Parker Brown
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MAE 144

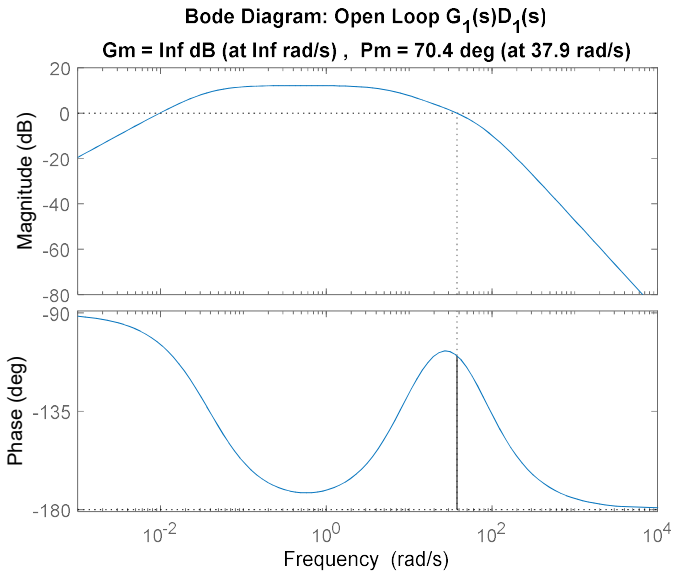
Final Project: Balance

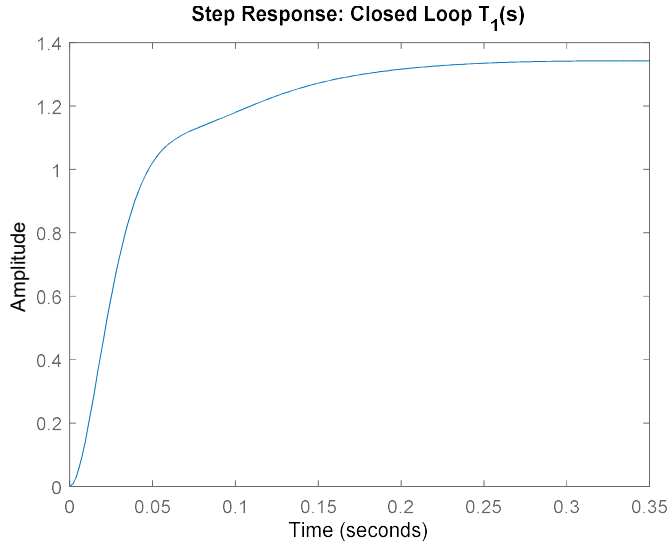
**G1: Inner Loop**

$$G_1(s) = -\frac{875.6s}{s^3 + 44.18s^2 - 143.8s - 2072}$$

$$D_1(s) = \frac{-4.95s^2 - 141.1s - 705.9}{s^2 + 73.15s + 2.822}$$

$$D_1(z) = \frac{-4.9500z^2 + 8.8709z - 3.9709}{z^2 - 1.4810z + 0.4812} \; at \; 100Hz$$



