Experiment - 3

# **Name of the Experiment:**

To study convolution operation in discrete domain.

## theory

**Convolution:**

Convolution is a mathematical operation used to express the relation between input and output of an LTI system. It relates input, output and impulse response of an LTI system as

𝑦(𝑡)=𝑥(𝑡)∗ℎ(𝑡)

There are two types of convolution.

1) Continuous Convolution

2) Discrete convolution

## Continuous time Convolution:

𝑦(𝑡)=𝑥(𝑡)∗ℎ(𝑡) =∫𝑥(𝜏)ℎ(𝑡−𝜏) =∫ℎ(𝜏)𝑥(𝑡−𝜏)

## Discrete time Linear Convolution:

𝑦[𝑛]=𝑥[𝑛]∗ℎ[𝑛] =Σ 𝑥[𝑘]ℎ[𝑛−𝑘] =Σ ℎ[𝑘]𝑥[𝑛−𝑘]

matlab code

clc;

clear all;

close all;

X=-15:1:15;

y(11)=0;

for i=1:31

y(i)=(.5.^X(1:i).\*u(X(1:i)))\*u(X(i)-X(1:i))';

end

subplot(5,3,1)

stem(X,(0.5.^X).\*u(X),'ko','filled')

subplot(5,3,2)

stem(X,u(X),'ko','filled')

subplot(5,3,3)

stem(X,y,'ko','filled','markerfacecolor','yellow')

for i=1:31

y(i)=2\*(u(X(1:i))-u(X(1:i)-5))\*(u(X(i)-X(1:i))-u(X(i)-X(1:i)-4))';

end

subplot(5,3,4)

stem(X,2\*(u(X)-u(X-5)),'ko','filled')

subplot(5,3,5)

stem(X,u(X)-u(X-4),'ko','filled')

subplot(5,3,6)

stem(X,y,'ko','filled','markerfacecolor','yellow')

a=.5;

b=.4;

for i=1:31

y(i)=a.^X(1:i).\*u(X(1:i))\*(b.^(X(i)-X(1:i)).\*u(X(i)-X(1:i)))';

end

subplot(5,3,7)

stem(X,a.^X.\*u(X),'ko','filled')

subplot(5,3,8)

stem(X,b.^X.\*u(X),'ko','filled')

subplot(5,3,9)

stem(X,y,'ko','filled','markerfacecolor','yellow')

for i=1:31

y(i)=r(X(1:i)).\*(u(X(1:i))-u(X(1:i)-6))\*(r(X(i)-X(1:i)).\*(u(X(i)-X(1:i))-u(X(i)-X(1:i)-6)))';

end

subplot(5,3,10)

stem(X,r(X).\*(u(X)-u(X-6)),'ko','filled')

subplot(5,3,11)

stem(X,r(X).\*(u(X)-u(X-5)),'ko','filled')

subplot(5,3,12)

stem(X,y,'ko','filled','markerfacecolor','yellow')

X1 = zeros(1,8);

X2=-2:1:5;

X1(5)=0.5;

H1=[0,0,1,2,3,2,1,0];

Y(8)=0;

for i=1:8

Y(i)=X1(1:i)\*H1(X2(i)-X2(1:i)+1)';

end

subplot(5,3,13)

stem(X2,X1,'ko','filled')

subplot(5,3,14)

stem(X2,H1,'ko','filled')

subplot(5,3,15)

stem(X2,Y,'ko','filled','markerfacecolor','yellow')

clc;

clear all;

close all;

x1=[1,1,1];

x=[0,1,2];

h1=[2,2,1];

for i=1:3

z(i)=x1(1:i)\*h1(i+1-x1(1:i))';

end

subplot(5,3,1)

stem(x,x1,'ko','filled')

subplot(5,3,2)

stem(x,h1,'ko','filled')

subplot(5,3,3)

stem(x,z,'ko','filled','markerfacecolor','yellow')

x=[-1,0,1,2,3];

x1=[1,2,3,4,5];

h1=[1,2,1,-1];

for i=2:5

y(i)=x(2:i)\*h1(i-x1(2:i)+1)';

end

subplot(5,3,4)

stem(x,x1,'ko','filled')

subplot(5,3,5)

stem(x(2:end),h1,'ko','filled')

subplot(5,3,6)

stem(x(2:end),y(2:5),'ko','filled','markerfacecolor','yellow')

x1=1:1:5;

x=[2,4,6,8,7];

for i=1:5

y(i)=x(1:i)\*x(i-x1(1:i)+1)';

end

subplot(5,3,7)

stem(x1,x,'ko','filled')

subplot(5,3,8)

stem(x1,x,'ko','filled')

subplot(5,3,9)

stem(x1,y,'ko','filled','markerfacecolor','yellow')

x1=-5:.5:5;

no=2;

y(21)=0;

for i=1:21

y(i)=d(x1(1:i)-no)\*(.5.^u(i-x1(1:i)).\*u(i-x1(1:i)))';

end

subplot(5,3,10)

stem(x1,d(x1-no),'ko','filled')

subplot(5,3,11)

stem(x1,.5.^x1.\*u(x1),'ko','filled')

subplot(5,3,12)

stem(x1,y,'ko','filled','markerfacecolor','yellow')

clc;

clear all;

close all;

x=[1,1,2,2];

h=[1,2,3,4];

y(4)=0;

for i=1:4

y(i)=x(1:i)\*h(i-h(1:i)+1)';

end

subplot(1,3,1)

stem(h,x,'ko','filled')

subplot(1,3,2)

stem(h,h,'ko','filled')

subplot(1,3,3)

stem(h,y,'ko','filled','markerfacecolor','yellow')