ES155 Problem Set 4

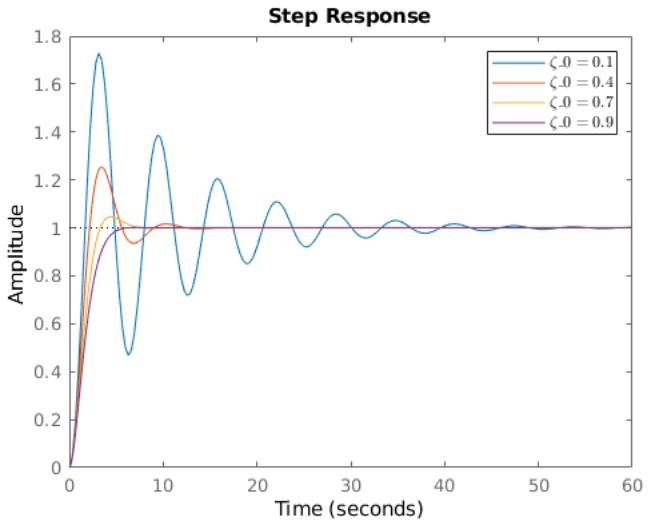
Contents

1.c

```
% define constants/parameters
w0 = 1;
z_0 = [0.1 0.4 0.7 0.9];
a0 = 1;
a1 = 2;
a2 = 1;
b0 = 0.5;

C = [0 1]
D = 0

eigs = zeros(2,length(z_0));

figure(1); clf;
hold on;

% try for each z0
for i = 1:length(z_0)
    z0 = z_0(i)

    % calculate control values
    k1 = 4*z0*w0 - 8;
    k2 = 2*w0^2 - 4*z0*w0 + 6;
    kr = 2*w0^2;

    % compute matrices
    A = [-a0 - a1, a1; a2, -a2];
    B = [b0; 0];
    K = [k1 k2];

    % compute the eigenvalues of (A - BK)
    eigs(:,i) = eig(A - B*K);

    % make state space model and plot step response
    sys = ss(A-B*K, kr*B, C, D);
    step(sys)
end
hold off;

z0_legend = strcat("${\zeta}_{0} = ", strtrim(cellstr(num2str(z_0'))'), "$")
legend(z0_legend, 'Interpreter', 'latex')

w = warning ('off','all');

fprintf(['The eigenvalues of the closed loop system response $(A - B*K)$ are '])
for i = 1:length(z_0)
    fprintf(['$%1.4f$ and $%1.4f$ for $\zeta_0 = %1.1f$'], eigs(1,i), eigs(2,i), z_0(i))
end
w = warning ('on','all');
```

```
C =

     0     1


D =

     0


z0 =

    0.1000


z0 =

    0.4000


z0 =

    0.7000


z0 =

    0.9000
```

```
z0_legend =

  1×4 string array

  Columns 1 through 3

    "${\zeta}_{0} = 0.1$"    "${\zeta}_{0} = 0.4$"    "${\zeta}_{0} = 0.7$"

  Column 4

    "${\zeta}_{0} = 0.9$"

The eigenvalues of the closed loop system response $(A - B*K)$ are $-0.1000$ and $-0.1000$ for $$0.1000$ and $$-0.4000$ and $-0.4000$ for $$0.4000$ ar
```



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