Table of Contents

Q1

```
N = 10000;
G0=tf([1 -.1 -.9],[1 -1.4 0.5],1); H0=tf([1 -.1],[1 -.9],1); F0 =
 tf([.72],[1 -.1 0],1);
u = randn(N,1); e = randn(N,1)*sqrt(.1);
y = lsim(G0,u) + lsim(H0,e);
yP = lsim((1-F0)*G0,u) + lsim(F0,y);

E = y-yP;
% tn = 10;
% RE = xcorr(E,E,tn,'biased');
% plot(-tn:tn,RE);
disp('Question 1: Variance of \eta: ');
var(E)
```

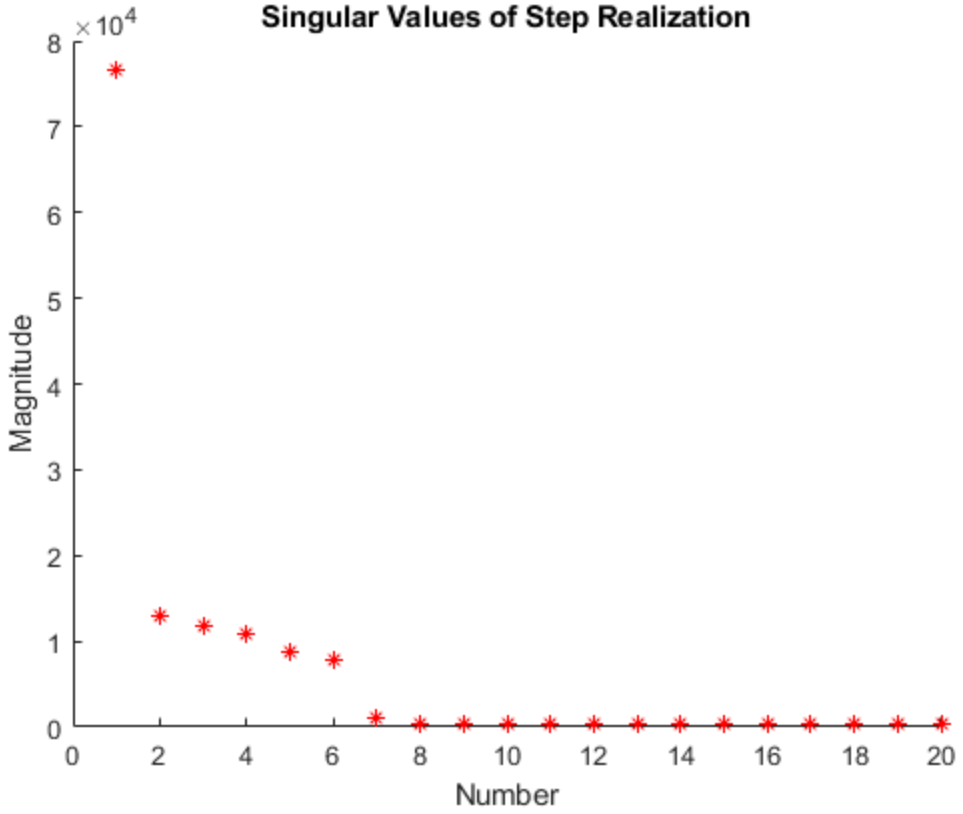
```
Question 1: Variance of \eta:

ans =

    0.1655
```

