Table of Contents

```
clc
clear
run ("Basics.m");
```

```
A = 4×4
         0    1.0000         0         0
   -4.0000   -1.3000    1.3333    0.1300
         0         0         0    1.0000
    1.3333    1.3000   -2.6333   -2.6667
sys =

                  1.3 s + 1.333
  ---------------------------------------------
  s^4 + 3.967 s^3 + 9.931 s^2 + 12.18 s + 8.756

Continuous-time transfer function.


sysd =

  0.0004156 z^3 + 0.001144 z^2 - 0.000978 z - 0.0003017
  -----------------------------------------------------
      z^4 - 3.463 z^3 + 4.55 z^2 - 2.685 z + 0.601

Sample time: 0.12835 seconds
Discrete-time transfer function.
c = 1×5
         0    0.0004    0.0011   -0.0010   -0.0003
d = 1×5
    1.0000   -3.4634    4.5497   -2.6854    0.6010
```

System identification

```
tic
tfinal=200;
t = 0:T_s:tfinal;
u = zeros(numel(t),1);
```

General Input+white Noise

```
% u = gensig('sine' , tfinal , tfinal ,T_s);
% Noise=-0.2+(0.2+0.2)*rand(numel(t),1);
% u=u+Noise;
```

1.Pulse Input

```
% u(1:50,1)=ones(50,1) ;
```

2.Step Input

```
% u=ones(numel(t),1);
% % u(round(numel(t)/10,0):end,1)=1;
```

3.Sine Input

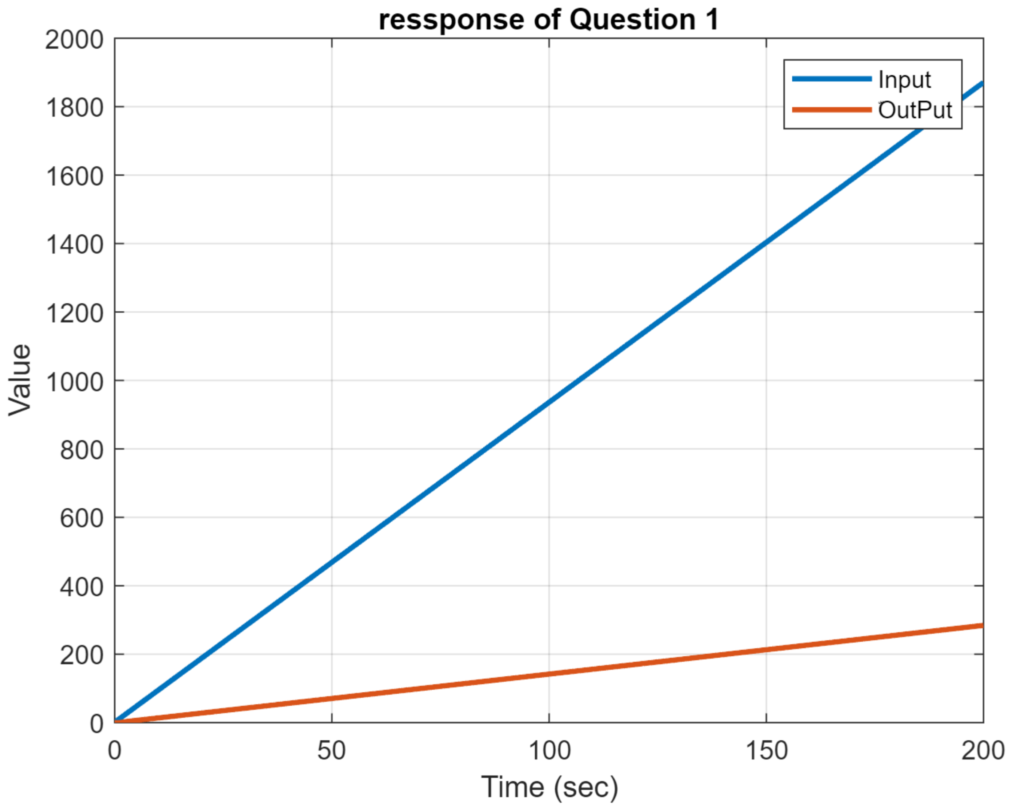
```
% u = gensig('sine' , tfinal/15 , tfinal ,T_s);
```

4.Ramp Input

```
for i=1:numel(t)
    u(i)= 1.2*i;%randi(1);
end
```

Out Put Generating

```
y = lsim(sysd  ,u ,t);
plot(t,u ,t , y ,'LineWidth',2) ;
xlabel('Time (sec)') ;
ylabel('Value') ;
title('ressponse of Question 1') ;
grid on
legend('Input' , 'OutPut') ;
xlim([0 200])
```



```
% ylim([-1.2 1.2])
```

