Second Order MSD Equation

Author: Mohammed Ijaz PS Number: 99003728 Date: 7th April 2021. Version: Matlab 2020b.

Plant Description

The Mass-damper Spring Second order system is taken as Plant. It is used in as suspension.

```
% Equation: Mx''(t)+ Bx'(t) + Kx(t)= Kf(t).
% f = force; B= coefficient of friction; M = mass ; v= velocity; k=spring constant.
% Values: K1= 0.9 B1= 0.4 M1=1000 Wn=0.03 ; K2= 1 B2= 0.5 M2= 500 Wn=0.44; K3= 3 B3= 1.7 M3= 340
Wn=0.09;
```

Math Analysis:

Independent: Time(t) Dependent: Velocity(v) and Force(f) Constant: Mass(M), Frictional Coefficient(B), Spring constant(K)

```
% Roots:((-B/M)+-sqrt(sq(B/M)-4K/M))/2


% IVT:
% 1. For step input: 0
% 2. For impulse input: 0

% FVT:
% 1. For step input: 1
% 2. For impulse input: K/M
```

Tool Analysis:

```
B1= ([0.1 0.5 1.7]);
M1=([1000 5 340]);M1=([1000 5 340]);
K1 = ([0.9 1 3]);
for i=1:3
    sys = tf([K1(i)/M1(i)],[1,B1(i)/M1(i),K1(i)/M1(i)])
    figure(i);
    subplot(2,1,1);
    impulse(sys);
    title('Impulse Input');
    subplot(2,1,2);
    step(sys);
    title('Step Input');
    [z,p,k]= tf2zp([K1(i)/M1(i)],[1,B1(i)/M1(i),K1(i)/M1(i)])
```

```
    figure(4);
    zplane(z,p);
    xlim([-5*1e5 3*1e5]);
    ylim([-5*1e5 3*1e5]);
    hold on;
    S = stepinfo(sys)
end
```

```
sys =

          0.0009
  -----------------------
  s^2 + 0.0001 s + 0.0009

Continuous-time transfer function.


z =

  0×1 empty double column vector


p =

  -0.0001 + 0.0300i
  -0.0001 - 0.0300i


k =

   9.0000e-04


License checkout failed.
License Manager Error -10
Your license for Signal_Toolbox has expired.
If you are not using a trial license contact your License Administrator to obtain an updated
license.
Otherwise, contact your Sales Representative for a trial extension.

Troubleshoot this issue by visiting:
<a
href="https://www.mathworks.com/support/lme/R2020b/10">https://www.mathworks.com/support/lme/R202
0b/10</a>

Diagnostic Information:
Feature: Signal_Toolbox
License path: C:\Users\99003728\AppData\Roaming\MathWorks\MATLAB\R2020b_licenses;C:\Program
Files\MATLAB\R2020b\licenses\license.dat;C:\Program
Files\MATLAB\R2020b\licenses\trial_8681003_R2020b.lic
Licensing error: -10,32.
```

```
Error in sec_order_sys_MSD (line 52)
    zplane(z,p);
```

Comparison Analysis:

Time Response Results:

```
%system
% K1= 0.9 B1= 0.4 M1=1000
%RiseTime: 34.7791
%SettlingTime: 7.8226e+04
%percentage Overshoot: 99.4778
%PeakTime: 104.7198


%K2= 1 B2= 0.5 M2= 500
%RiseTime:2.5448
%SettlingTime: 78.1524
%percentage Overshoot: 70.2118
%PeakTime: 70.2118

%K3= 3 B3= 1.7 M3= 340
%RiseTime:1.5426e+03
%SettlingTime: 0.1540
%percentage Overshoot: 70.2118
%PeakTime: 33.4448
%Speed: System 2 is having low raise time and is therefore speed system.
%Stability: Settling time of system of system 3 is less and therefore is
%the stable system.
%Accuracy: Settling time of system of system 3 is less and therefore is
%more accurate.
```

Published with MATLAB® R2020b