信号与系统实验报告

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实验一：基本信号的产生

实验目的：

A. 学习使用 MATLAB 产生基本信号、绘制信号波形、实现信号的基本运算， 为信号分析和系统设计奠定基础；

B. 深刻理解卷积运算，掌握离散线性卷积、连续线性卷积的计算方法。

实验内容：整理实验代码和产生波形

（1）验证实例：

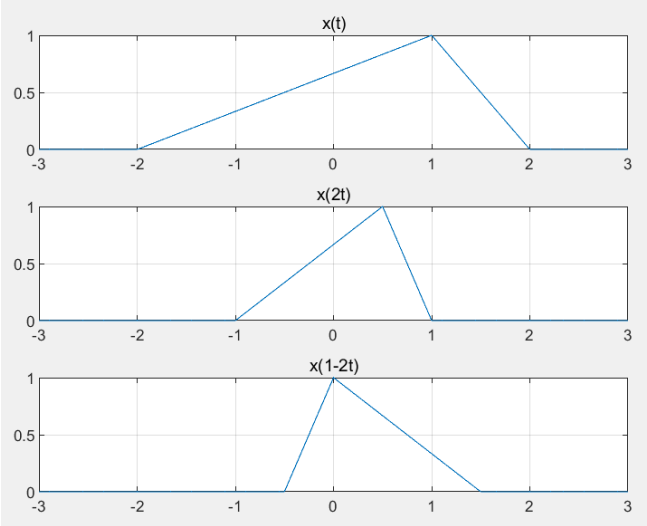
平移、翻转和尺度变换

A

```
close all;
clc;
t=-3:0.001:3;
xt=tripuls(t,4,0.5);
subplot(3,1,1);%分割3个窗口
plot(t,xt);
grid on;
title('x(t)');

x2t=tripuls(2*t,4,0.5);
subplot(3,1,2);
plot(t,x2t);
grid on;
title('x(2t)');

x3t=tripuls(1-2*t,4,0.5);
subplot(3,1,3);
plot(t,x3t);
grid on;
title('x(1-2t)');
```

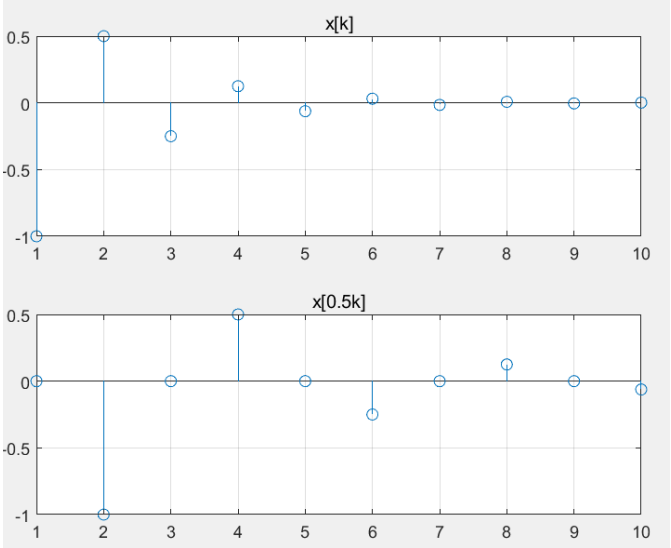


B

```
close all;
clc;
A=2;
a=-0.5;
k=1:10;

xk=A*a.^k;
subplot(2,1,1);
stem(k,xk);%离散显示
grid on;
title('x[k]');

xk2=A*a.^(0.5*k);
subplot(2,1,2);
stem(k,xk2);
grid on;
title('x[0.5k]');
```



