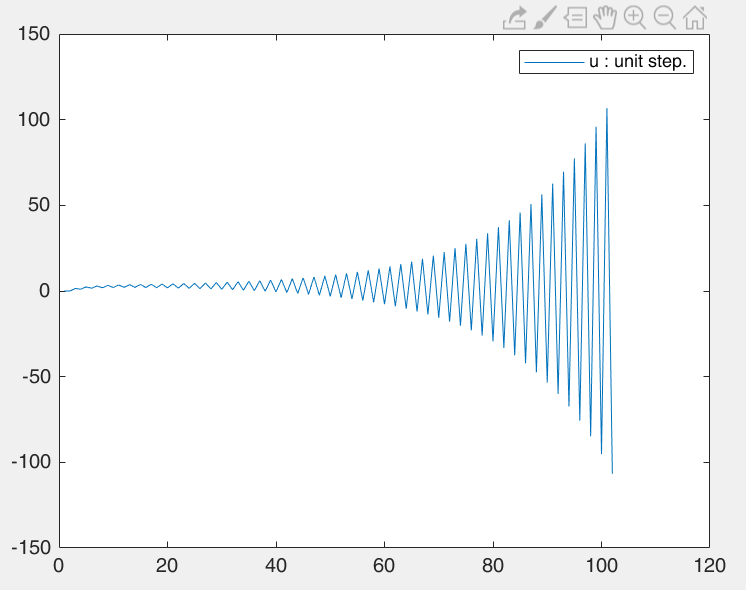
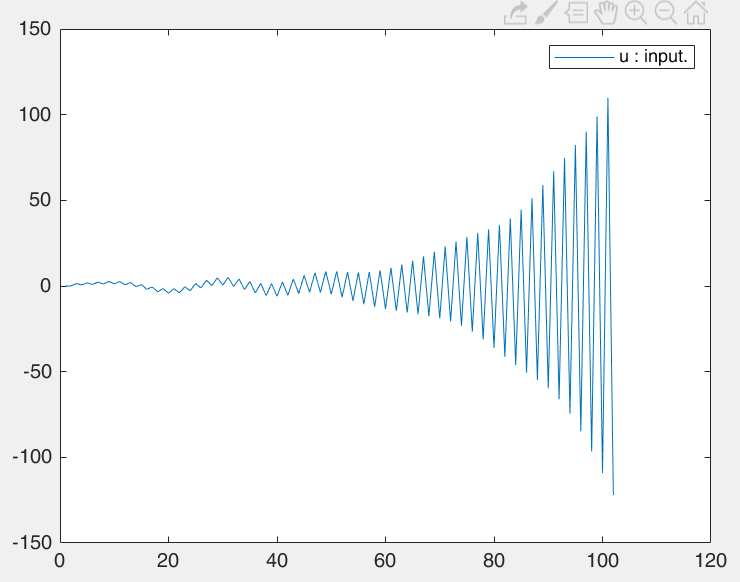
**1-a**

a-A a-B

使用G = =

可得y(k+1) = -0.3y(k) + 0.8y(k-1) + 0.9u(k) + 0.6u(k-1)

加入輸出前的誤差向d = 0.01 ~ - 0.01

Code:

%% 1-a

y(1) = 0;y(2) = 0;

u(1) = 0;u(2) = 0;

delt = 0.1;

totTime = 10;

totalStep = totTime/delt ;

tarr= [0 : 1 : totalStep]\*delt;

for i=1:totalStep

k = i+2;

u(k) = 100;

%u(k) = sin(6\*k/20) + 0.5\*sin(6\*k/15+3.2) + 0.2\*sin(2.57\*k/15+1.63);

d = 0.02\*(rand-0.5);

y(k) = -0.3\*y(k-1) + 0.8\*y(k-2) + 0.9\*u(k-1) + 0.6\*u(k-2) + d;

end

plot(y)

legend('u : input.')