LS Identification

```
N = numel(y) ;
Parameters_in_den=4
```

```
Parameters_in_den = 4
```

```
Parameters_in_num=4
```

```
Parameters_in_num = 4
```

```
Nv=Parameters_in_num+Parameters_in_den
```

```
Nv = 8
```

```
phi=[];
for i=(max(Parameters_in_num,Parameters_in_den)+1):N
    phi(i,:) = [(y(i-1:-1:i-Parameters_in_den))' , (u(i-1:-1:i-Parameters_in_num))'];
end
theta_hat=((phi'*phi)^(-1))*(phi'*y)
```

```
theta_hat = 8×1
    3.4230
   -4.4370
    2.5686
   -0.5637
    0.2500
   -0.3125
   -0.3750
    0.1875
```

```
% norm([theta_hat]-[d,c(2:end)]')
% norm(Y-phi*theta_hat)
sysdd=tf(theta_hat((Parameters_in_num+1):end,end)' ,[1 -theta_hat(1:Parameters_in_num ,end)'],
```

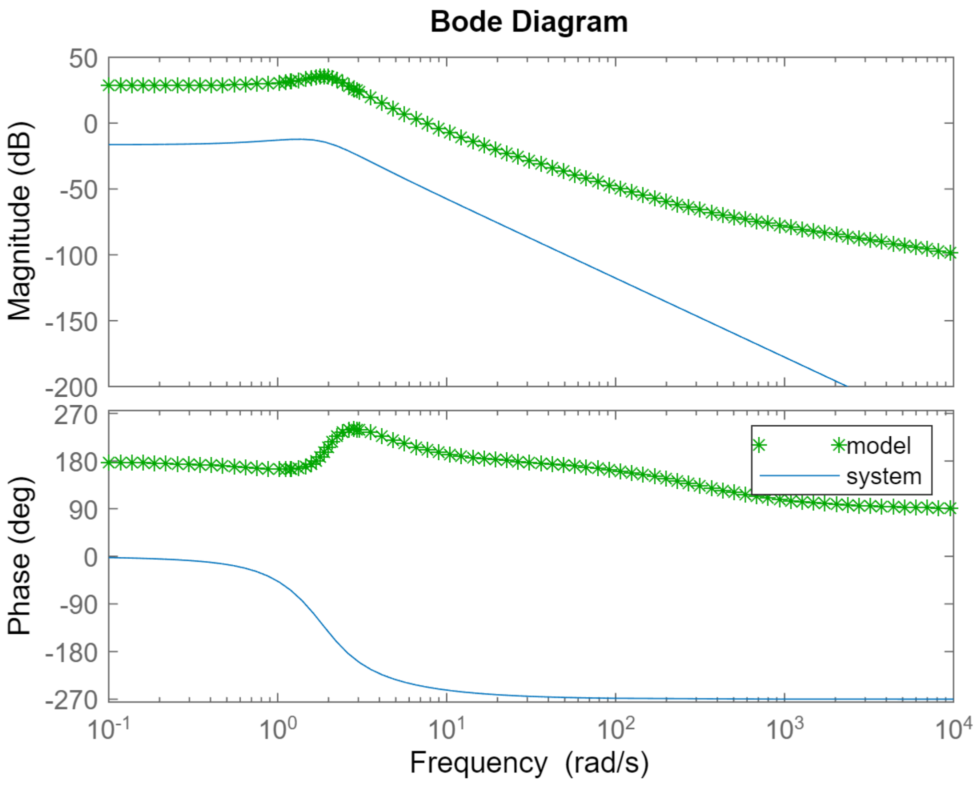
```
sysdd =
 
     0.25 z^3 - 0.3125 z^2 - 0.375 z + 0.1875
  ----------------------------------------------
  z^4 - 3.423 z^3 + 4.437 z^2 - 2.569 z + 0.5637
 
Sample time: 0.12835 seconds
Discrete-time transfer function.
```

