EE352 Automatic Control Assignment - Question 2

Iterative Reduction of mm

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1. Define System Parameters

```
clc;
clear;
close all;

% Parameters (DOB: 2003-01-18)
yy = 3;
mm = 1;
dd = 18;
SE = 291;

fprintf('Parameters: yy=%d, mm=%d, dd=%d, SE=%d\n', yy, mm, dd, SE);
```

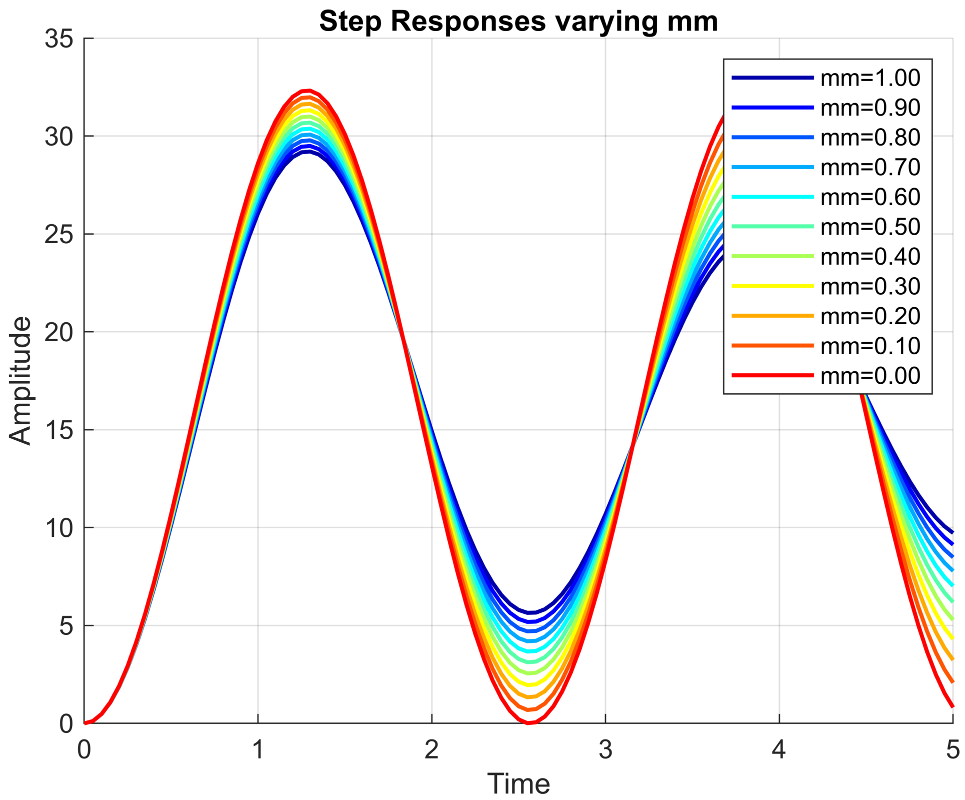
```
Parameters: yy=3, mm=1, dd=18, SE=291
```

Q2: Effect of Dampening (mm) reduction

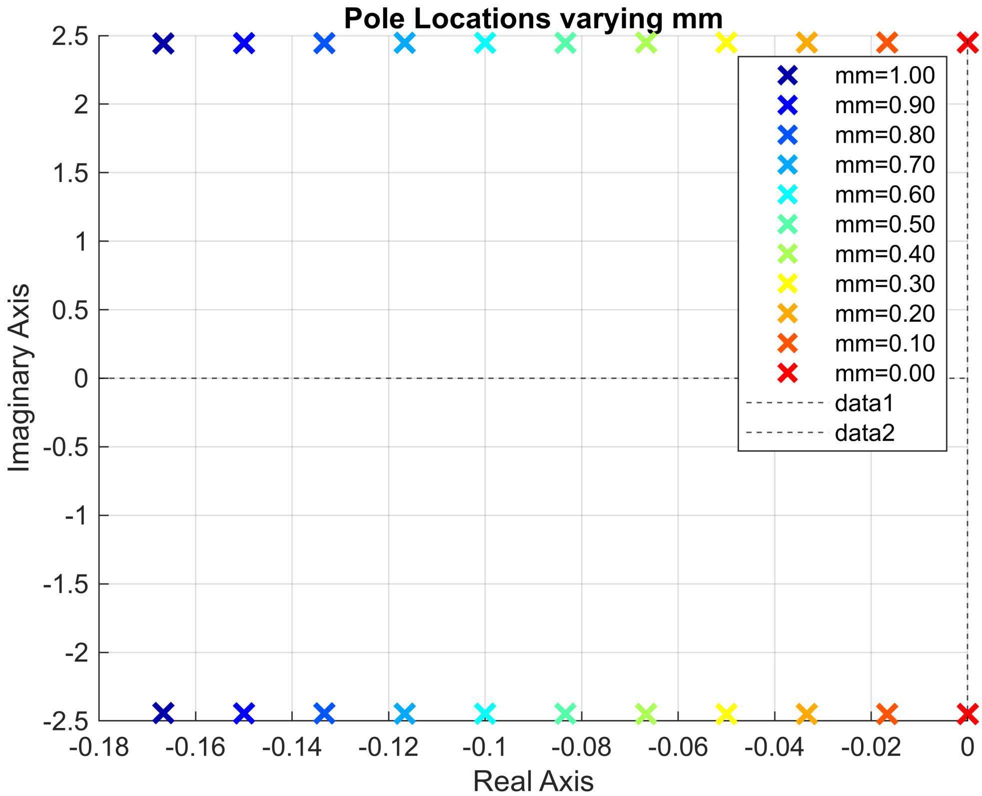
We will reduce the value of mm in 10 equal steps to zero.

```
num = [SE];
mm_values = linspace(mm, 0, 11); % Range from mm down to 0

% Prepare Figures
fig_resp = figure('Name', 'Q2: Step Responses');
hold on;
title('Step Responses varying mm');
xlabel('Time'); ylabel('Amplitude');

fig_poles = figure('Name', 'Q2: Pole Locations');
hold on;
title('Pole Locations varying mm');
xlabel('Real Axis'); ylabel('Imaginary Axis');
grid on; xline(0,'k--'); yline(0,'k--');

colors = jet(length(mm_values));

% Iteration Loop
for i = 1:length(mm_values)
    curr_mm = mm_values(i);
    curr_den = [yy, curr_mm, dd];

    % Create temp TF
    G_temp = tf(num, curr_den);

    % Plot Step Response
    figure(fig_resp);
```

```
    [y, t] = step(G_temp, 5);
    plot(t, y, 'Color', colors(i,:), 'LineWidth', 1.5, ...
        'DisplayName', sprintf('mm=%.2f', curr_mm));

    % Plot Poles
    figure(fig_poles);
    p = roots(curr_den);
    plot(real(p), imag(p), 'x', 'Color', colors(i,:), 'LineWidth', 2,
'MarkerSize', 10, ...
        'DisplayName', sprintf('mm=%.2f', curr_mm));
end

figure(fig_resp); legend show; grid on;
```




```
figure(fig_poles); legend show;
```



Q2c: Explanation of Result for mm = 0

Observation:

As mm decreases, the damping ratio ζ of the system decreases. The system becomes more oscillatory (higher overshoot).

At mm = 0: The denominator becomes $yy \cdot s^2 + dd$. The roots are at $s = \pm j\sqrt{dd/yy}$. Since the real part of the poles is zero, the system is undamped and marginally stable. The step response will exhibit sustained oscillations.