EE132 Automatic Control

Lab 4: Bank Angle Hold

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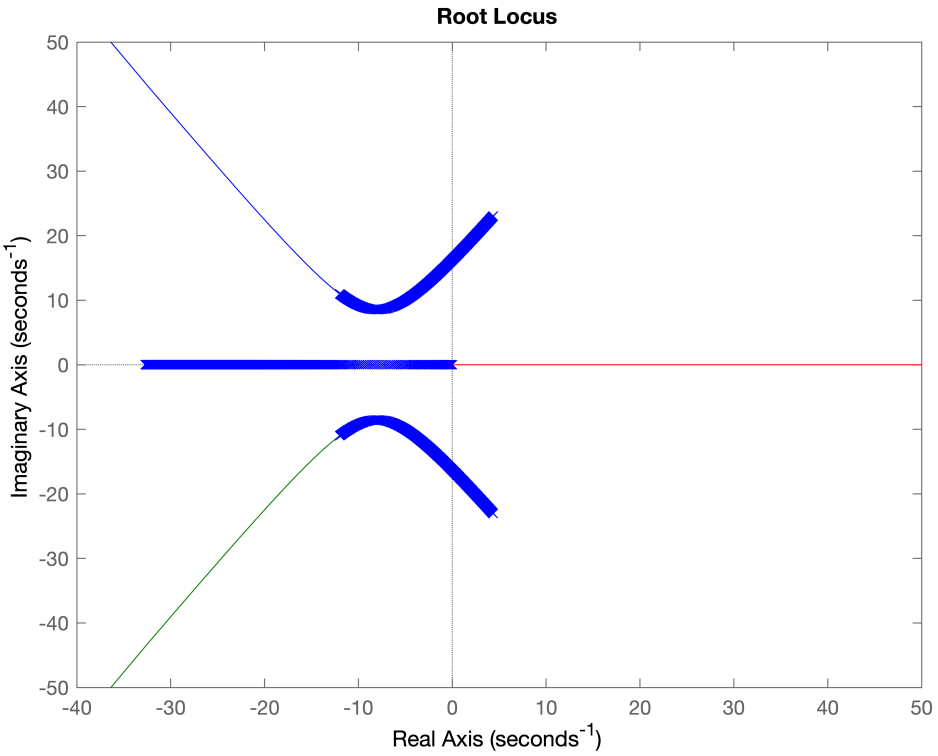
2) Calculate Poles

```
poles = roots([1 24.002 265.048 0.008])
```

```
poles = 3×1 complex
 -12.0010 +11.0011i
 -12.0010 -11.0011i
  -0.0000 + 0.0000i
```

3) Draw our own Root Locus

```
clear all
for k = 0:0.1:100
    p = roots([1 24.002 265.048 (0.53 + 180*k)]);
   for j = 1:length(p)
       hold on
        scatter(real(p(j)), imag(p(j)), 'bx')
    end
end
```



As can be seen from the root locus graph of the proportional controller, there exists both a constant damping ratio and mass overshoot. This shows that we have a constant damping ratio. We can also see that our system is marginally stable because there exists a pole on the imaginary axis. Moreover, this is a three pole system because we have three lines.

Use Matlab to find the values of k

```
K = 2;
poles = roots([1 24 265+(180*K)])
```

```
poles = 2×1 complex
 -12.0000 +21.9317i
 -12.0000 -21.9317i
```

```
wn = sqrt(poles(1)*poles(2))
```

```
wn = 25.0000
```

```
zeta = -(poles(1)+poles(2))/(2*wn)
```

```
zeta = 0.4800
```

```
Ts = 4.6/(wn*zeta)
```

```
Ts = 0.3833
```

```
Tp = pi/(wn*sqrt(1-zeta^2))
```

```
Tp = 0.1432
```

```
K = 30;
poles = roots([1 24.002 265.048 0.53+(180*K)])
```

```
poles = 3×1 complex
 -22.7757 + 0.0000i
  -0.6132 +15.3864i
  -0.6132 -15.3864i
```

```
wn = sqrt(poles(2)*poles(3))
```

```
wn = 15.3986
```

```
zeta = -(poles(2)+poles(3))/(2*wn)
```

```
zeta = 0.0398
```

```
Ts = 4.6/(wn*zeta)
```

```
Ts = 7.5022
```

```
Tp = pi/(wn*sqrt(1-zeta^2))
```

```
Tp = 0.2042
```

```
K = 15;
poles = roots([1 24.002 265.048 0.53+(180*K)])
```

```
poles = 3×1 complex
 -17.6535 + 0.0000i
  -3.1743 +11.9540i
  -3.1743 -11.9540i
```

```
wn = sqrt(poles(2)*poles(3))
```

```
wn = 12.3683
```

```
zeta = -(poles(2)+poles(3))/(2*wn)
```

```
zeta = 0.2566
```

```
Ts = 4.6/(wn*zeta)
```