BODE

```
ident_analog = d2c(sysdd)
```

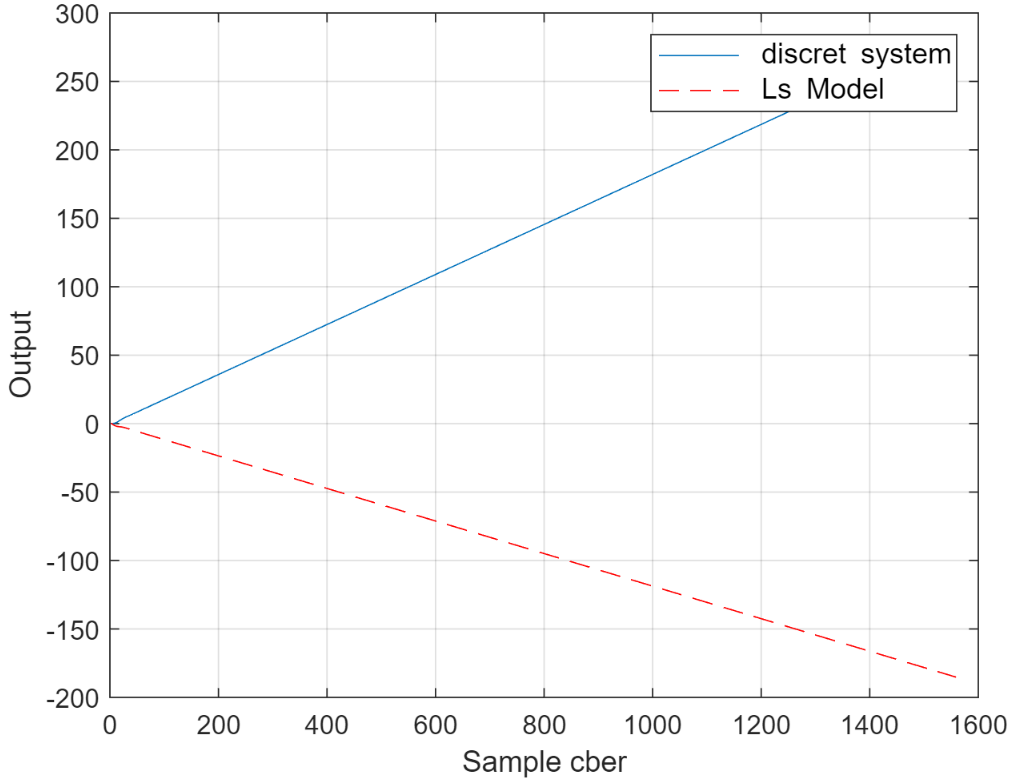
```
ident_analog =
 
    -0.1209 s^3 + 36.57 s^2 + 86.32 s - 1228
  ---------------------------------------------
  s^4 + 4.466 s^3 + 10.46 s^2 + 11.19 s + 44.96
 
Continuous-time transfer function.
```

```
figure
bode(ident_analog ,'g*',sys )
legend('model','system')
```



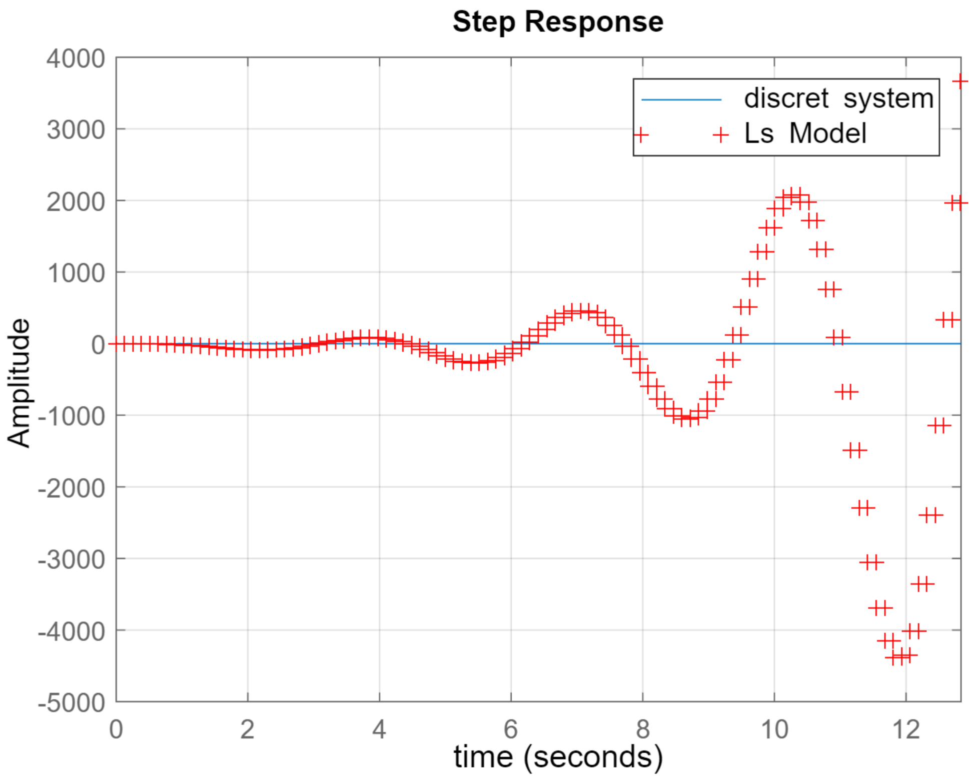
Ploting discret system and Least square Model

```
figure
plot(y)
hold on
plot(phi*theta_hat,'r--')
xlabel('Sample cber')
ylabel('Output')
legend('\fontsize{12} discret system','\fontsize{12} Ls Model');
grid on;
```



Ploting discret system and Least square Model via step input

```
figure
step(sysd,0:T_s:100*T_s)
hold on
step(sysdd,0:T_s:100*T_s,'r+')
legend('\fontsize{12} discret system','\fontsize{12} Ls Model');
grid on;
xlabel('time','fontsize',12);
```



```
% ylabel('x2','fontsize',16);
toc
```

```
Elapsed time is 2.961130 seconds.
```