**1-b**

b-A

設定:

由於

所以

在原先假設中u(0)=u(1)=1且y(0)=y(1)=0

如果u(k)設為unit step input則u(k)=1

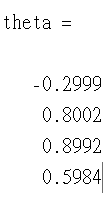
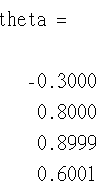
在inverse inf 造成theta的預測回歸線無法正確得到

所以在初始假設中我將u(0)=u(1)=0且y(0)=y(1)=0

如果u(k)設為unit step input則u(k)=1

在後，會造成後2行的數值些許差異

所以進行inverse不會為inf

得到結果:

(u=1) (u=100)

此外設定100步是因為此系統為發散系統，所以跑太多部會發散，所以也不能取得正確數值；但在有限步數，如果可以使後2行的數值差異變大則理論上可以得到比較準確結果，其中一種方法就是將u>>u(0)=0。

b-B

所以不會造成b-A的後2行的數值相同，進而產生

inverse inf 的問題，可以直接得到正確的theta

Code:

%% 1-b

len = length(u);

tmp = 0;

tmp2 = 0;

for i=4:len

phi = zeros(4,1);

phi(1) = y(i-1);

phi(2) = y(i-2);

phi(3) = u(i-1);

phi(4) = u(i-2);

tmp = tmp + phi\*phi';

tmp4(:,:,i) = tmp;

tmp2 = tmp2 + y(i)\*phi;

end

tmp3 = inv(tmp);

%[-a1 -a2 b1 b2]

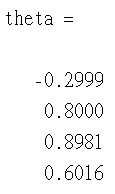
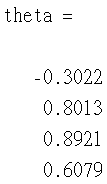
theta = tmp3\*tmp2

a1 = -theta(1);

a2 = -theta(2);

b1 = theta(3);

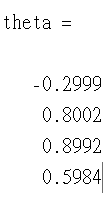
b2 = theta(4);

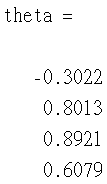
得到結果:

(原本) (震幅為1)

震幅為1改為:

u(k) = 0.3\*sin(6\*k/20) + 0.5\*sin(6\*k/15+3.2) + 0.2\*sin(2.57\*k/15+1.63);

b-C



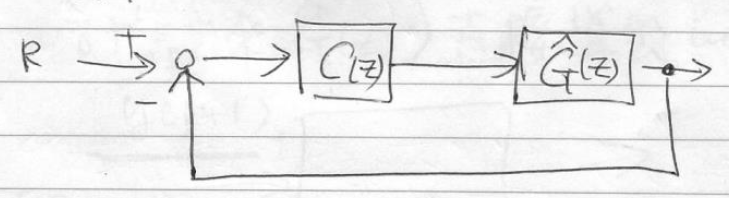
(b-B) (b-A)

皆取兩者震幅為1的結果

觀測結果大致可以發現b-A結果比較準確

**1-c**

使用pole asignment方式設計閉迴路



設定 ，

G帶入b題結果:

進行pole assignment，取分母部分:

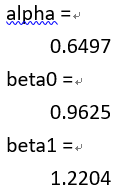
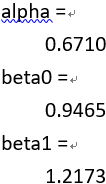
= 0

放入z = :