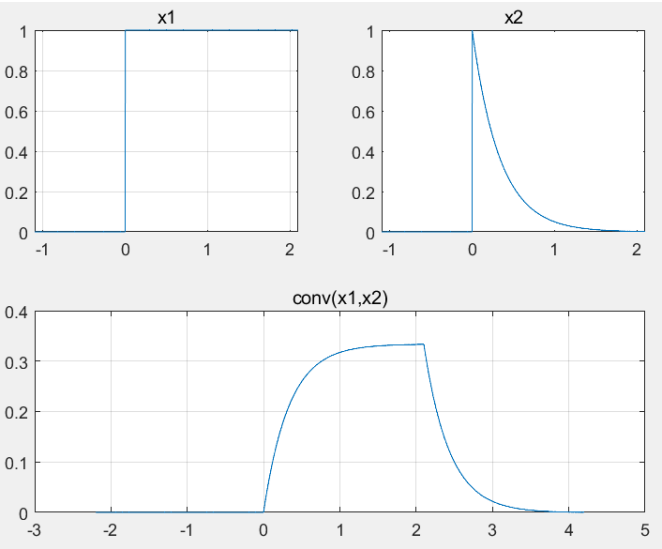
求卷积

A

```
close all;
clc;
fs=1000;
t=-1.1:1/fs:2.1;
x11=(t>=0); %定义阶跃函数
x12=exp(-3*t).*(t>=0);
y1=conv(double(x11),double(x12))/fs;
n=length(y1);%
tt=(0:n-1)/fs-2.2;%定义新序列时间范围 左移2.2
subplot(2,2,1);
plot(t,x11);
grid on;
title('x1');

subplot(2,2,2);
plot(t,x12);
title('x2');

subplot(2,1,2);
plot(tt,y1);
grid on;
title('conv(x1,x2)');
```

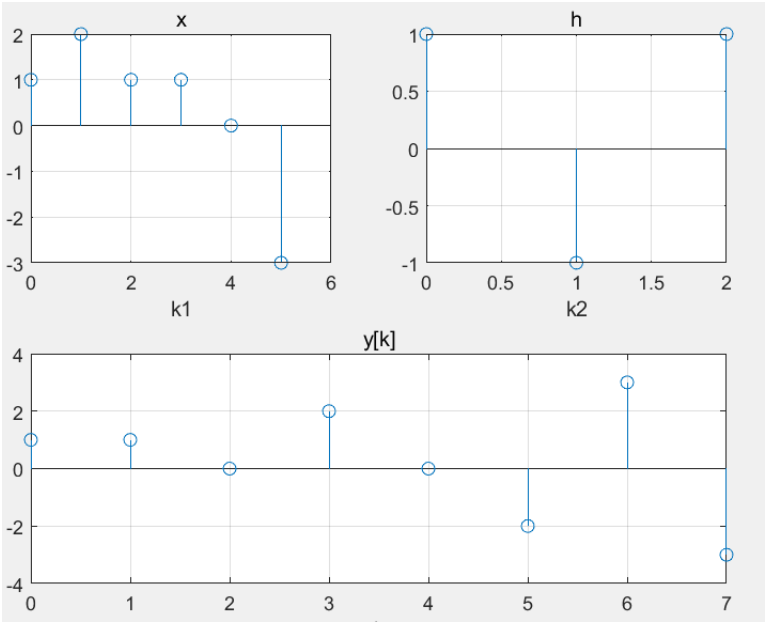


B

```
close all;
clc;
x=[1 2 1 1 0 -3];
k1=[0,1,2,3,4,5];
h=[1 -1 1];
k2=[0,1,2];
y=conv(x,h);
subplot(2,2,1);
stem(k1,x);
title('x');
xlabel('k1');
grid on;

subplot(2,2,2);
stem(k2,h);
title('h');
xlabel('k2');
grid on;

subplot(2,1,2);
stem([0:length(y)-1],y);
title('y[k]');
xlabel('k');
grid on;
```

