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This file produces root locus diagram and step responses for
Proportional position control of a spring-mass-damper system.

Clear Variables and turn on pause feature

```
clear m c kspring Kp poles Kstring numP denP sysOL sysCL
clear titlestringRL titlestring
disp('Proportional Position Control of a Spring-Mass-Damper');
% turn on pause feature
pause on;
```

Define parameters

```
m = 1.0; % mass in slugs
c = 8.8; % damping coefficient in lb-s/ft
kspring = 40.0; % spring stiffness in lb/ft
```

Define the open-loop transfer function and plot the root locus diagram

```
% define the open-loop transfer function (sysOL)
numP = [1]; denP = [m,c,kspring]; sysOL = tf(numP,denP);
% plot the root locus diagram in figure window #1
figure(1); clf; hold on;
rlocus(sysOL); grid on;
titlestringRL = ['Root Locus Diagram for Kp'];
title(titlestringRL);
```
Find a suitable proportional gain "Kp" for the closed loop system

% pause to allow user to zoom into areas of interest
pause;

% call rlocfind to allow user to pick the pole locations
[Kp,poles] = rlocfind(sysOL);

disp('Proportional Gain:'); disp(Kp);
disp('Poles Associated with this Gain:'); disp(poles);

Select a point in the graphics window

selected_point =
    -4.40374787052811 + 10.9128630705394i

Proportional Gain:
    98.4506003325402

Poles Associated with this Gain:
    -4.4 + 10.9128639839659i
    -4.4 - 10.9128639839659i
Define the closed-loop transfer function with the selected gain "Kp" and plot the step response

```matlab
% define the closed-loop transfer function (sysCL) with selected gain (Kp) and negative unity feedback
sysCL = feedback(Kp*sysOL,1,-1);

% plot the closed loop step response in figure #2
figure(2); clf; hold on;
step(sysCL); grid on;
ylabel('Position Change (ft)');
titlestring = ['Step Response of SMD with P Control. (Kp = ', num2str(Kp), ')'];
title(titlestring);

% pause to allow user to annotate the plot
pause;
```
Calculate and display the closed-loop performance characteristics to Command Window

```matlab
% calculate performance characteristics; stored in structure PerChar
performanceCharacteristics = stepinfo(sysCL);

% display results to Command Window
disp('Performance Data for the Compensated System');
disp('=============================================');
disp('Rise Time (sec) ='); disp(performanceCharacteristics.RiseTime);
disp('Settling Time (sec) ='); disp(performanceCharacteristics.SettlingTime);
disp('Percent Overshoot ='); disp(performanceCharacteristics.Overshoot);
disp('Peak Value ='); disp(performanceCharacteristics.Peak);
disp('Peak Time (sec) ='); disp(performanceCharacteristics.PeakTime);

% turn pause feature off
pause off;
```

Performance Data for the Compensated System
=============================================
Rise Time (sec) =
0.121421629549257

Settling Time (sec) =
0.905520164773013
Percent Overshoot = 28.1708592458886

Peak Value = 0.911407968444143

Peak Time (sec) = 0.286137751568751

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