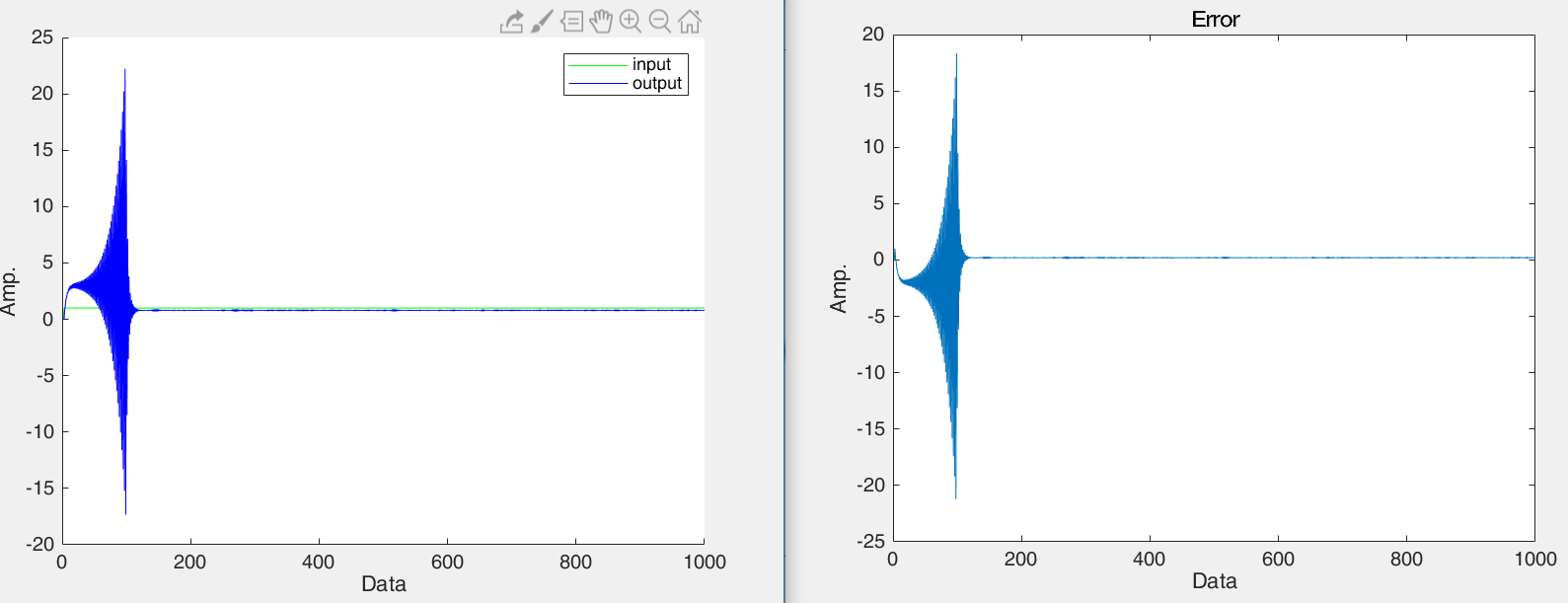
= 0

計算三元一次方程式取得

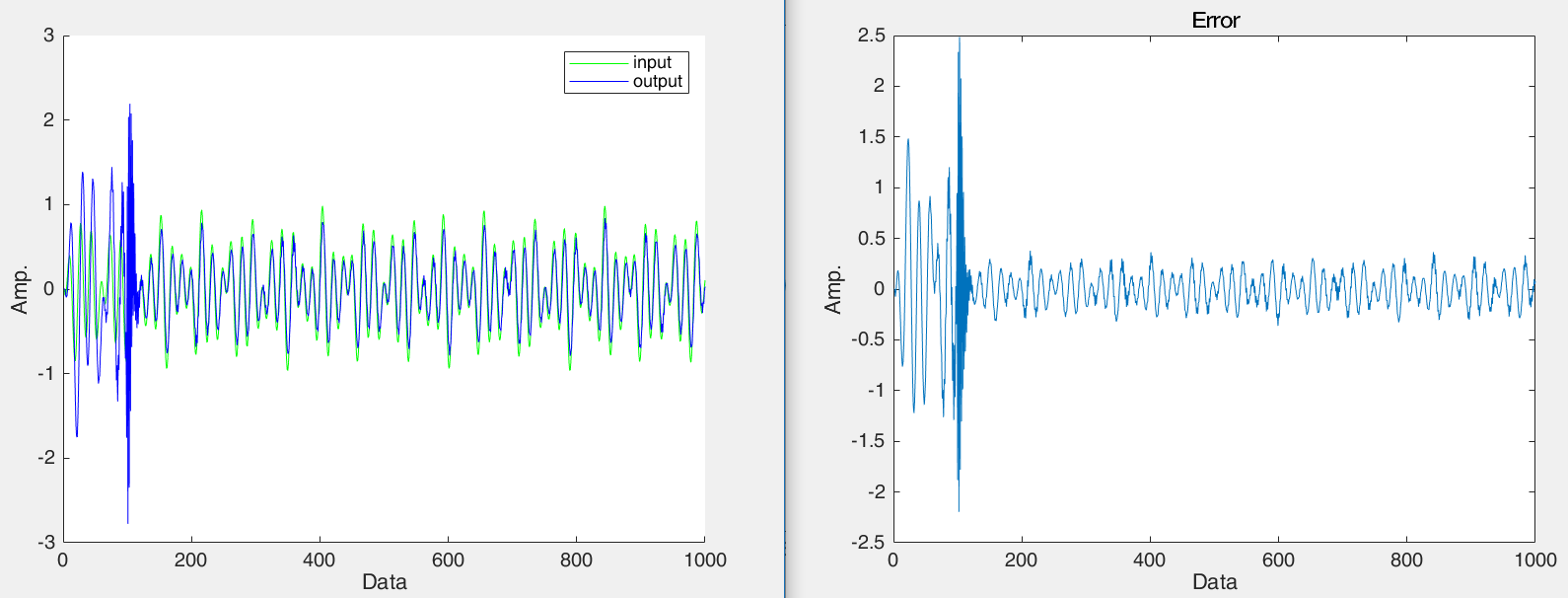
結果:

(c-A) (c-B)

(c-A) 200到1000後誤差最大為0.3126

(c-B) 200到1000後誤差最大為0.3424



Code:

%% 1-c

syms alpha beta0 beta1

sol1 = alpha + a1 + beta0\*b1 - 1.82;

sol2 = alpha\*a1 + a2 + beta1\*b1 + beta0\*b2 - 1.07;

sol3 = alpha\*a2 + beta1\*b2 - 0.205;

[alpha beta0 beta1] = solve(sol1,sol2,sol3);

Alpha = double(alpha)

Beta0 = double(beta0)

Beta1 = double(beta1)

r=u;

%開路等校

for k=totalStep:1000

%r(k) = 1;

r(k) = (0.3\*sin(6\*k/20) + 0.5\*sin(6\*k/15+3.2) + 0.2\*sin(2.57\*k/15+1.63))\*1;

d = 0.02\*(rand-0.5);

y(k) = -(Alpha+a1+Beta0\*b1)\*y(k-1) - (Alpha\*a1+a2+Beta1\*b1+Beta0\*b2)\*y(k-2) - (Alpha\*a2+Beta1\*b2)\*y(k-3) + (Beta0\*b1)\*r(k-1) + (Beta1\*b1+Beta0\*b2)\*r(k-2) + (Beta1\*b2)\*r(k-3) + d;

end

%閉路等校

% for k=totalStep:1000

% %r(k+1) = 1;

% r(k+1)=(0.3\*sin(6\*k/20) + 0.5\*sin(6\*k/15+3.2) + 0.2\*sin(2.57\*k/15+1.63))\*1;

% e(k)=r(k)-y(k);

% u(k)=(-Alpha\*u(k-1)+Beta0\*e(k)+Beta1\*e(k-1));

% d = 0.02\*(rand-0.5);

% y(k+1)=-a1\*y(k)-a2\*y(k-1)+b1\*u(k)+b2\*u(k-1)+d;

% end

figure()

%plot(y,'r')

hold on;

plot(r,'g')

plot(y,'b')

figure()

plot(r-y)

**1-d**

前900步持續改變G,C的值，進行On Line控制

後600步固定G,C的值，不隨時間改變

明顯可以看出A的震幅比B的震幅小很多

|  |  |  |
| --- | --- | --- |
|  | A | B |
| 數據 |  |  |
| 誤差 |  |  |

Code:

%% 1-d: STC on line

y(1) = 0;y(2) = 0;

u(1) = 0;u(2) = 0;

delt = 0.1;

totTime = 150;

totalStep = totTime/delt ;

tarr= [0 : 1 : totalStep]\*delt;

for i=1:totalStep

k = i+2;

r(k) = 1;

%r(k) = 0.3\*sin(6\*k/20) + 0.5\*sin(6\*k/15+3.2) + 0.2\*sin(2.57\*k/15+1.63);

d = 0.01\*(rand-0.5);

if i<6

y(k) = -0.3\*y(k-1) + 0.8\*y(k-2) + 0.9\*r(k-1) + 0.6\*r(k-2) + d;

u(k) = r(k);

else

r(k+1) = 1;

%r(k+1)=(0.3\*sin(6\*k/20) + 0.5\*sin(6\*k/15+3.2) + 0.2\*sin(2.57\*k/15+1.63))\*1;

e(k-1)=r(k-1)-y(k-1);

u(k-1)=(-Alpha\*u(k-2)+Beta0\*e(k-1)+Beta1\*e(k-2));

d = 0.02\*(rand-0.5);

y(k)=-a1\*y(k-1)-a2\*y(k-2)+b1\*u(k-1)+b2\*u(k-2)+d;

end

if i>4 && i<900

theta = findtheta(u,y);

a1 = -theta(1);

a2 = -theta(2);

b1 = theta(3);

b2 = theta(4);

syms alpha beta0 beta1;

sol1 = alpha + a1 + beta0\*b1 - 1.82;

sol2 = alpha\*a1 + a2 + beta1\*b1 + beta0\*b2 - 1.07;

sol3 = alpha\*a2 + beta1\*b2 - 0.205;

