現代控制理論HW6

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1.

x1\_dot=x2

x2\_dot=x3

x3\_dot=α(x12sin(x2)+x22sin(x3))+(x1+x32)cos(x3)+u+d(t)

令f=x3+2λx2+λ2 x1

則f\_dot

= x3\_dot +2λx2\_dot+λ2x1\_dot

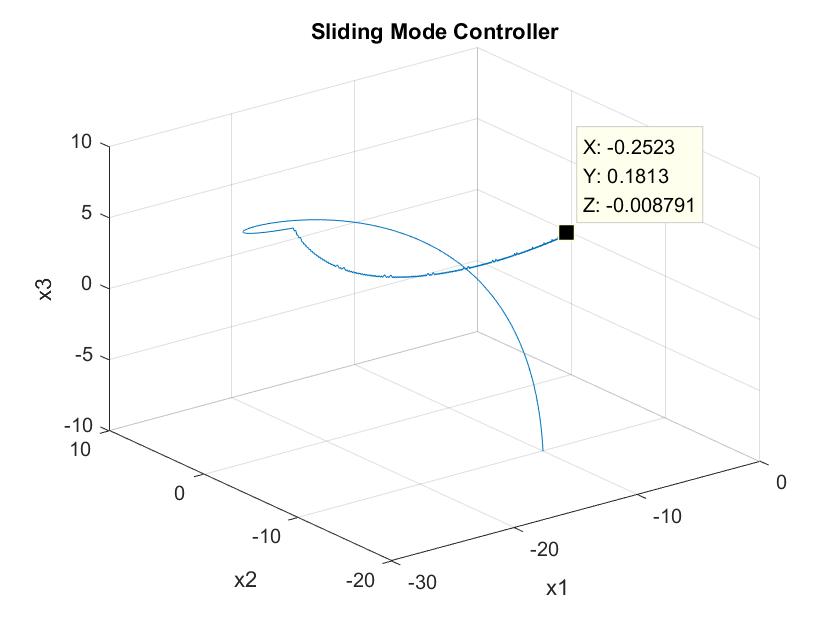
= x3\_dot +2λx3+λ2 x2

=α(x12sin(x2)+x22sin(x3))+(x1+x32)cos(x3)+u+d(t)+ 2λx3+λ2 x2

=-sign(f)\*K

設計u=-sign(f)\*K-(α(x12sin(x2)+x22sin(x3))+(x1+x32)cos(x3) + 2λx3+λ2 x2)

模擬結果(初值(-10,-10,-10),K=10,λ=1)：



程式碼：

clc;clear;

delta=0.01;

totalTime=10;

totalStep=totalTime/delta;

x1array=[1:totalStep]\*0;x2array=x1array;x3array=x1array;

x1array(1)=-10;x2array(1)=-10;x3array(1)=-10;%init condition

alpha=0.9;

K=10;lambda=1;

for i=1:totalStep

x1=x1array(i);x2=x2array(i);x3=x3array(i);

f=x3+2\*lambda\*x2+lambda^2\*x1;

u=-sign(f)\*K-(alpha\*(x1^2\*sin(x2)+x2^2\*sin(x3))+(x1+x3^2)\*cos(x3)+2\*lambda\*x3+lambda^2\*x2);

d(i)=0.2\*sin(i)+0.1\*cos(5\*i+pi);

x1\_dot=x2;

x2\_dot=x3;

x3\_dot=alpha\*(x1^2\*sin(x2)+x2^2\*sin(x3))+(x1+x3^2)\*cos(x3)+u+d(i);

x1array(i+1)=x1+x1\_dot\*delta;

x2array(i+1)=x2+x2\_dot\*delta;

x3array(i+1)=x3+x3\_dot\*delta;

end

plot3(x1array,x2array,x3array);

grid on;

xlabel('x1');

ylabel('x2');

zlabel('x3');

