Contents


```
% Joel Lubinitsky - 02/04/15
% MAE 321 - HW 3.1

clear all
close all
clc
```

Problem 1:

A spring-mass-damper system having mass of 100 kg, stiffness of 3000 N/m, and damping coefficient of 300 Ns/m is given a zero initial velocity and an initial displacement of 0.1 m. Calculate the form of the response and plot it for as long as it takes to die out.

Unknown: Form of response (ζ), Plot response

Known

```
mass                = 100;  % kg
stiffness           = 3000; % kg/s^2
coefficientDamping  = 300;  % kg/s
velocityInitial     = 0;    % m/s
xInitial            = 0.1;  % m
```

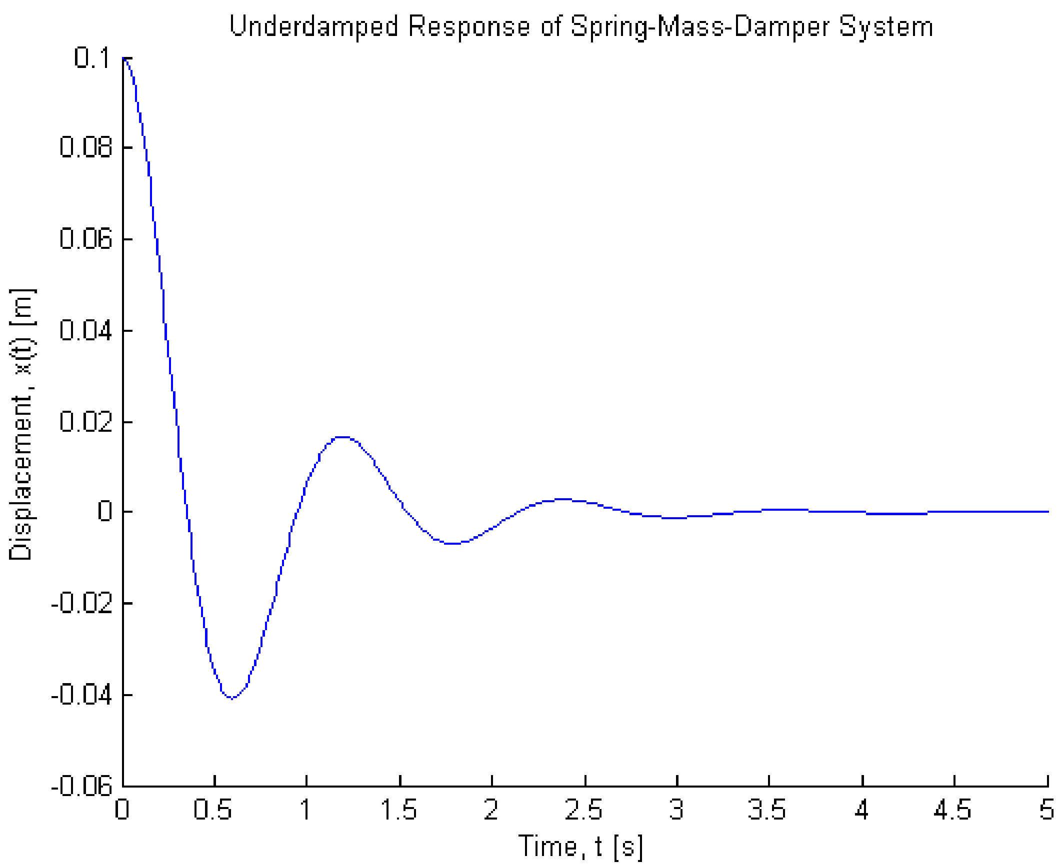
Calculations

```
frequencyNatural             = sqrt(stiffness / mass);                      % rad/s
coefficientDampingCritical = 2 * sqrt(stiffness * mass);                   % kg/s
ratioDamping                 = coefficientDamping / coefficientDampingCritical;
frequencyNaturalDamped       = frequencyNatural * sqrt(1 - ratioDamping ^ 2); % rad/s

% [ratioDamping < 1] -> Underdamped Response
disp('[ratioDamping < 1] -> Underdamped Response')
constantA   = sqrt(((velocityInitial + ratioDamping * frequencyNatural * xInitial) ^ 2 + (xInitial
* frequencyNaturalDamped) ^ 2) / frequencyNaturalDamped ^ 2);
constantPhi = atan((xInitial * frequencyNaturalDamped) / (velocityInitial + ratioDamping * frequenc
yNatural * xInitial));
time        = [0 : 0.01 : 5];

x = constantA .* exp(-ratioDamping .* frequencyNatural .* time) .* sin(frequencyNaturalDamped .* ti
me + constantPhi);
```

```
[ratioDamping < 1] -> Underdamped Response
```

Plot

```
figure(1)
hold on
title('Underdamped Response of Spring-Mass-Damper System')
xlabel('Time, t [s]')
ylabel('Displacement, x(t) [m]')
plot(time, x)
```



Results

System is underdamped because $\zeta < 1$

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