DIGITAL CONTROL OF POWER ELECTRONICS
Proportional Controller

$$G_c(z) = K \tag{1}$$

Let the plant be

$$G_p(z) = \frac{2}{z(z-1)} \tag{2}$$

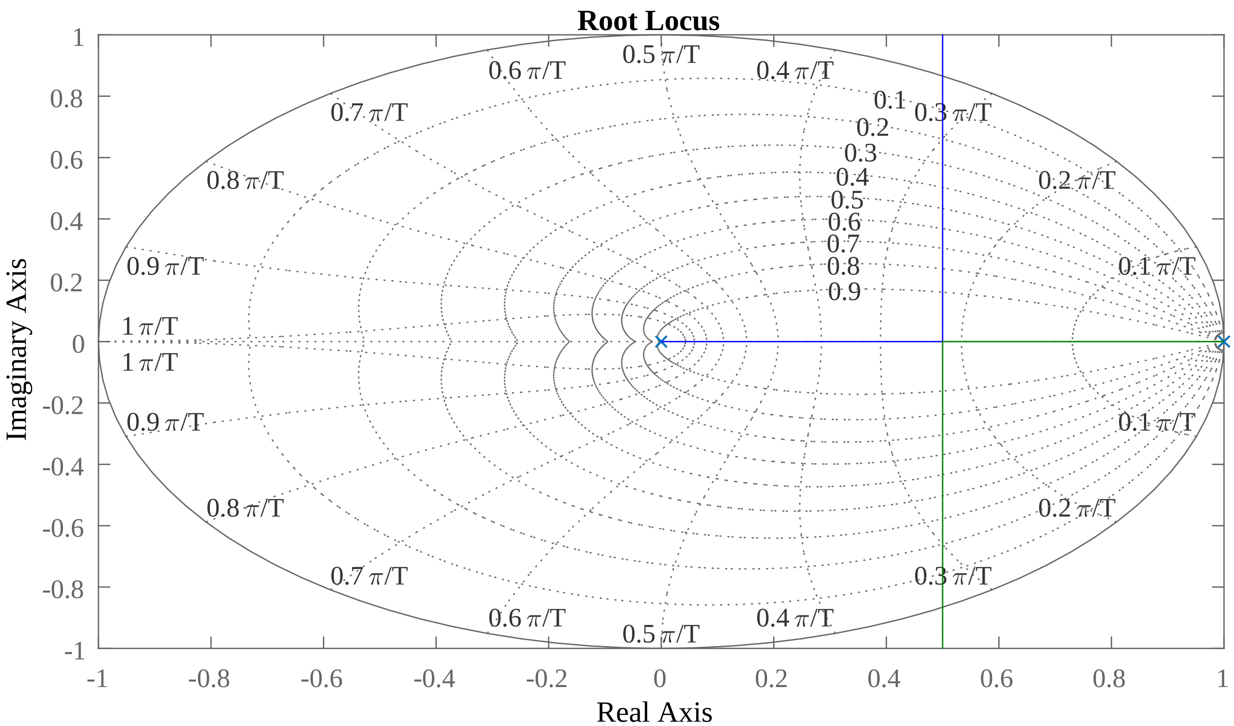
Lets assess the stability of the system based on selection of gain K
Find the open loop expression

$$G_{ol} = \frac{2K}{z(z-1)} \tag{3}$$

$$G_{cl} = \frac{2K}{z^2 - z + 2K} \tag{4}$$

The roots of the closed loop equation are

$$r_{1,2} = \frac{1 \pm \sqrt{1-8K}}{2} \tag{5}$$



$$a \tag{6}$$

The roots must remain inside the unit circle in order for the system to be stable
The closed loop system is stable for gains of

$$0 < K < 0.5 \tag{7}$$

What happens when K=0.1?