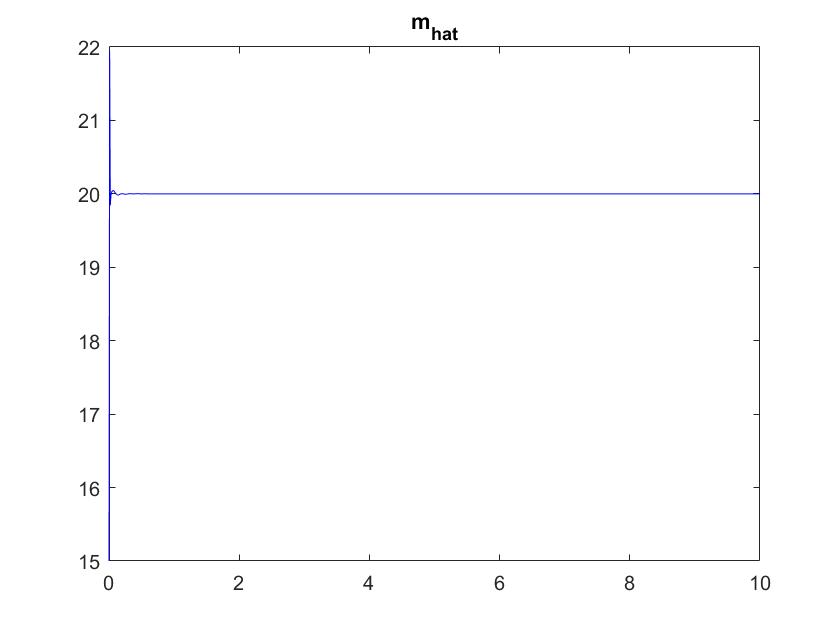
title('Sliding Mode Controller');

2.

測試1：

disturbance(i)=10\*(-1+rand);

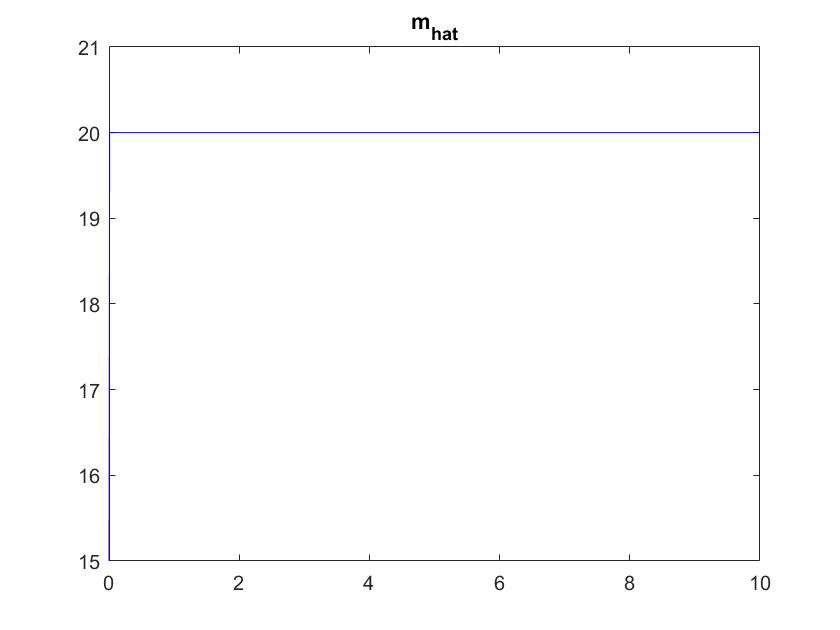
noise(i)=0.001\*sin(25\*i)+0.005\*cos(100\*i+pi);



測試2：

disturbance(i)=10\*(-1+rand);

