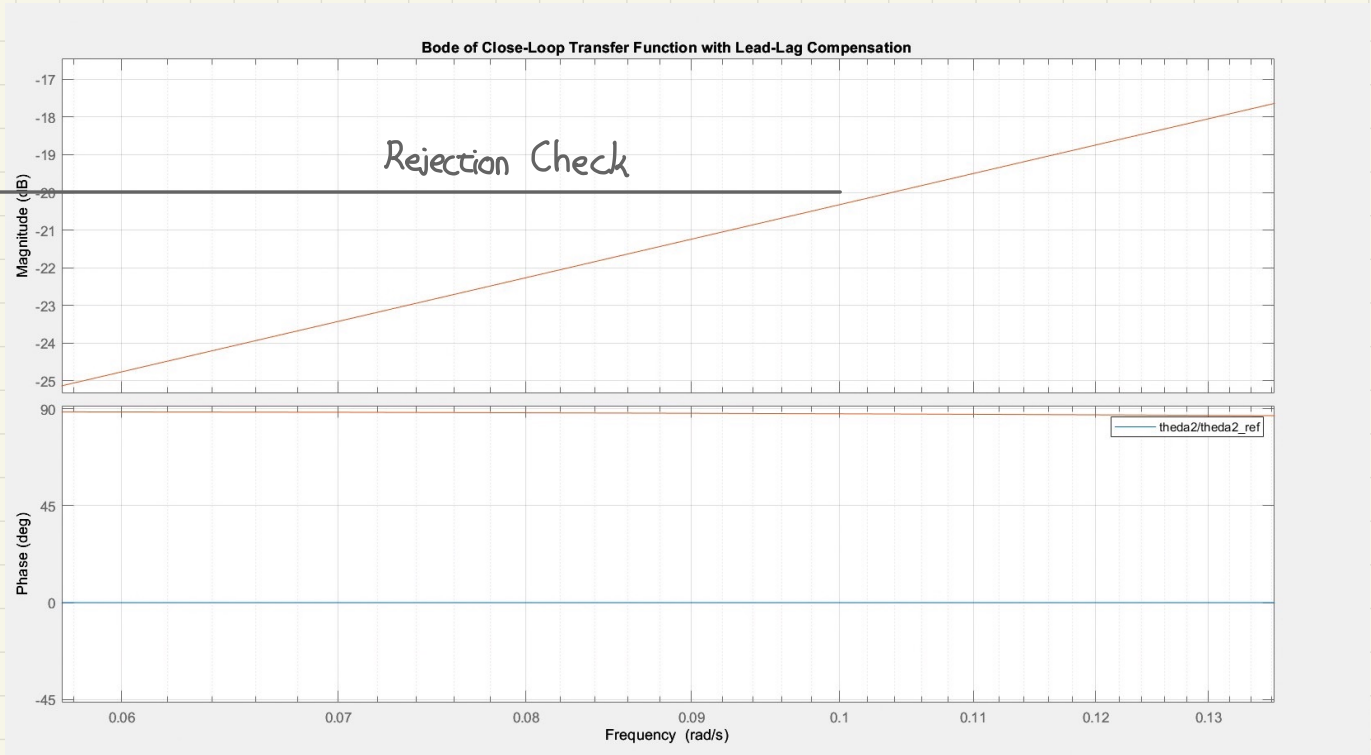
```
%% LAG Compensator

figure()
LAG_s = tf([1, 2.6], [1, 0]);
LAG_z = c2d(LAG_s, Ts, 'tustin');
bode(LAG_z)
grid on
legend('Discrete Time')
```