[alpha beta0 beta1] = solve(sol1,sol2,sol3);

Alpha = double(alpha);

Beta0 = double(beta0);

Beta1 = double(beta1);

end

end

plot(y)

legend('u : input.')

function [theta]=findtheta(u,y)

len = length(u);

tmp = 0;

tmp2 = 0;

for i=4:len

phi = zeros(4,1);

phi(1) = y(i-1);

phi(2) = y(i-2);

phi(3) = u(i-1);

phi(4) = u(i-2);

tmp = tmp + phi\*phi';

tmp2 = tmp2 + y(i)\*phi;

end

tmp3 = inv(tmp);

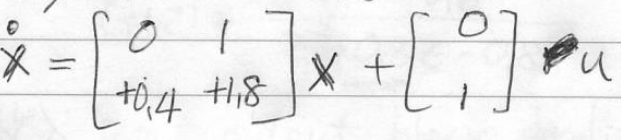
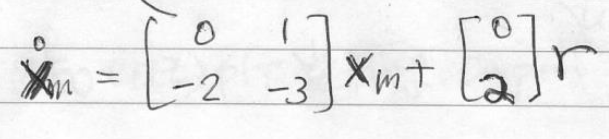
%[-a1 -a2 b1 b2]

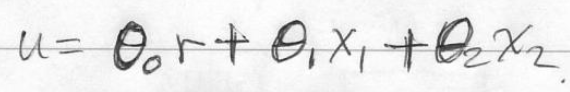
theta = tmp3\*tmp2;

end

**2**

基本設定:





設定:

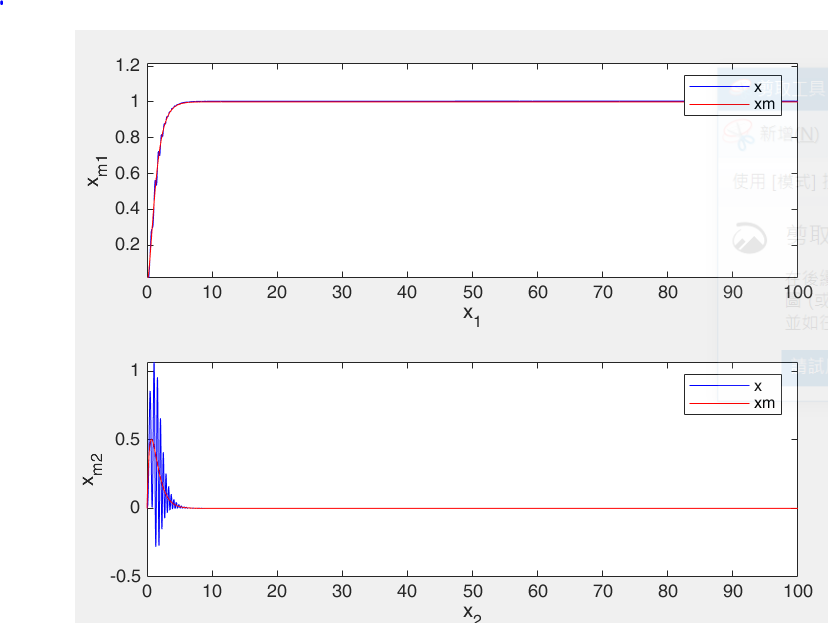
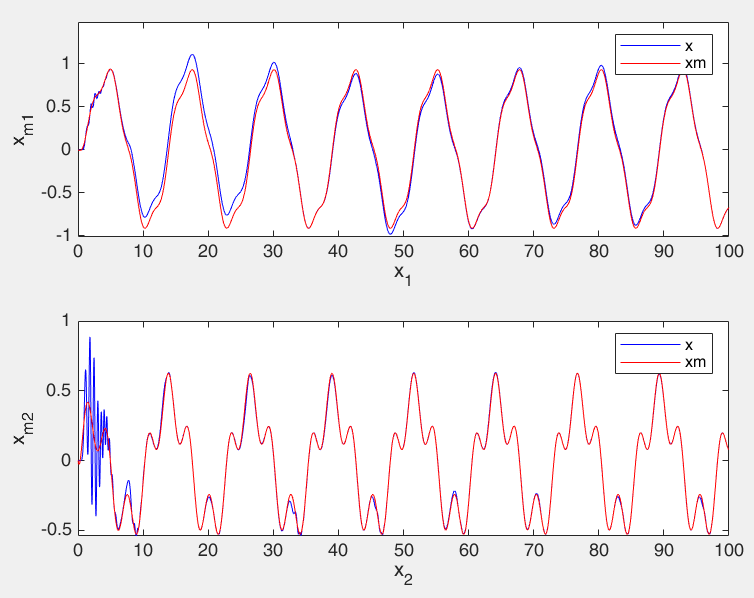
gama1 = 1;