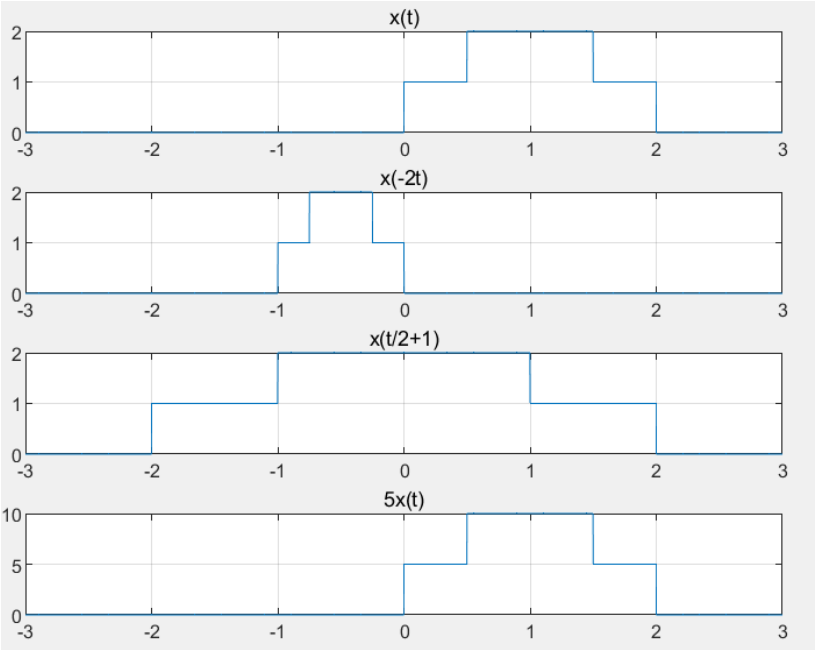


（2）利用 x(t)= u(t) - u(t-2) + u(t - 0.5) - u(t - 1.5)(-1 ⩽ t ⩽ 1),绘制出 x(-2t)，x(t/2+1)和5x(t)的波形。

xt(t)即 x(t)= u(t) - u(t-2) + u(t - 0.5) - u(t - 1.5)

```
function f=xt(t)
f=(t>=0)-(t>=2)+(t>=0.5)-(t>=1.5);
end
```

```
t=-3:0.001:3;
x1=xt(t);     %
x2=xt(-2*t); %
x3=xt(t/2+1);%
x4=5*xt(t);  %
subplot(4,1,1);
plot(t,x1);
grid on;
title('x(t)');
subplot(4,1,2);
plot(t,x2);
grid on;
title('x(-2t)');
subplot(4,1,3);
plot(t,x3);
grid on;
title('x(t/2+1)');
subplot(4,1,4);
plot(t,x4);
grid on;
title('5x(t)');
```

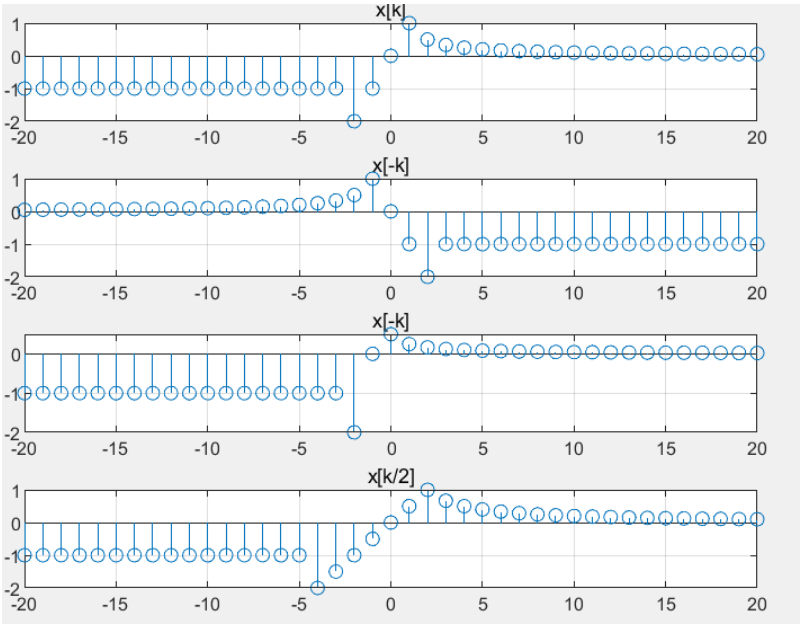


(3)

设$x[k]=\begin{cases}-1 & k<-2\\ k & -2\le k\le 1\\ \frac{1}{k} & k>1\end{cases}$，编写程序，绘制表示 $x[-k],x[2k+2],x[k/2]$;

```
function f=xk(k)
len=length(k);
for i=1:len
    if k(i)<-2
        x1(i)=-1;
    elseif k(i)>=-2 & k(i)<=1
        x1(i)=k(i);
    else
        x1(i)=1/k(i);
    end
end
f=x1;
end
```