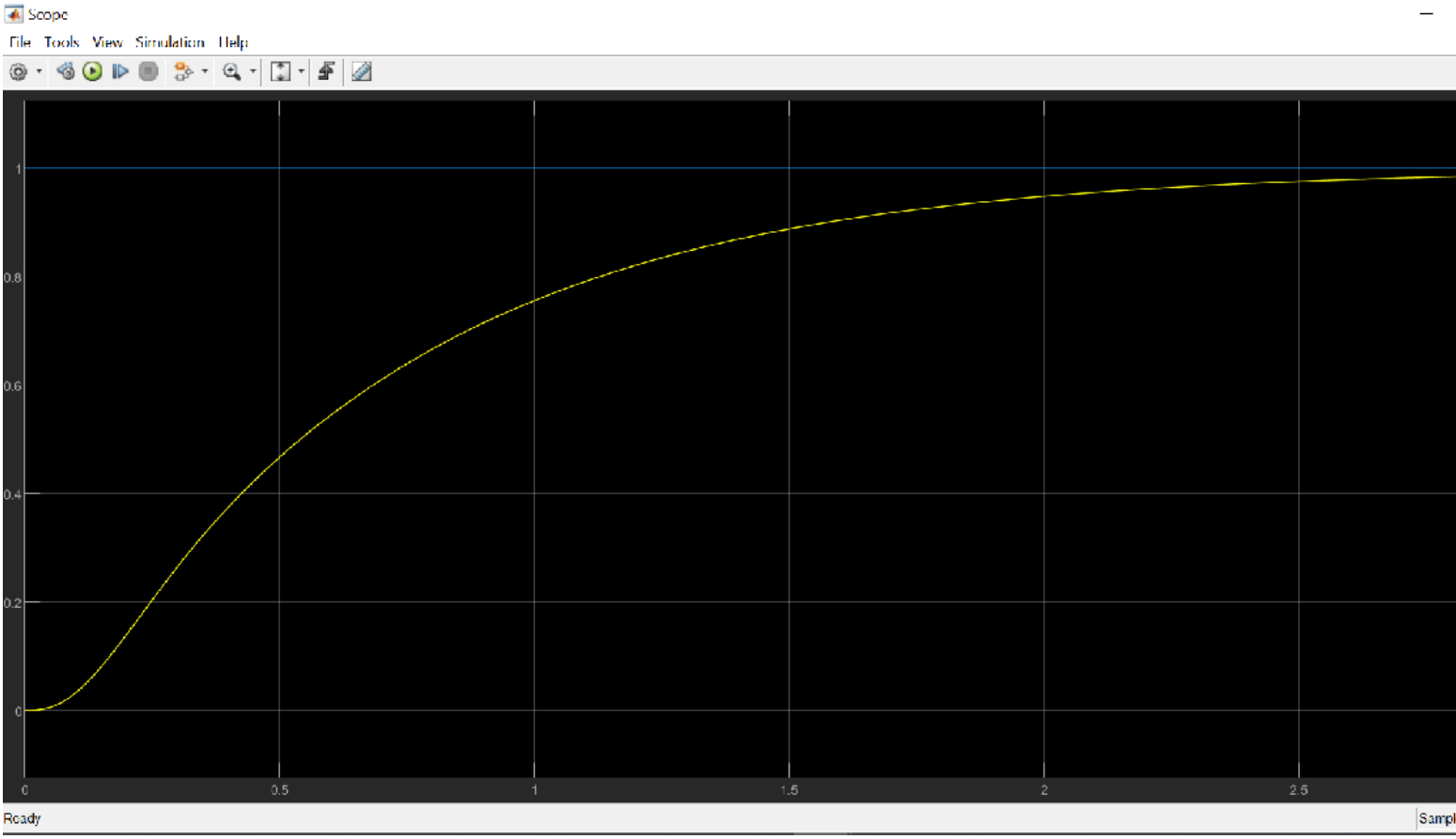
```
Ts = 1.4492
```

```
Tp = pi/(wn*sqrt(1-zeta^2))
```

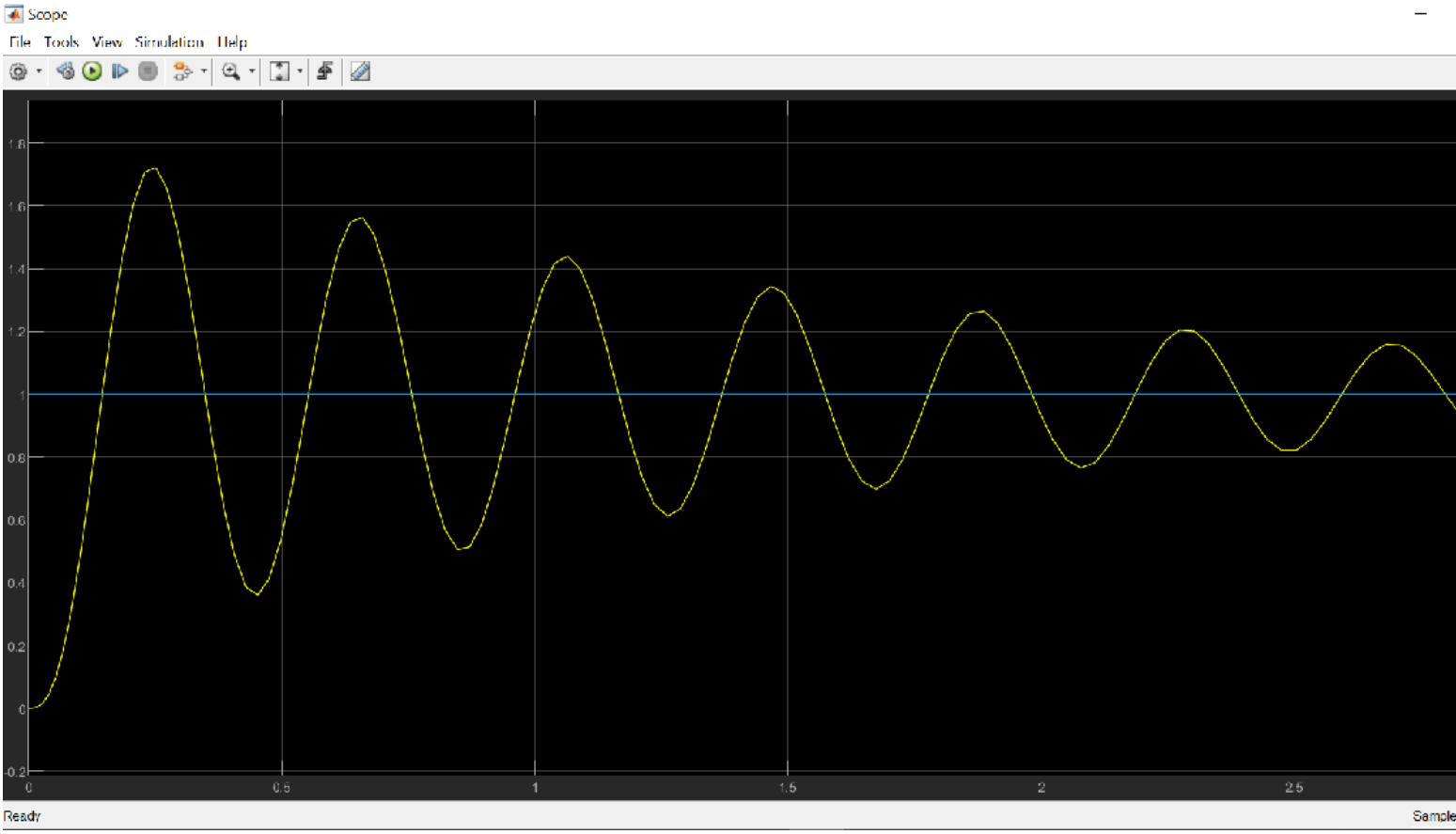
```
Tp = 0.2628
```

K	ω	ζ	Estimated T_s	Estimated T_p	Actual T_s	Actual
2	25	0.4800	0.3833	0.1432	X	X
30	15.3986	0.0398	7.5022	0.2042	7.084	0.242
15	12.3683	0.2566	1.4492	0.2680	1.4960	0.32

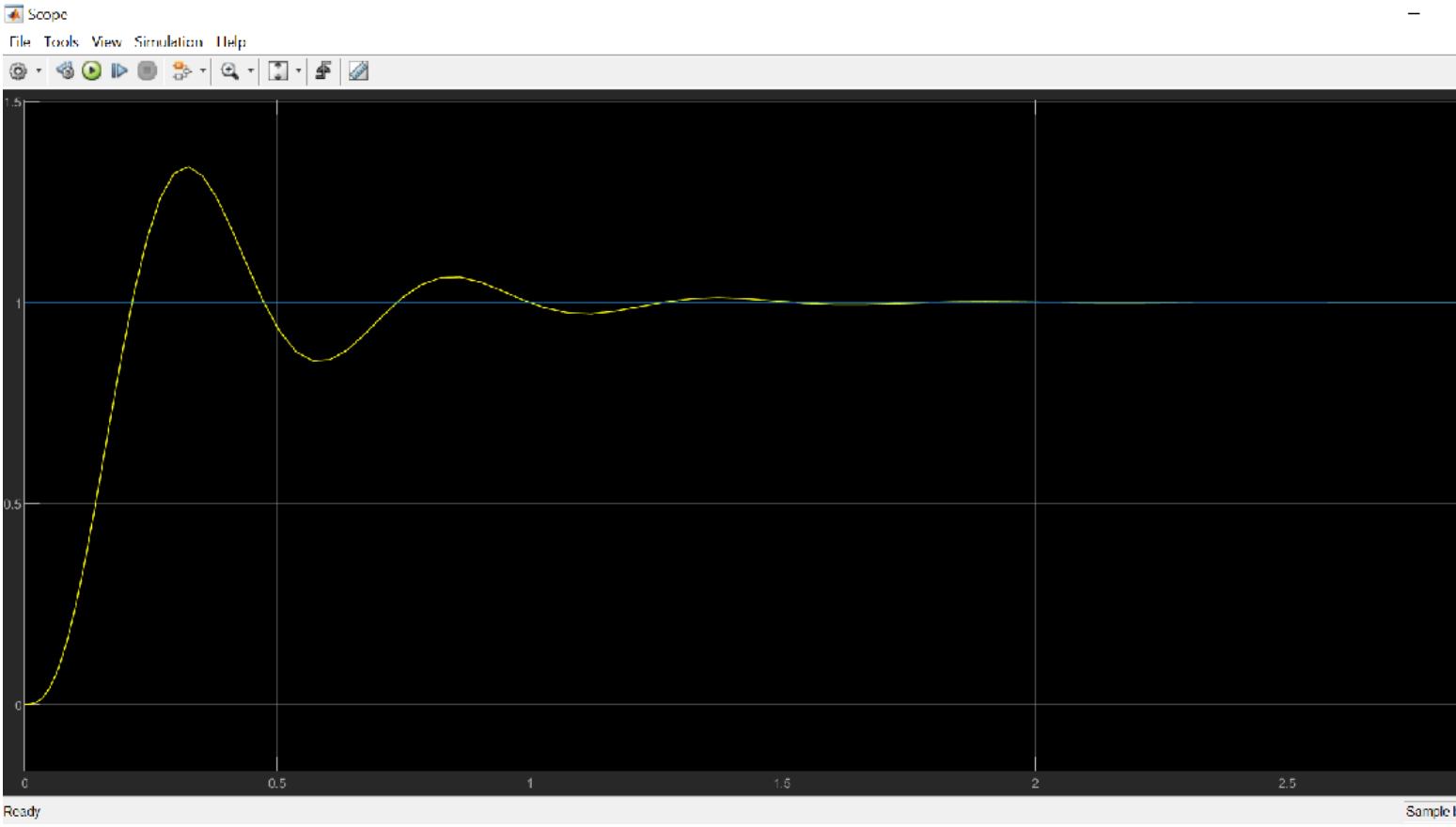
K=2



K=30


Scope
File Tools View Simulation Help
1.8
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
Ready
Sample

K=15


Scope
File Tools View Simulation Help
1.5
1
0.5
0
0
0.5
1
1.5
2
2.5
Ready