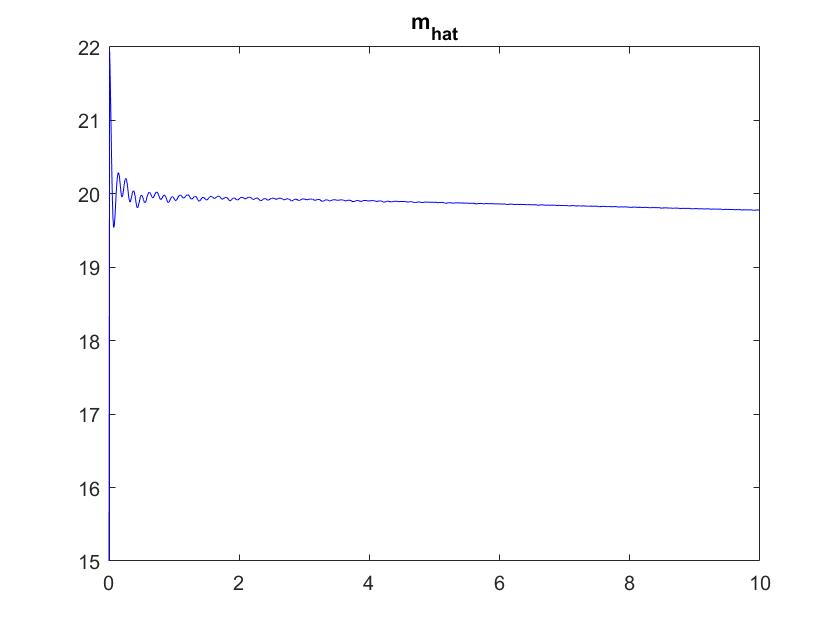
noise(i)=0



測試3：

disturbance(i)=0

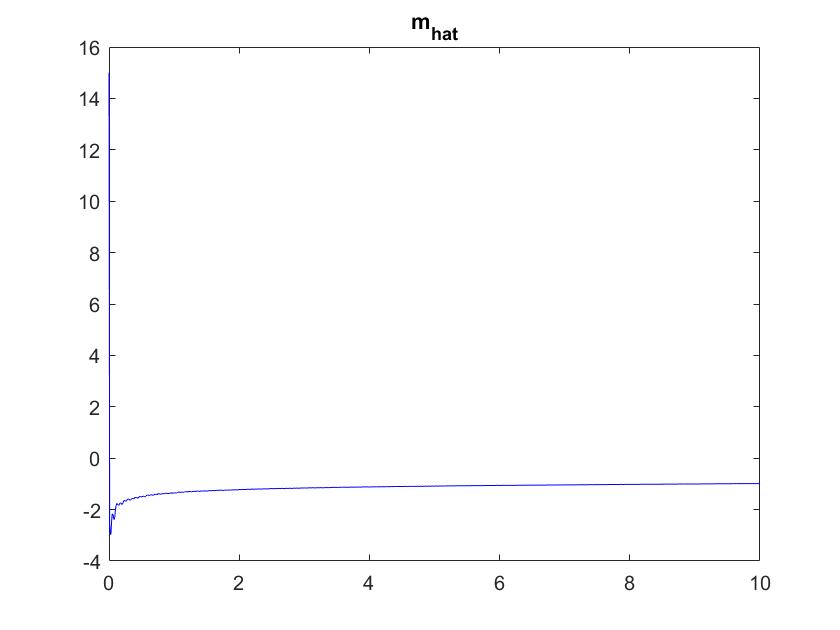
noise(i)=0.001\*sin(25\*i)+0.005\*cos(100\*i+pi);



測試4(noise很大則mhat無法收斂到m=20)：

disturbance(i)=10\*(-1+rand);

noise(i)=0.001\*sin(25\*i)+0.005\*cos(100\*i+pi);



經多次測試結論：

1.mhat收斂情形受到disturbanse影響很小，但是對noise非常敏感。

2.兩條線重疊，用m和m\_dot做出來的結果一模一樣@@????????????

程式碼：

clear;clc;

totaltime=10;

delta=0.01;

totalstep=totaltime/delta;

m=20;

m\_hat1(1)=15;

u(1)=1;

%make n,d

for i=1:totalstep

disturbance(i)=10\*(-1+rand);

noise(i)=0.001\*sin(25\*i)+0.005\*cos(100\*i+pi);

end

% use m

for i=1:totalstep

yarray(i)=(u(i)/m)+noise(i);

num=delta\*sum(yarray.\*u);

den=delta\*sum(yarray.\*yarray);

m\_hat1(i+1)=(num/den);

u(i+1)=m\_hat1(i+1)\*(yarray(i))+disturbance(i);

end;

%clear var.