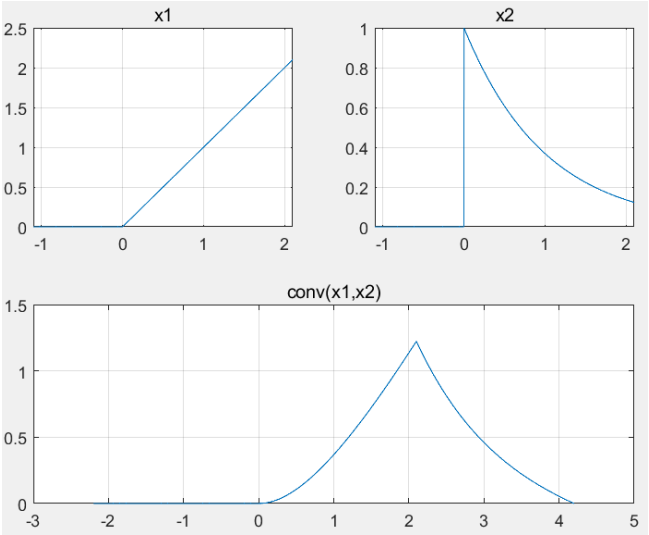
```
k=-20:20;
x1=xk(k);%
subplot(4,1,1);
stem(k,x1);
grid on;
title('x[k]');
x2=xk(-1*k);%
subplot(4,1,2);
stem(k,x2);
grid on;
title('x[-k]');
x3=xk(2*k+2);%
subplot(4,1,3);
stem(k,x3);
grid on;
title('x[-k]');
x4=xk(k/2);%
subplot(4,1,4);
stem(k,x4);
grid on;
title('x[k/2]');
```



（4）绘制两个信号的卷积

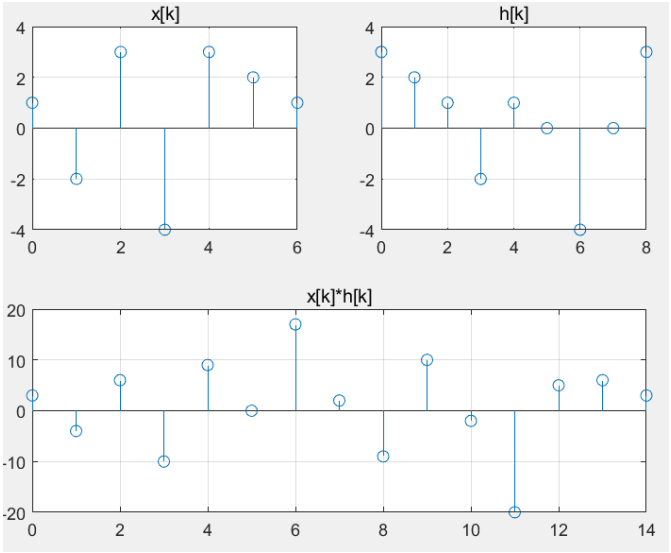
A：x1(t)=tu(t); x2(t)=e^{-t}u(t)

```
fs=1000;
t=-1.1:1/fs:2.1;
x1=t.*(t>=0);
x2=exp(-1*t).*(t>=0);
y=conv(double(x1),double(x2))/fs;
len=length(y);
tt=(0:len-1)/fs-2.2;
subplot(2,2,1);
plot(t,x1);
grid on;
title('x1');
subplot(2,2,2);
plot(t,x2);
grid on;
title('x2');
subplot(2,1,2);
plot(tt,y);
grid on;
title('conv(x1,x2)');
```



B：x[k]=[3,2,1,-2,1,0,4,0,3;k=0:8];h[k]=[1,-2,3,-4,3,2,1;k=0:6];

```
kh=0:8;
kx=0:6;
h = [3 2 1 -2 1 0 -4 0 3]; % impu
x = [1 -2 3 -4 3 2 1]; % input s
y = conv(x,h);
n = 0:(length(h)+length(x)-2);%
subplot(2,2,1);
stem(kx,x);
grid on;
title('x[k]');
subplot(2,2,2);
stem(kh,h);
grid on;
title('h[k]');
subplot(2,1,2);
stem(n,y);
grid on;
title('x[k]*h[k]');
```



思考题：

A 卷积作用在于时域的卷积等于频域的乘积，将时间向量和卷积的结果对应起来需要重新定义卷积后函数的时间轴。

B 卷积后新序列长度为 n1+n2-1,区间起点应为第一个序列的起点。