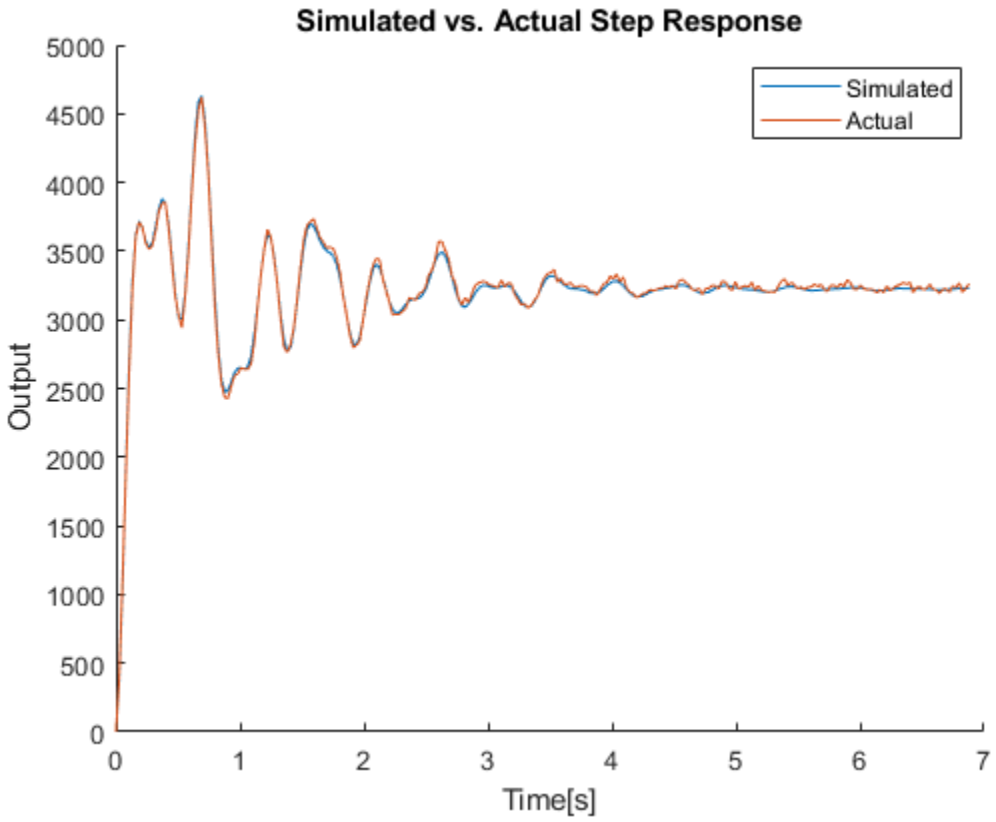
Q2

```
load('R333_STEP_data.mat');
load('R333_FRF_data.mat');

N1 = 129; N2 = 129;
u = ones(length(y),1);
t = 0:Ts:(length(y)-1)*Ts;


for i = 2:N2+1
    R(:,i-1) = y(i:N1+i-1) - y(1:N1);
end

for i = 3:N2+2
    Rb(:,i-2) = y(i:N1+i-1) - y(2:N1+1);
end
```

```
[U,S,V] = svd(R);

s = diag(S);
figure(1); hold on; title('Singular Values of Step Realization');
 ylabel('Magnitude'); xlabel('Number');
plot(1:20,s(1:20),'r*');

%n = input('What Rank?(Recomended 6): ');
n = 6;

R1 = U(:,1:n)*S(1:n,1:n)^.5;
R2 = S(1:n,1:n)^.5*V(:,1:n)';

R1L = S(1:n,1:n)^-.5*U(:,1:n)';
R2R = V(:,1:n)*S(1:n,1:n)^-.5;

D = y(1);
C = R1(1,:);
B = R2(:,1);
A = R1L*Rb*R2R;

ysim = lsim(ss(A,B,C,D,Ts),u,t);
figure(2); hold on; title('Simulated vs. Actual Step Response');
 xlabel('Time[s]'); ylabel('Output');
plot(t,ysim);
plot(t,y); legend('Simulated','Actual');

[num den] = ss2tf(A,B,C,D,1);
num = num(num~=0);
theta0 = [num den(2:end)];
disp('theta0 from Step Respone Realization: ');
theta0

Ghat1 = tf(num,den,Ts);
```

```
theta0 from Step Respone Realization:

theta0 =

   1.0e+03 *

  Columns 1 through 7

    0.3855   -1.3785    1.9088   -1.1858    0.2476    0.0257   -0.0054

  Columns 8 through 12

    0.0124   -0.0159    0.0118   -0.0049    0.0009
```


Singular Values of Step Realization
×10^4
8
7
6
5
4
3
2
1
0
Magnitude
0
2
4
6
8
10
12
14
16
18
20
Number

