Report for Auto Control Lab11

Jacky Yeh 4107064003

2020/11/24

1 Introduction

This is the eleventh Experiment of Auto Control Lab where TAs taught us the plot of root locus and the finding for the determination of the stability.

2 LAB11

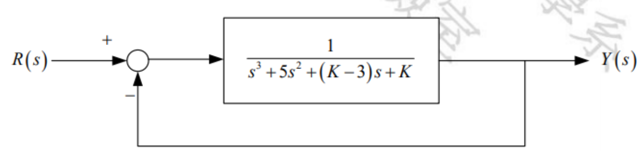
2.1 Part 1 Homework problems and its codes

Objective:To perform operations to find out the ROOT LOCUS located at the LHP, also find out the minimum value of k!

These are the stated Homework problems

Problem 1

Consider the feedback control system
Using the for function , develop a MATLAB script to compute the closed-loop transfer function poles for K=0:0.1:20 and plot the results denoting the poles with the "×" symbol. Determine the maximum range of K for stability with the Routh-Hurwitz method. Compute the roots of the characteristic equation when K is the minimum value allowed for stability.



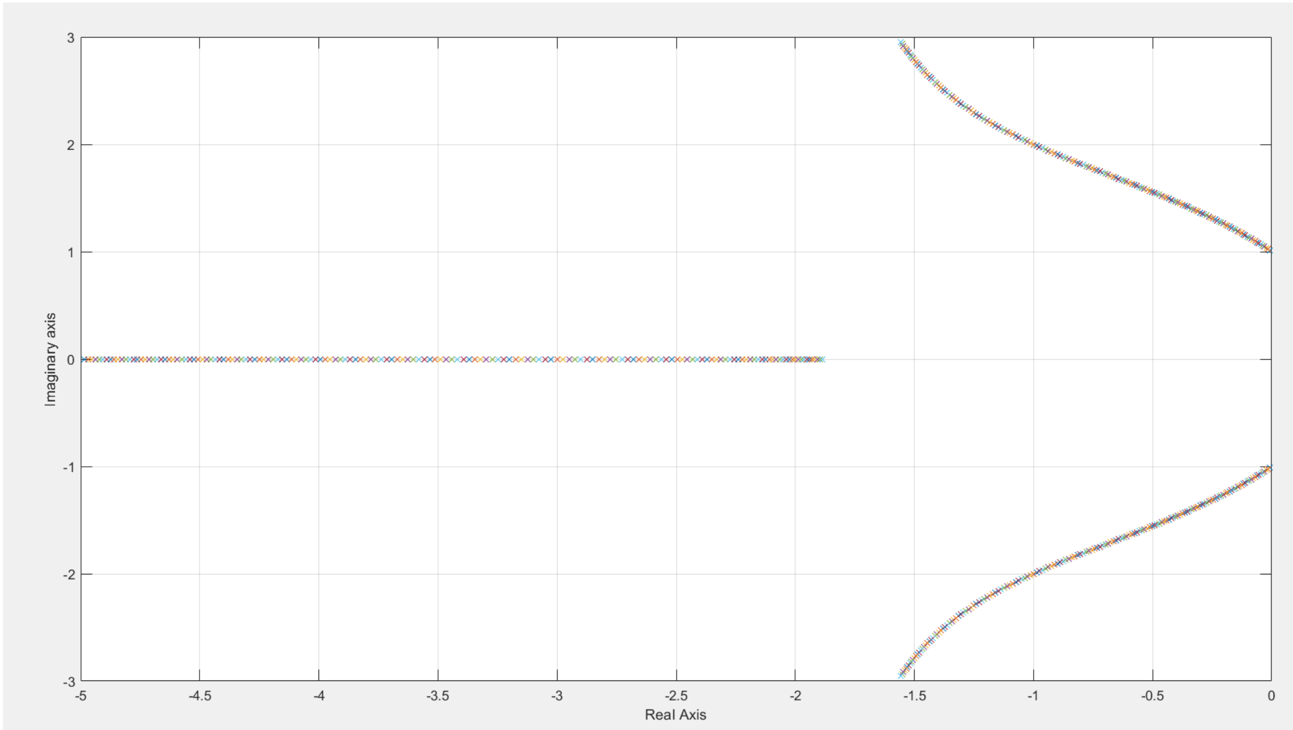
2.2 CODES FOR PROBLEM1

In order to perform the tasks, Matlab codes are needed. The following is the code needed for plotting

```
clear all;
clc;

K = [0 : 0.1 : 20]; %Trace out different K
j = 1;

for i = 1:length(K) %i index for different range of K
    num = 1; den = [1 5 (K(i)-3) K(i)];
    sys = feedback(tf(num,den),1); %system

    P(:,i) = pole(sys);  %3*1 array which stores the pole, this system has 3 poles, thus 3*1
    if(real(P(:,i)) < 0) %Trace the pole at the LHP
        k(j) = K(i); %We only need to specify poles at LHP,thus use a different index j.
        p(:,j) = P(:,i);
        j = j+1;
    end
end

k_min = min(k) %Get the min of index(k)
index = find( k == min(k))
p(:,index) %the min of that certain index in the 3*1 array,which is the pole
plot(real(p),imag(p) , 'x'),grid
xlabel('Real Axis'),ylabel('Imaginary axis');
```

2.3 Result of the Code and the plot of the ROOT LOCUS also the minimum k value

```
k_min =

    4.1000


index =

     1


ans =

  -4.9846 + 0.0000i
  -0.0077 + 1.0115i
  -0.0077 - 1.0115i

>>
```



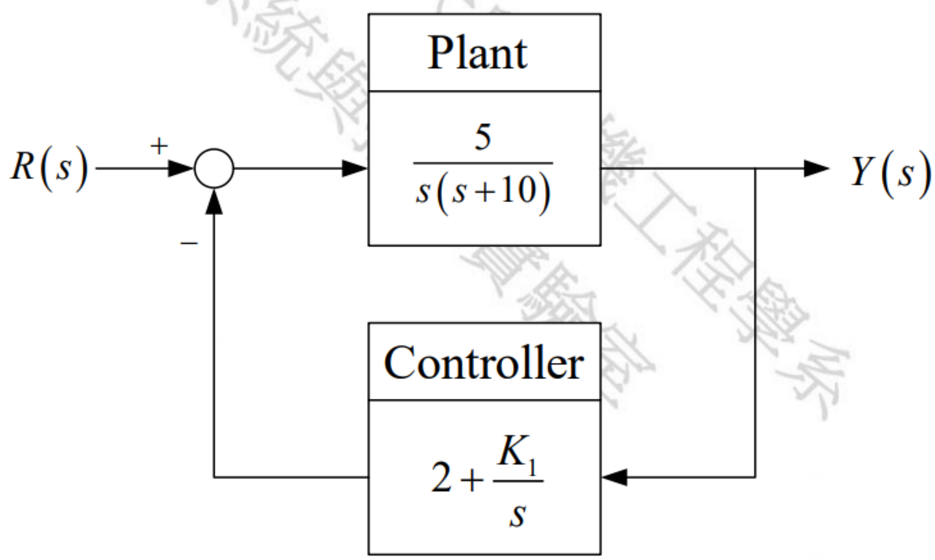
3
2
1
0
-1
-2
-3
Imaginary axis
-5
-4.5
-4
-3.5
-3
-2.5
-2
-1.5
-1
-0.5
0
Real Axis

2.4 Part 2 Homework problems

Objective:To plug in and plot out the ROOT LOCUS FOR THE SPECIFIED feedback system located at LHP.

Problem 2

Consider the feedback control system in (b)
Using MATLAB, plot the pole locations
as a function of $K_1 = 0:0.1:30$ and comment on the results.



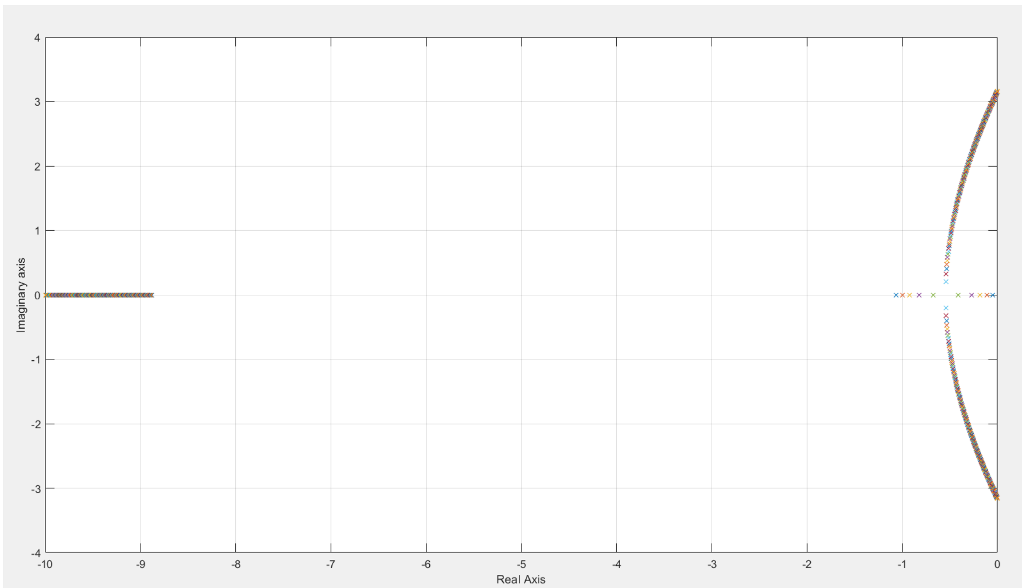
2.5 CODE FOR Part2

In order to perform the tasks, Matlab codes are needed. The following code is used for plotting the system with different damping ratios and natural frequency

```
clear all;
clc;
K = [0 : 0.1 : 30];
j = 1;



for i = 1:length(K)
    n1 = 5;d1 = [1 10 0];
    t1 = tf(n1,d1);

    n2 = [2 K(i)];d2 = [1 0];
    t2 = tf(n2,d2);
    sys = feedback(t1,t2);

    P(:,i) = pole(sys);
    if(real(P(:,i)) < 0)
        k(j) = K(i);
        p(:,j) = P(:,i);
        j = j+1;
    end
end

k_min = min(k)
index = find( k == min(k))
p(:,index);
plot(real(p),imag(p) , 'x'),grid
xlabel('Real Axis'),ylabel('Imaginary axis');
```

2.6 Plot out the root locus for the given feedback system!

The following is the ROOT LOCUS of the system



3 Conclusion

Today we learn how to plot the root locus of the system which is related to what we are learning right now, i.e the root locus plotting. Although originally, root locus plotting involves lots of trivial steps, including finding centroids of the poles, finding angle for asymptotes, also the intersections of imaginary axis with the root locus. By using MATLAB, these trivial stuff can be simplified, thus proved that MATLAB is a powerful tool for system analysis!

This concludes the eleventh Week of Auto Control LAB