Signals and Systems Lab 6

Submitted by

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Title : Convolution of signals in transformed domain and verification of convolution property of Fourier and Z transform.

Experiment 1 : Find the fourier transform (in symbolic form) of

- $f = a|t|$

  Code:
  ```
  syms a t
  f = a*abs(t);
  fourier(f)
  ```
  Output :
  ```
  >> lab6_1i

  ans =

  -(2*a)/w^2
  ```

- $f = acos\omega t$

  Code:
  ```
  syms a t w
  f = a*cos(w*t);
  fourier(f)
  ```
  Output :
  ```
  >> lab6_1ii

  ans =

  pi*a*(dirac(t - v) + dirac(t + v))
  ```

- $f = e^{-t|a|}u(t)$

  Code:
  ```
  syms a t
  f = exp(-t*abs(a))*heaviside(t);
  fourier(f)
  ```

Output:

```
>> lab6_1iii

ans =

1/(abs(a) + w*1i) - (sign(abs(a))/2 - 1/2)*fourier(exp(-t*abs(a)), t, w)
```

- $f = e^{-t^2 - x^2}$

Code:

```
syms x t
f = exp(-(t^2 + x^2));
fourier(f)
```

Output:

```
>> lab6_1iv

ans =

pi^(1/2)*exp(- t^2 - w^2/4)
```

Experiment 2: Find the inverse Fourier Transform (in symbolic form) of

- . $F = e^{\frac{-\omega^2}{4}}$

Code:

```
syms w
f = exp(-w^2/4);
ifourier(f)
```

Output:

```
>> lab6_2i

ans =

exp(-x^2)/pi^(1/2)
```

- $F = e^{-\omega^2 - a^2}$

Code:

```
syms w a
f = exp(-(w^2 + a^2));
ifourier(f)
```

Output:

```
>> lab6_2ii

ans =

exp(- a^2 - x^2/4)/(2*pi^(1/2))
```

Experiment 3: Find the Z-transform (in symbolic form) of

- $f(k) = sin(k)$

  Code:

  ```
  syms k x
  f = sin(k);
  ztrans(f,k,x)
  ```

  Output:

  ```
  >> lab6_3i

  ans =

  (x*sin(1))/(x^2 - 2*cos(1)*x + 1)
  ```

- $f(n) = a^n$

  Code:

  ```
  syms a n x
  f = a^n;
  ztrans(f,x)
  ```

  Output:

  ```
  >> lab6_3ii

  ans =

  -x/(a - x)
  ```

- c. $f(n) = u(n - 3)$

  Code:

  ```
  syms n x
  f = heaviside(n-3);
  ztrans(f,n,x)
  ```

Output:

```
>> lab6_3iii

ans =

(1/(x - 1) + 1/2)/x^3
```

- $f[n] = \left(\frac{1}{4}\right)^n u[n]$

Code:

```
syms x n
f = 1/4^n;
ztrans(f,x)
```

Output:

```
>> lab6_3iv

ans =

x/(x - 1/4)
```

- $f(n) = 2^{n+1} + 4\left(\frac{1}{2}\right)^n$

Code:

```
syms x n
f = 2*2^n+4*(1/2)^n;
ztrans(f,x)
```

Output:

```
>> lab6_3v

ans =

(2*x)/(x - 2) + (4*x)/(x - 1/2)
```

Experiment 4: Find the inverse Z-transform (in symbolic form) of

- $x(z) = \frac{2z}{(2z-1)}$

Code:

```
syms z n
f = 2*z/(2*z-1);
iztrans(f)
```

Output:

```
>> lab6_4i

ans =

(1/2)^n
```

- $$x(z) = \frac{6-9z^{-1}}{(1-2.5z^{-1}+z^{-2})}$$

  Code:

  ```
  syms z n
  f = (6-9*z^-1)/(1-2.5*z^-1+z^-2);
  iztrans(f)
  ```

  Output:

  ```
  >> lab6_4ii

  ans =

  2*2^n + 4*(1/2)^n
  ```

- $$x(z) = \left(\frac{1}{6-5z^{-1}+z^{-2}}\right)\left(\frac{4z}{4z-1} - z^{-1} + 5z^{-1}\right)$$

  Code:

  ```
  syms z n
  f = ((1/(6 - 5*z^-1 + z^-2))*(4*z/(z - 1) - z^-1 + 5*z^-2));
  iztrans(f)
  ```

  Output:

  ```
  >> lab6_4iii

  ans =

  7*(1/2)^n - (40*(1/3)^n)/3 + 5*kroneckerDelta(n, 0) + 2
  ```

Experiment 6:
Verification of convolution property of

- Fourier transform

  Code:

  ```
  function [ w ] = convmat( x1,x2 )
  n=0:100;
  x1=[1 2 3 4 5];
  x2=[6 7 8 9 10];
  ```

```
lengthofx1=length(x1);
lengthofx2=length(x2);
X1=[x1,zeros(1,lengthofx2)];
X2=[x2,zeros(1,lengthofx1)];
for k=1:(lengthofx1+lengthofx2-1)
w(k)=0;
for j=1:lengthofx1
if(k-j+1)>0
w(k)=w(k)+X1(j)*X2(k-j+1);
end
end
end
subplot(2,4,2)
r=x1.*x2;
f=abs(fft(r));
stem(f)
title('fourier transform of two multiplied signals')
subplot(2,4,6)
a1=abs(fft(x1));
a2=abs(fft(x2));
b=conv(a1,a2);
stem(b)
title('convolution of two fourier transformed signals')
end
```

Graph: