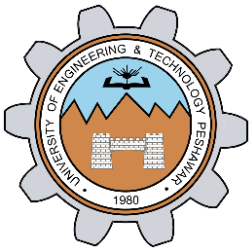
Implementation of Root Locus using MATLAB

LAB # 10



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CSE-310L Control Systems Lab

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"On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work."

Submitted to:

Dr. Muniba Ashfaq

Date:

10th **December 2024**

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Objectives:

To Implement Root Locus in MATLAB

Task 1 (Example):

- Find the root locus for the following systems using Matlab. [Hint: use *rlocus* command].

$$G(s)H(s) = \frac{K(s-2)}{(s+2)(s+2j)(s-2j)}$$

G(s)H(s) = (s-2)/(s+2)(s+2j)(s-2j)

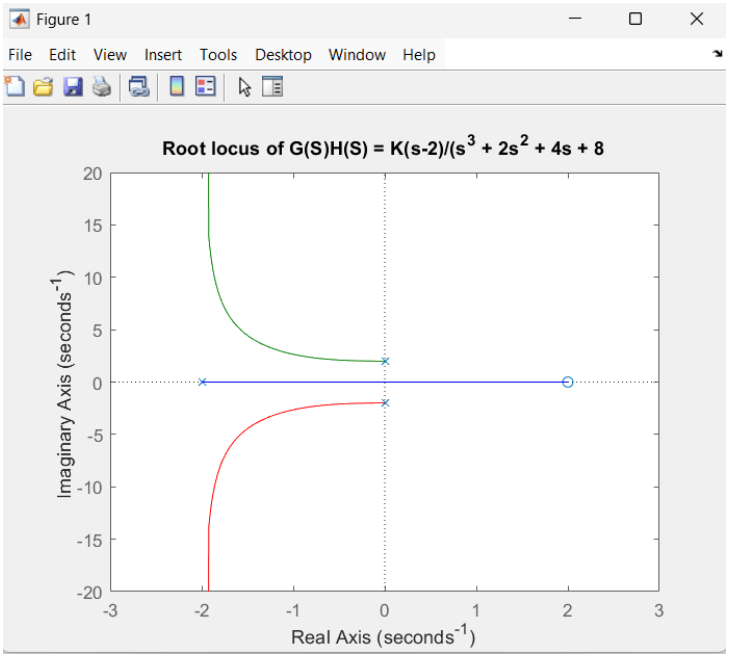
= (s-2)/(s+2)(s^2+2s+3)

= (s-2)/(s^3+2s^2+4s+8)

Code:

```
clear;
clc;
%Lab Example
num=[1  -2];
denum=[1  2  4  8];
sys = tf(num,denum)
rlocus(sys)
title("Root locus of G(S)H(S) = K(s-2)/(s^3 + 2s^2 + 4s + 8")
```

Output:



Task 1 part 2:

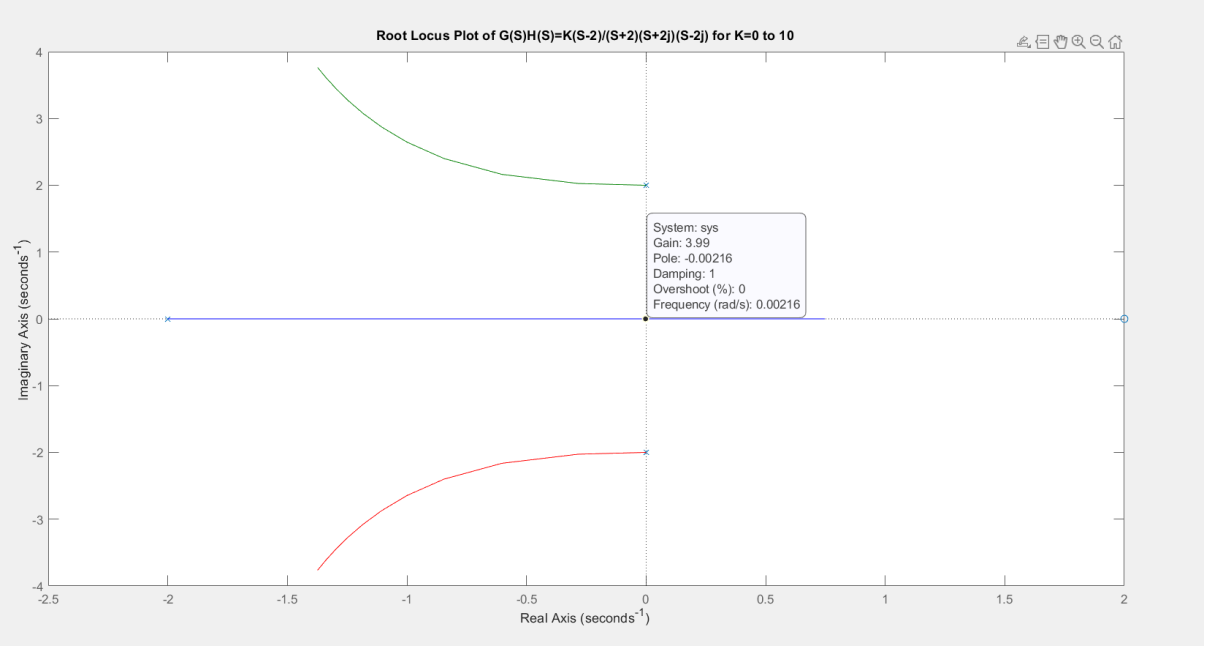
find values of poles at K=0,1,2,3...10

Code:

```
%%
num = [1  -2];
denum = [1  2  4  8];
sys = tf(num,denum);
k = [0:1:10];
for i=k;
    poles=rlocus(sys,i);
    display("poles " + i + " = " + poles);

end
title("Root Locus Plot of G(S)H(S)=K(S-2)/(S+2)(S+2j)(S-2j) for K=0 to 10")
```

Output:



3×1 **string** array

"poles for k = 0 is -2+0i"
"poles for k = 0 is -1.5543e-15+2i"
"poles for k = 0 is -1.5543e-15-2i"

3×1 **string** array

"poles for k = 1 is -0.28356+2.0266i"
"poles for k = 1 is -0.28356-2.0266i"
"poles for k = 1 is -1.4329+0i"

3×1 **string** array

"poles for k = 2 is -0.60339+2.163i"
"poles for k = 2 is -0.60339-2.163i"
"poles for k = 2 is -0.79322+0i"

3×1 **string** array

"poles for k = 3 is -0.84563+2.4006i"
"poles for k = 3 is -0.84563-2.4006i"
"poles for k = 3 is -0.30875+0i"

3×1 **string** array

"poles for k = 4 is 0+0i"
"poles for k = 4 is -1+2.6458i"
"poles for k = 4 is -1-2.6458i"

"poles for k = 5 is -1.1056+2.8714i"
"poles for k = 5 is -1.1056-2.8714i"
"poles for k = 5 is 0.21126+0i"

3×1 **string** array

"poles for k = 6 is -1.184+3.0773i"
"poles for k = 6 is -1.184-3.0773i"
"poles for k = 6 is 0.36794+0i"

3×1 **string** array

"poles for k = 7 is -1.2454+3.2667i"
"poles for k = 7 is -1.2454-3.2667i"
"poles for k = 7 is 0.49089+0i"

3×1 **string** array

"poles for k = 8 is -1.2956+3.4429i"
"poles for k = 8 is -1.2956-3.4429i"
"poles for k = 8 is 0.5912+0i"

3×1 **string** array

"poles for k = 9 is -1.3377+3.608i"
"poles for k = 9 is -1.3377-3.608i"
"poles for k = 9 is 0.67536+0i"

```
"poles for k = 10 is -1.3737+3.7638i"
"poles for k = 10 is -1.3737-3.7638i"
"poles for k = 10 is 0.74749+0i"
```

Analysis:

Loop gain or K start from 0 and approaches to 3.99 for stable system. As the values goes beyond 3.99 or 4 so the system become unstable. K is stable for 0 to 3.99 and unstable for 4 to 10.

Conclusion:

Rlocus() is used to check the stability of a system. It's or very hard to determine from the differential equation or the transfer function of a system whether the system is stable not. MATLAB helps in properties or characteristics of a system.