gama2 = 1;

gama3 = 5;

Q = [1 0;0 40];

結果(檢查收斂情況):

clc;clear;

%% main code.

%MRAC

delt = 0.01;

totTime = 100;

totalStep = totTime/delt ;

tarr= [0 : 1 : totalStep]\*delt;

x = [0;0];

xm = [0;0];

%

am1=-2; am2=-3; a1=0.4; a2=1.8;

bm = 2;b = 1;

Am = [ 0 1;

am1 am2];

A = [ 0 1;

a1 a2];

Bm = [0;bm];

B = [0;b];

gama1 = 1;

gama2 = 0.5;

gama3 = 4;

Q=[1 0;0 1000];

P = lyap(Am,Q)

theta(:,1)=[0;0;0];

xarr1 = zeros(totalStep+1,1);xarr2 = xarr1;

xmarr1 = xarr1;xmarr2 = xmarr1;

earr1 = xarr1;earr2 = earr1;

xarr1(1) = x(1);xarr2(1) = x(2);

x\_1 = xarr1(1);x\_2 = xarr2(1);

xmarr1(1) = xm(1);xmarr2(1) = xm(2);

xm\_1 = xmarr1(1);xm\_2 = xmarr2(1);

for i=1:totalStep

k = i;

%r(k+1) = 1;

r(k+1)=sin(0.5\*k\*delt)+0.3\*cos(2\*k\*delt+4);

u(k+1) = theta(1,k)\*r(k) + theta(2,k)\*x\_1 + theta(3,k)\*x\_2;

%Xm (Mode)

xm\_dot = Am\*xm + Bm\*r(k);

xmN = xm + xm\_dot\*delt;

xmarr1(i+1) = xmN(1);xmarr2(i+1) = xmN(2);

xm = xmN;

xm\_1 = xmN(1);xm\_2 = xmN(2);

%X

x\_dot = A\*x + B\*u(k);

xN = x + x\_dot\*delt;

xarr1(i+1) = xN(1);xarr2(i+1) = xN(2);

x = xN;

x\_1 = xN(1);x\_2 = xN(2);

%E

e\_1 = xm\_1-x\_1;

e\_2 = xm\_2-x\_2;

%cal

zeta = 0.5\*(P(1,2)\*e\_1+P(2,2)\*e\_2);

theta(1,k+1) = theta(1,k) + delt\*(zeta\*r(k))/(b\*gama1);

theta(2,k+1) = theta(2,k) + delt\*(zeta\*x\_1)/(b\*gama2);

theta(3,k+1) = theta(3,k) + delt\*(zeta\*x\_2)/(b\*gama3);

end

figure(1)

subplot(2,1,1)

plot(tarr,xarr1,'b',tarr,xmarr1,'r')

xlabel('x\_1');ylabel('x\_m\_1');

legend('x','xm')

subplot(2,1,2)

plot(tarr,xarr2,'b',tarr,xmarr2,'r')

xlabel('x\_2');ylabel('x\_m\_2');

legend('x','xm')

figure(2)

plot(tarr,xmarr1-xarr1,'b',tarr,xmarr2-xarr2,'r')

xlabel('Time');ylabel('Error');

legend('e1','e2')

figure(3)

plot(tarr,u,'b',tarr,r,'r')

xlabel('Time');ylabel('Input');

legend('u','r')

figure(4)

plot(tarr,theta(1,:),'b',tarr,theta(2,:),'r',tarr,theta(3,:),'g')

xlabel('Time');ylabel('Theta');

legend('theta0','theta1','theta2')