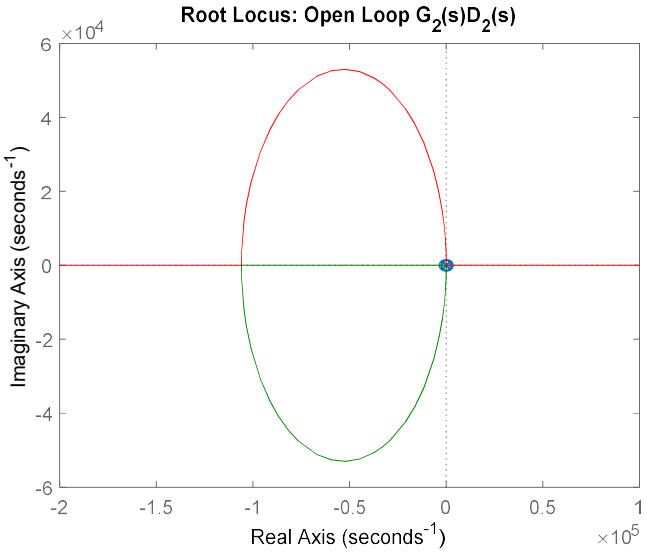



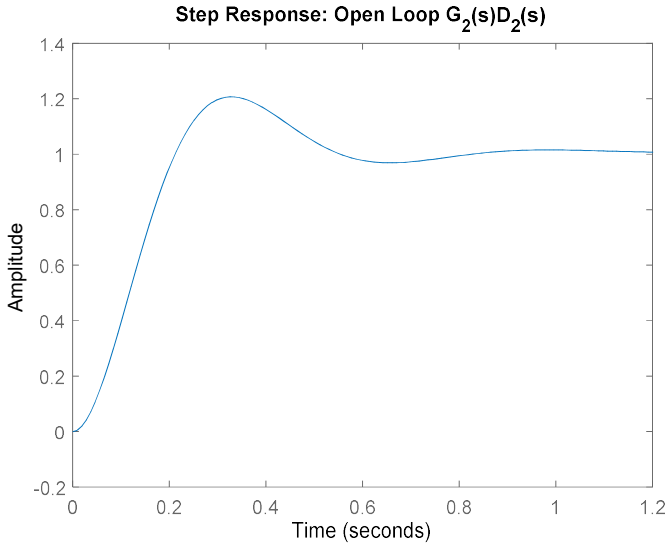
**G2: Outer Loop**

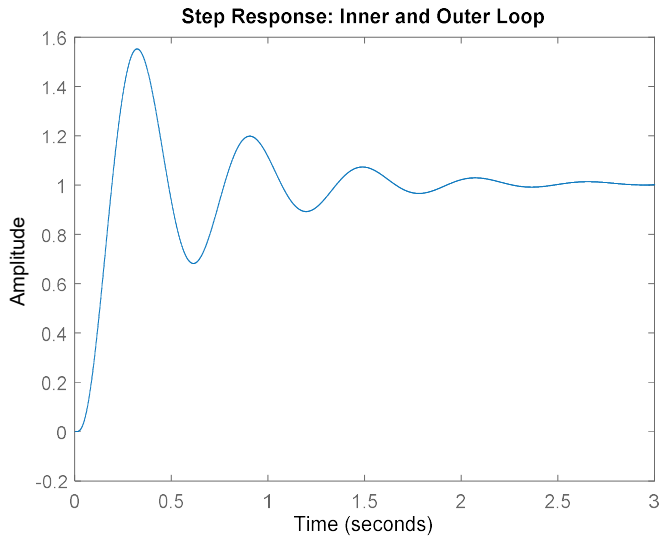
$$G_2(s) = \frac{-0.0002233s^2 + 117.1}{s^2}$$

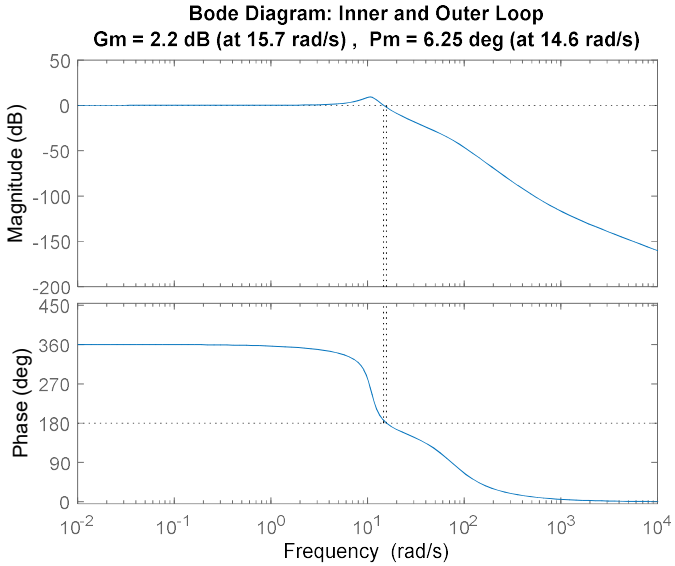
$$D_2(s) = \frac{s + 0.1}{s + 10}$$

$$D_2(z) = \frac{z - 0.9961}{z - 0.6065} \; at \; 20Hz$$




Step Response: Inner and Outer Loop
Amplitude
Time (seconds)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0
0.5
1
1.5
2
2.5
3


Bode Diagram: Inner and Outer Loop
Gm = 2.2 dB (at 15.7 rad/s) , Pm = 6.25 deg (at 14.6 rad/s)
Magnitude (dB)
Phase (deg)
Frequency (rad/s)
50
0
-50
-100
-150
-200
450
360
270
180
90
0
10-2
10-1
100
101
102
103
104