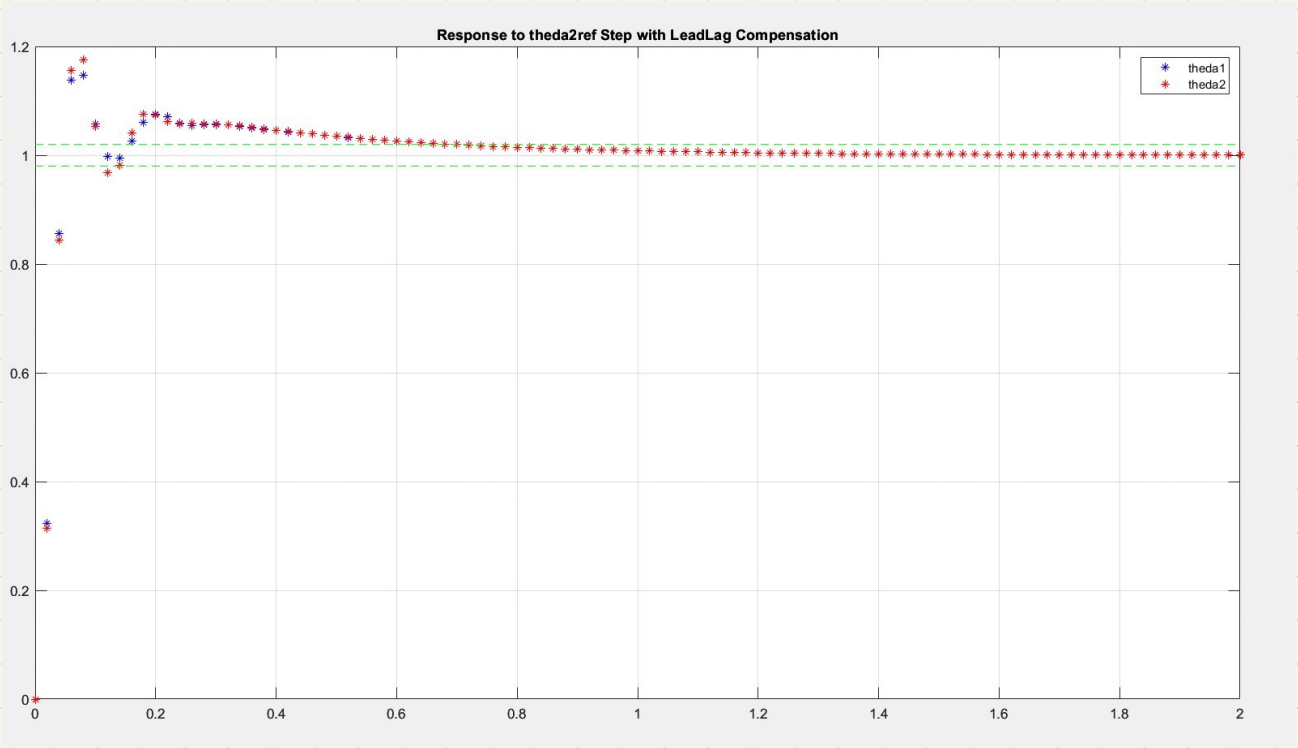


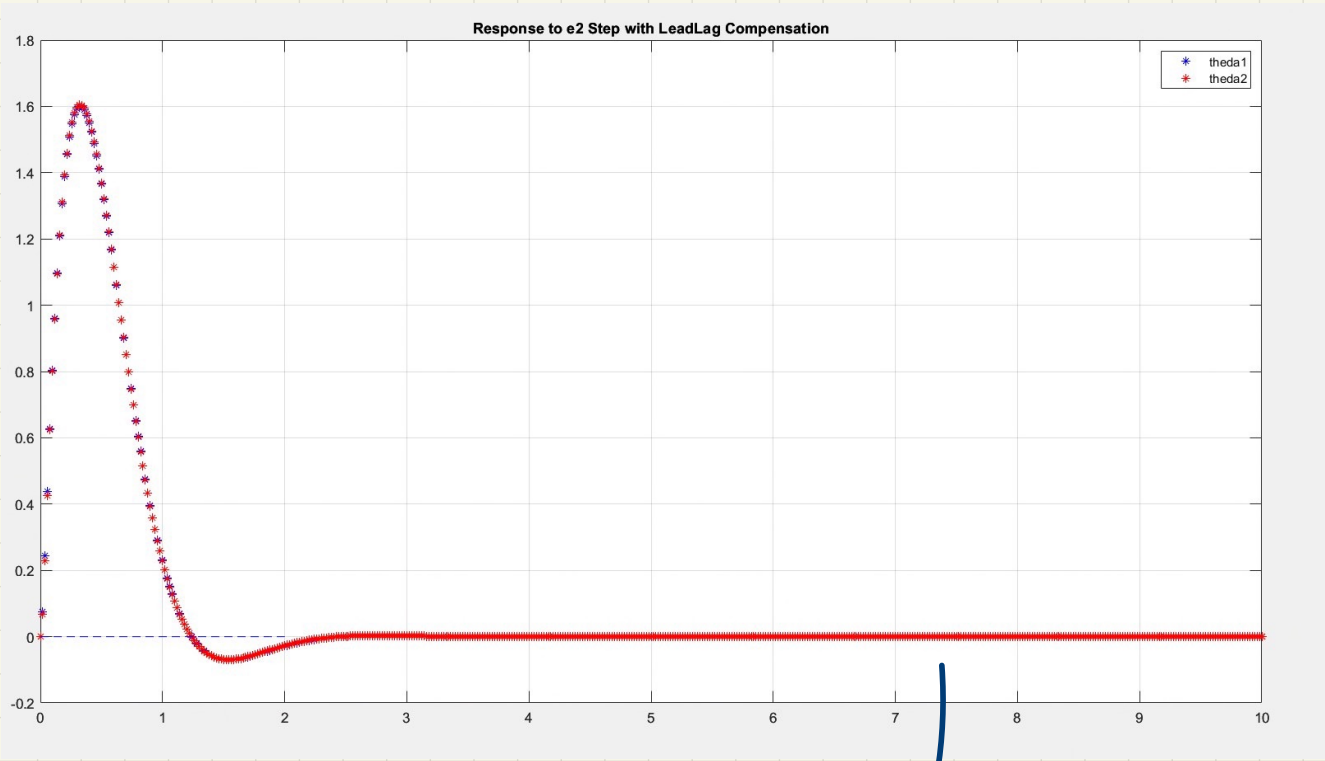

Bode of Lead-Lag Compensators
High Gain
Magnitude (dB)
20
15
10
5
0
-5
45
0
-45
-90
Phase (deg)
Phase Lead
10^{-1}
10^{0}
10^{1}
10^{2}
Frequency (rad/s)
10π


Bode of Loop Transfer Function with Lead-Lag Compensation
Magnitude (dB)
80
60
40
20
0
-20
-40
Phase (deg)
-90
-135
-180
-225
Lead_Lag
Lead
System: Lead_Lag
Phase Margin (deg): 54.5
Delay Margin (samples): 1.48
At frequency (rad/s): 32.2
Closed loop stable? Yes
About 60°
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (rad/s)


Bode of Close-Loop Transfer Function with Lead-Lag Compensation
System: theda2/theda2_ref
Frequency (rad/s): 63
Magnitude (dB): -1.83
BW Check
Magnitude (dB)
Phase (deg)
theda2/theda2_ref
Frequency (rad/s)


Bode of Close-Loop Transfer Function with Lead-Lag Compensation
Rejection Check
Magnitude (dB)
Phase (deg)
theda2/theda2_ref
Frequency (rad/s)





$\theta_1 = 0$ in steady state

in response to an e_2 step input, when $\theta_{2ref} = 0$.