yarray=[0:1:totalstep-1]\*0;

u=yarray;

m\_hat2(1)=15;

u(1)=1;

%use m\_dot

for i=1:totalstep

yarray(i)=(u(i)/m)+noise(i);

num=(u(i)-m\_hat2(i)\*yarray(i))\*yarray(i);

den=delta\*sum(yarray.\*yarray);

m\_hat\_dot(i)=(num/den);

m\_hat2(i+1)=m\_hat2(i)+m\_hat\_dot(i)\*delta;

u(i+1)=m\_hat2(i+1)\*(yarray(i))+disturbance(i);

end;

plot([0:1:totalstep]\*delta,m\_hat1,'r');

hold on;

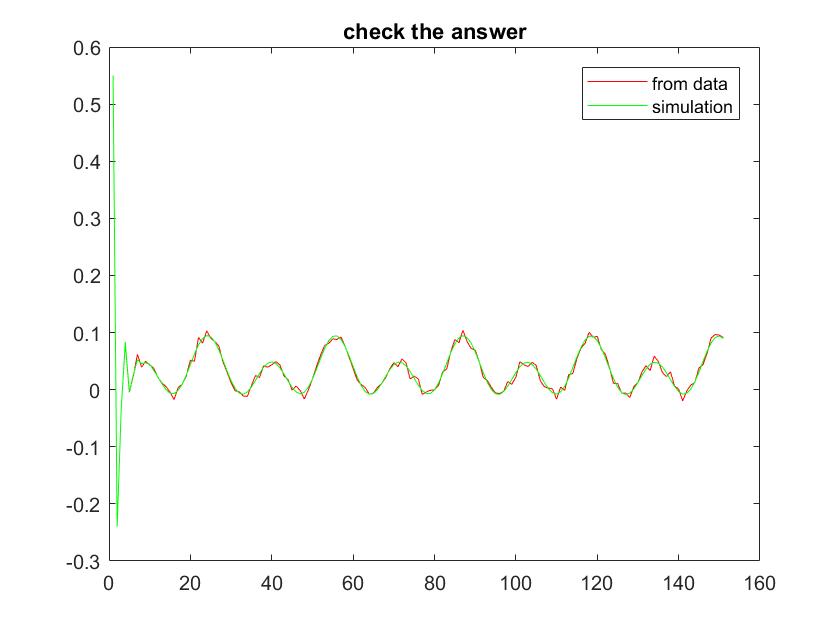
plot([0:1:totalstep]\*delta,m\_hat2,'b');

title('m\_h\_a\_t');

3.

算出答案：a1=0.453557 a2=0.250984 b1=-0.356244 b2=0.168191。

使用算出的答案和同樣u做模擬，並和所給的y做比較：



Matlab程式碼：

clear;clc;

%read data%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Data=textread('hw6Data.txt','%f');

y=zeros(1,length(Data)/2);u=zeros(1,length(Data)/2);k=1;

for i=1:length(Data)

if mod(i,2)==0

y(k)=Data(i);

k=k+1;

else

u(k)=Data(i);

end

end

%find matrix phi%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

for k=3:length(y)+1

phi(k-1,1)=y(k-1);

phi(k-1,2)=y(k-2);

phi(k-1,3)=u(k-1);

phi(k-1,4)=u(k-2);

end

%find matrix theta%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

tmpA=[0 0 0 0;0 0 0 0;0 0 0 0;0 0 0 0];

tmpB=[0 0 0 0];

for k=3:151

for i=1:4

for j=1:4

tmpA(i,j)=tmpA(i,j)+phi(k-1,j)\*phi(k-1,i);

end

tmpB(i)=tmpB(i)+y(k)\*phi(k-1,i);

end

end

theta=inv(tmpA)\*tmpB';

a1=-theta(1);

a2=-theta(2);

b1=theta(3);

b2=theta(4);

fprintf('a1=%f a2=%f b1=%f b2=%f \n',a1,a2,b1,b2);

%check the answer%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

yy(1)=y(1);yy(2)=y(2);

for k=3:151

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

end

plot(y,'r');

hold on;

plot(yy,'g');

legend('from data','simulation');

title('check the answer');