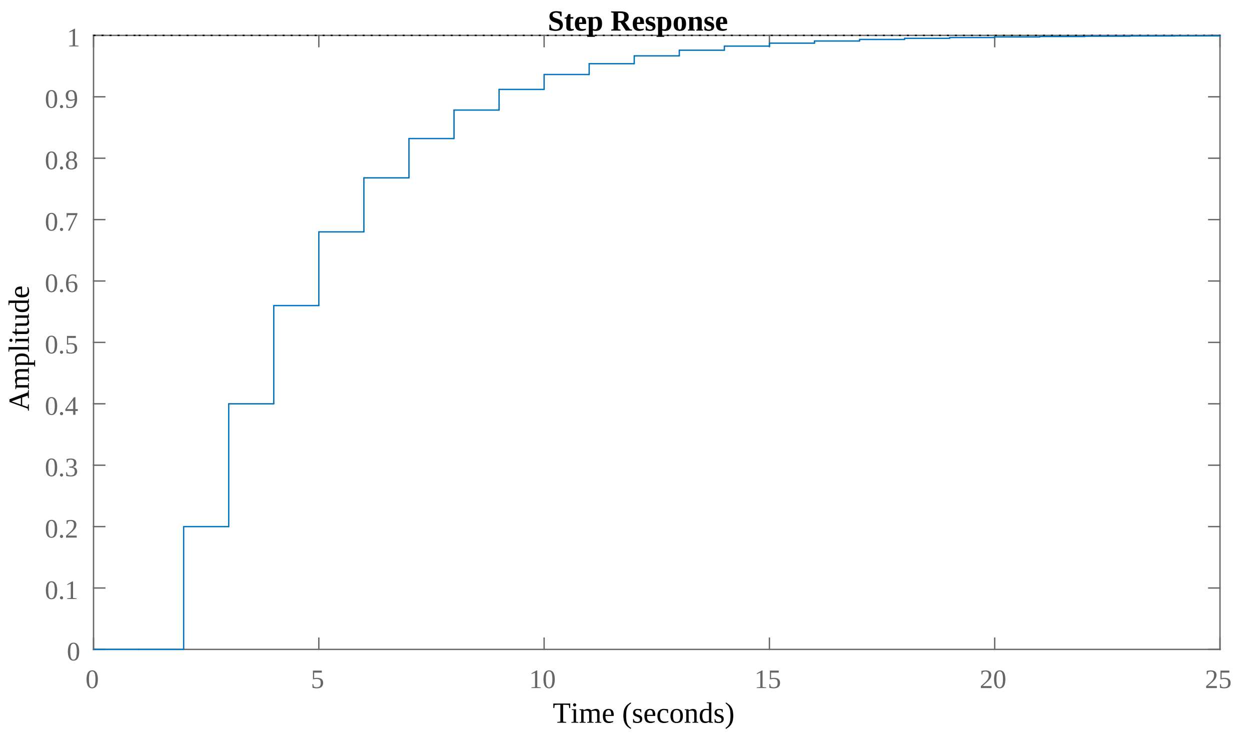
$$G_c = 0.1 \tag{8}$$

$$G_{cl} = \frac{0.2}{z^2 - z + 0.2} \tag{9}$$

The roots are

$$r_1 = 0.7236 \quad r_2 = 0.2764 \tag{10}$$

The system is over-damped because there are two distinct real roots. The anticipated response is a decaying exponential.



What happens when K=0.4?

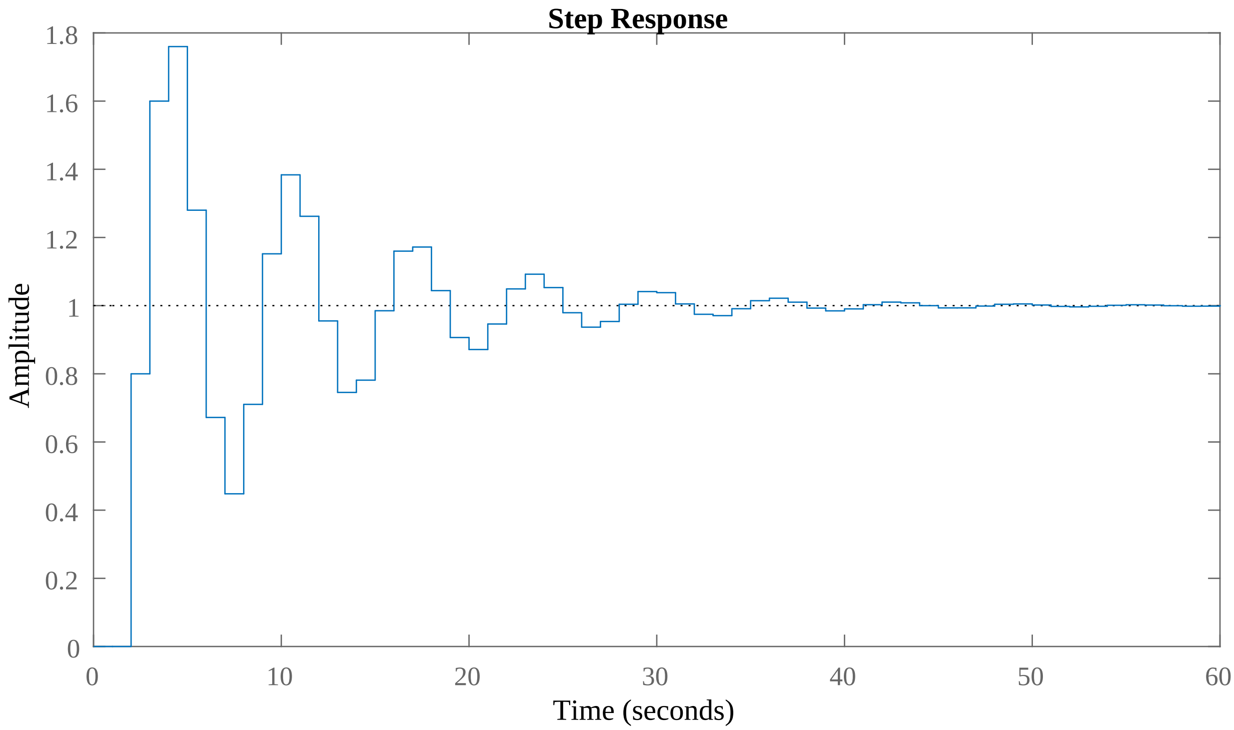
$$G_c = 0.4 \tag{11}$$

$$G_{cl} = \frac{0.8}{z^2 - z + 0.8} \tag{12}$$

The roots are

$$r_1 = 0.5 + 0.7416i \quad r_2 = 0.5 - 0.7416i \tag{13}$$

The system is under-damped because there are two distinct complex roots. The anticipated response should be a decaying sine wave.


Step Response
Amplitude
Time (seconds)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
10
20
30
40
50
60