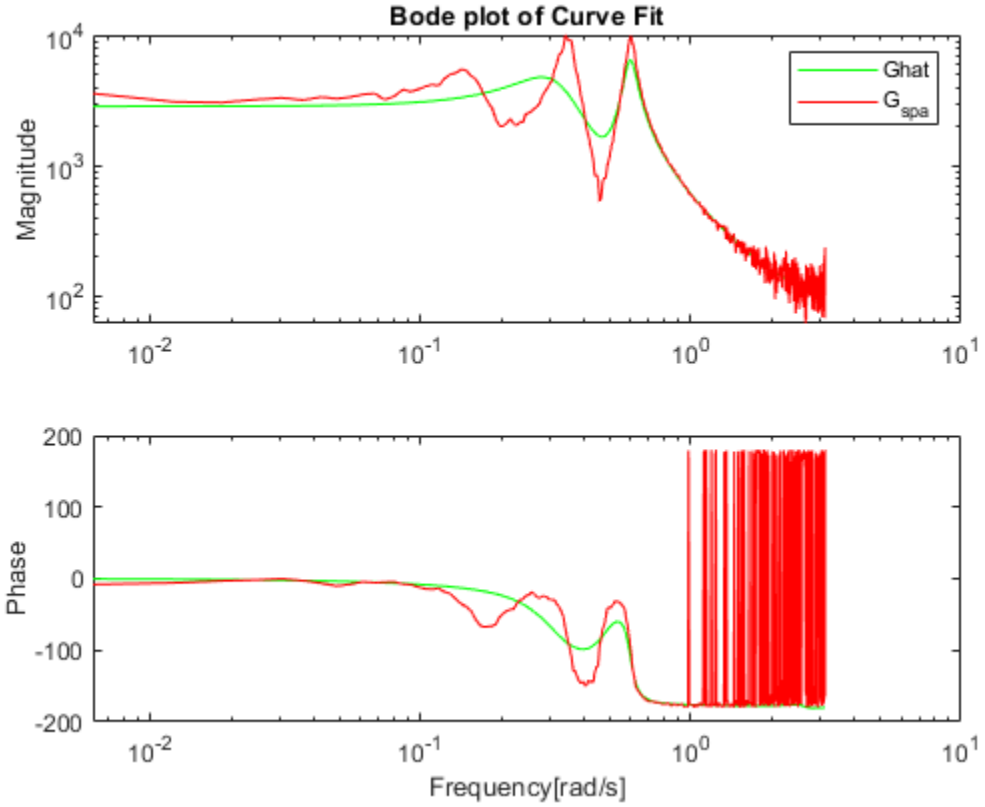

Simulated vs. Actual Step Response
Simulated
Actual
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Output
0
1
2
3
4
5
6
7
Time[s]

Q2 Part 2

```
N = 513;
w=linspace(0,pi/1,N)';
X=[exp(-[length(den)-length(num):length(den)-1]*1j.*w) -exp(-
[1:length(den)-1]*1j.*w).*Gspa];
theta=[real(X);imag(X)]\[real(Gspa);imag(Gspa)];

% max_par_diff = 10;
% counter = 0;
% while max_par_diff>1e-8 && counter < 100
%     Weight=[ones(N,1) exp(-1j*w) exp(-2j*w) exp(-3j*w) exp(-4j*w)
 exp(-5j*w) exp(-6j*w)]*[1;theta(8:13)];
%     %Weight=abs(Weight).^4;
%     X=[Weight./ones(N,1) Weight./exp(-1j*w) Weight./exp(-2j*w)
 Weight./exp(-3j*w) Weight./exp(-4j*w) Weight./exp(-5j*w) Weight./
exp(-6j*w) Weight./-Gspa.*exp(-1j*w) Weight./-Gspa.*exp(-2j*w)
 Weight./-Gspa.*exp(-3j*w) Weight./-Gspa.*exp(-4j*w) Weight./-
Gspa.*exp(-5j*w) Weight./-Gspa.*exp(-6j*w)];
%     theta_new=[real(X);imag(X)]\[real(Weight.\Gspa);imag(Weight.
\Gspa)];
%     counter=counter+1
%     max_par_diff=max(abs(theta-theta_new));
%     theta=theta_new;
% end

Ghat=tf(theta(1:length(num))',[1 theta(length(num)+1:end)'],1);
[mghat,pghat]=bode(Ghat,w);



figure(3);
subplot(2,1,1);
loglog(w,squeeze(mghat),'g',w,abs(Gspa),'r'); title('Bode plot of
 Curve Fit'); legend('Ghat','G_{spa}');
ylabel('Magnitude');
subplot(2,1,2);
semilogx(w,squeeze(pghat),'g',w,angle(Gspa)*180/pi,'r');
xlabel('Frequency[rad/s]'); ylabel('Phase');

disp('theta0 from Frequency Domain Curve Fit: ');
theta
```

```
theta0 from Frequency Domain Curve Fit:

theta =

  405.1008
 -101.2407
 -301.3621
   36.9077
  224.1914
    3.3153
```

```
-1.9563
 0.5710
 1.1654
-0.3115
-0.9054
 0.5297
```



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