Contents

Student ID

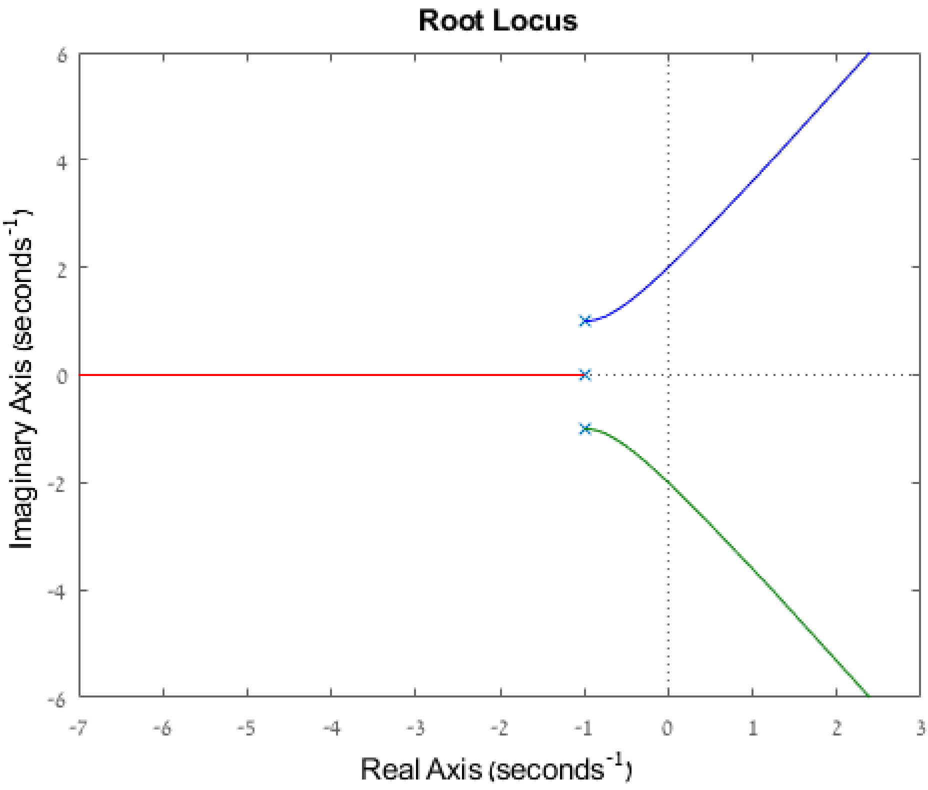
```
ID = 316098052;
disp(ID)
```

```
   316098052
```

1 Sketch a Root locus

```
s =tf('s');

H = 1/((s^2+2*s+2)*(s+1))

rlocus(H)
```

```
H =

            1
  ---------------------
  s^3 + 3 s^2 + 4 s + 2

Continuous-time transfer function.
```



2 State space system

1. The characteristic equation of the system is:

$$s^3 + s^2\left(2+k\right) + 5s + 1 = 0$$

2. Following the Routh Hurwitz algorithem:

$$\begin{array}{c|cc} s^3 & 1 & 5 \\ s^2 & 2+k & 1 \\ s^1 & \frac{5k+9}{k+2} & 0 \\ s^0 & 1 & 0 \end{array}$$

It can be obtained that for $k > -\frac{9}{5}$\$ the system is stable.

3. According to the equation that describes the feedback of the open loop:

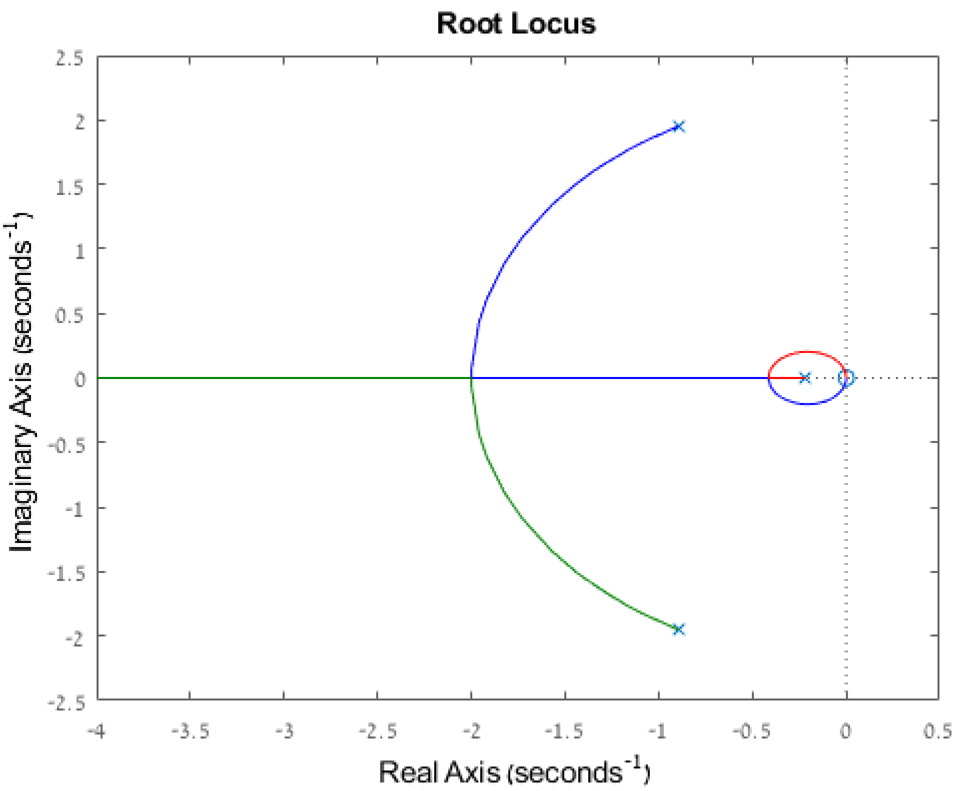
$$1 + k\frac{s^2}{s^3 + 2s^2 + 5s + 1} = 0$$

The Root Locus:

```
Q = [0 1 0 0]
P = [1 2 5 1]

rlocus(tf(Q,P))
```

```
Q =

     0     1     0     0
```

```
P =

     1     2     5     1
```



3 Pilot crane

The system transfer function:

$$H(s) = \frac{10k\left(s^2+10\right)}{s^3+20s+10k\left(s^2+10\right)}$$

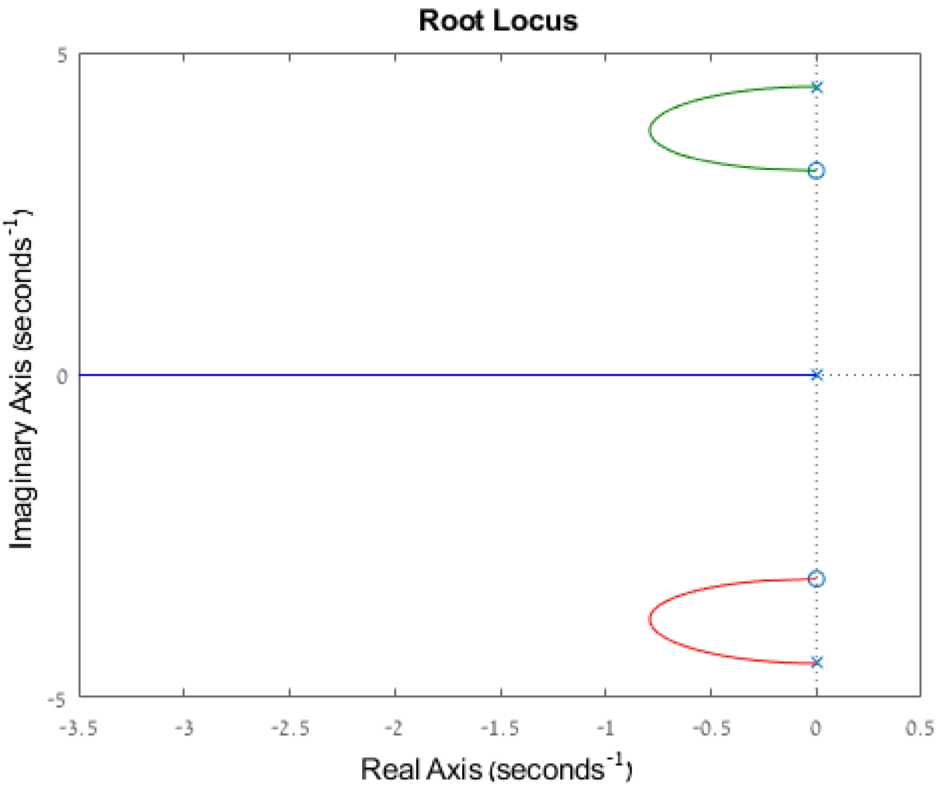
The characteristic equation:

$$1 + k\frac{10\left(s^2+10\right)}{s^3+20s} = 0$$

According to Routh Hurwitz algorithem, the system will be stabled for any positive k. Therefore from the Root Locus graph, the k that will bring the system to maximum damping rate (real part of the poles is smallest) is:

$k = 0.4644$

```
Q = [0 10 0 100];
P = [1 0 20 0];

rlocus(tf(Q,P))
[R,K] = rlocus(tf(Q,P));

min_array = real(R(2,:))*(-1);
index = find(min_array == max(min_array(:)));
k_optimal = K(index);
```



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