Control Lab 5: Generation and Analysis of Root Locus Plots and Methods

Group 6

Name	Work (%)
Nate	33%
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Intro

The root locus method is a very useful method of analyzing the stability of a system. In this lab we use MATLAB to take a differential equation and analyze its poles using the root locus method and determine the sensitivity of a system to changing characteristics.

Part 1 Code: Plotting using manual root calculations

```
%G(s) = 1/(s(s+2)(s+5))
%G(s) = 1/(s(s^2+7s+10))
%G(s) = 1/(s^3+7s^2+10s)

syms g s k

g = 1/(s*(s^2+7*s+10));

tf = (g*k)/(1+g*k);

disp(tf);

% Calculate the roots (poles) of the closed-loop system using its
characteristics equation for k epsilon [0, 100]
% Plot all calculated roots on a complex plane.

figure;
hold on;
for k = 0:100
    eq = (s^3+7*s^2+10*s) + k;
    roots = solve(eq, s);
    plot(real(roots), imag(roots), 'o');
end
title("Roots of the Closed-Loop System");
```

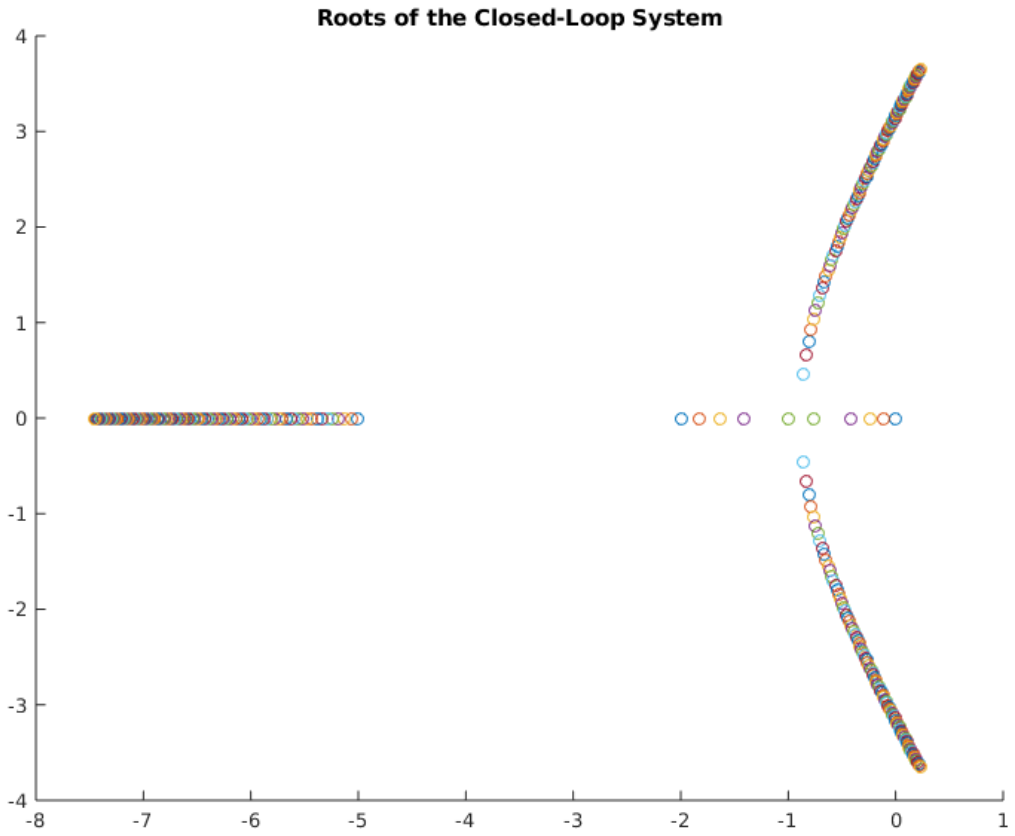

Figure 1: Plot of poles of the “systems” characteristic equation. These are manually calculated and not using MATLAB’s native rlocus() function.

Part 2 Code: Plotting poles using the rlocus() MATLAB function

```
k = 0:0.5:100;

% Define the transfer function using the tf function
tff = tf(1, [1 7 10 0]);

disp(k)

% Plot the root locus
figure;
rlocus(tff, k);
title('Root Locus of the System');
xlabel('Real Axis');
ylabel('Imaginary Axis');
grid on;
title('Root Locus of the System');
```

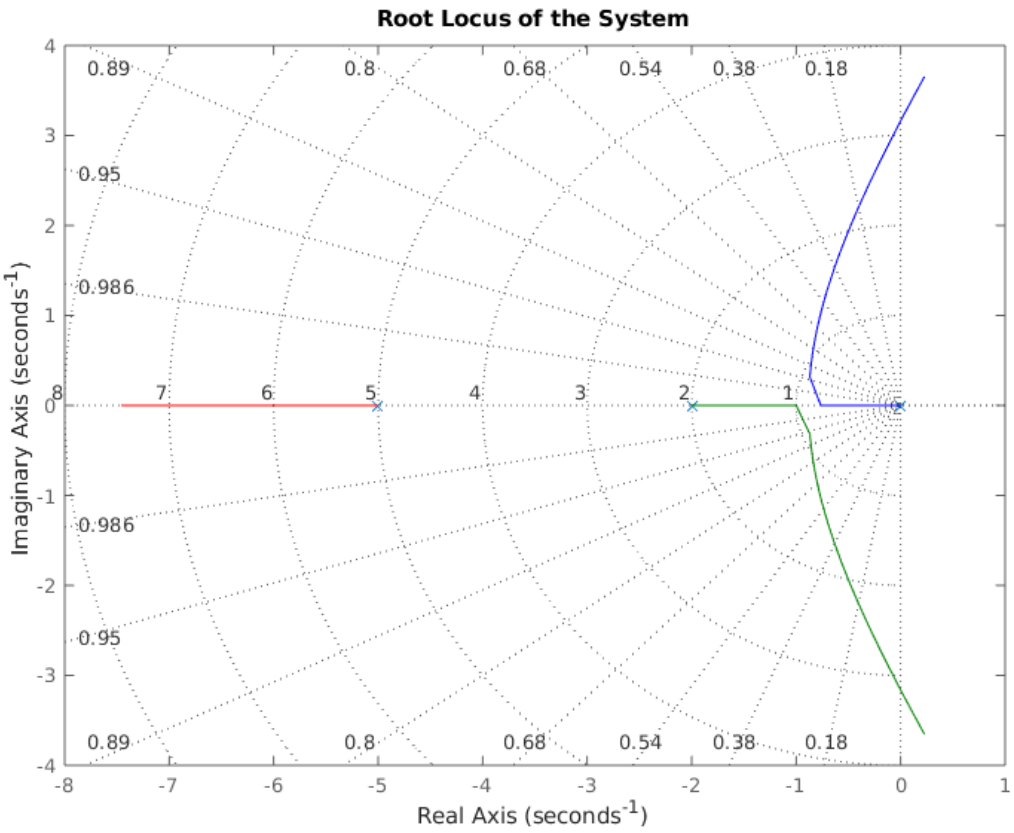

Figure 2: Root locus plot using the rlocus() MATLAB function.

Analysis and Conclusion

As K is increased, we can see the poles shift into the non-real dimensions and the system tends to lower stability and longer response times, and more oscillation. This method allows us to visualize the regions that indicate these characteristics and get practice in analyzing systems and their stability. Overall, rlocus() function and system analysis visualization is a great tool for system control and design, especially when given specific design characteristics.