

**The LNM Institute Of Information Technology**  
**Department Of Electronics and Communication**  
**Engineering**  
**DSP Lab**

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## **1. AIM**

1. Circular convolution and DFT Multiplication for two sequences.
2. Simulink based convolution.

## **2. Software Used**

- MATLAB

## **3. Tasks**

- 3.1 Generate Circular Convolution matrix H.
- 3.2 Perform circular convolution code and compare your results with MATLAB built-in command for circular convolution.
- 3.3 Generate myIDFT using myDFT function. Verify 'Circular convolution DFT multiplication are Fourier transform pair' using the first five steps of the change of basis section and Verify the above answers using the matrix multiplication steps given in the change of basis section.

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```
function[H] = cirmat(N,h)
H = zeros(N,N);
Temp = 0;
for i=1:N
    if(i==1)
        H(:,i) = h(:);
    else
        H(1,i) = Temp;
        H(2:N,i) = H(1:N-1,i-1);
        Temp = H(N,i);
    end
end
end
```

Not enough input arguments.

Error in cirmat (line 2)  
H = zeros(N,N);

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```
function[D] = MyDFT(N)
D = zeros(N,N);
for i=1:N
    for k=1:N
        D(i,k) = exp(-1j*2*pi*(i-1)*(k-1)/N);
    end
end
end
```

Not enough input arguments.

Error in MyDFT (line 2)  
D = zeros(N,N);

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```
function[D] = MyIDFT(N)
D = zeros(N,N);
for i=1:N
    for k=1:N
        D(i,k) = exp(1j*2*pi*(i-1)*(k-1)/N);
    end
end
end
```

Not enough input arguments.

Error in MyIDFT (line 2)  
D = zeros(N,N);

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---

```

clc;
close all;
clear all;

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

M = length(x);
N = length(h);

L = max(M,N);
x = [x, zeros(1,L-M)];
h = [h, zeros(1,L-N)];

H = cirmat(N,h);
Y = H * transpose(x);
y = cconv(x,h);

x1 = zeros(1,10);
h = [h,zeros(1,length(x1)-N)];

for i=1:10
    x1(i) = 0.5^(i-1);
end

H1 = cirmat(10,h);
Y1 = (H1*transpose(x1));
y1 = cconv(x1,h,length(x1));

display(H);
display(Y);
display(y);

display(H1);
display(Y1);
display(y1);

```

$H =$

2	0	2	1
1	2	0	2
2	1	2	0
1	2	1	2

$Y =$

12
13
10
16

---

$Y =$

2.0000      5.0000      10.0000      16.0000      12.0000      11.0000      4.0000

$H1 =$

2	0	0	0	0	0	0	1	2	1
1	2	0	0	0	0	0	0	1	2
2	1	2	0	0	0	0	0	0	1
1	2	1	2	0	0	0	0	0	0
0	1	2	1	2	0	0	0	0	0
0	0	1	2	1	2	0	0	0	0
0	0	0	1	2	1	2	0	0	0
0	0	0	0	1	2	1	2	0	0
0	0	0	0	0	1	2	1	2	0
0	0	0	0	0	0	1	2	1	2

$Y1 =$

2.0176  
2.0078  
3.0020  
2.5000  
1.2500  
0.6250  
0.3125  
0.1562  
0.0781  
0.0391

$y1 =$

Columns 1 through 7

2.0176      2.0078      3.0020      2.5000      1.2500      0.6250      0.3125

Columns 8 through 10

0.1563      0.0781      0.0391

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---

```
clc;
close all;
clear all;

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

M = length(x);
N = length(h);
H = zeros(N,N);

x2 = [0,0,0,0,0,0,0,0,0,0];
h2 = [2,1,2,1,0,0,0,0,0,0];

for i=1:10
    x2(i) = 0.5.^(i-1);
end

M2 = length(x2);
N2 = length(h2);
H2 = zeros(N,N);

for n=1:N
    for i=1:N
        index = mod((n-i),N)+1;
        H(n,i) = h(index);
    end
end
Y = cconv(x,h,4);
Y2 = cconv(x2,h2,10);

%display(H)
display(Y)

display(Y2);

Y =

    14    16    14    16

Y2 =

Columns 1 through 7

    2.0176    2.0078    3.0020    2.5000    1.2500    0.6250    0.3125

Columns 8 through 10
```

---

---

0.1563      0.0781      0.0391

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---

```
clear all;
close all;
clc;

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

M=length(x);
N=length(h);

L=max(M,N);

x=[x,zeros(1,L-M)];
h=[h,zeros(1,L-N)];

H=ciramat(N,h);
Y=H*transpose(x);

D=MyDFT(8);

H_k=D*transpose(h);
X_k=D*transpose(x);
Y_k=H_k.*X_k;
Do=MyIDFT(8);
Yout=(Do*Y_k)/8;

display(Yout)
```

*Yout =*

```
12.0000 - 0.0000i
12.0000 - 0.0000i
12.0000 + 0.0000i
12.0000 + 0.0000i
12.0000 + 0.0000i
12.0000 + 0.0000i
12.0000 + 0.0000i
12.0000 - 0.0000i
12.0000 - 0.0000i
```

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---

```

clc;
clear all;
close all;

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

hN = length(h);
xN = length(x);

L = max(xN,hN);

h = [h,zeros(1,L-hN)];
H2 = cirmat(xN,h);

y2 = transpose(H2*transpose(x));

D = MyDFT(L);

Hk = D * transpose(h);
Xk = D * transpose(x);

yk = Hk.*Xk;
D0 = MyIDFT(L);
Y_out = transpose(1/L * abs(D0*yk));
H = cirmat(xN,h);
D8 = MyDFT(L);
Xf = D8*transpose(x);
Hf = D8*H*inv(D8);
Yf = Hf*Xf;
y = inv(D8)*Yf;
y = transpose(abs(y));

display(y);
display(Yf);

y =

Columns 1 through 7

    10.0000    10.0000    10.0000    10.0000    10.0000    10.0000    10.0000

Column 8

    12.0000

Yf =

    82.0000 - 0.0000i
     1.4142 + 1.4142i
    -0.0000 + 2.0000i

```

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---

$-1.4142 + 1.4142i$   
 $-2.0000 - 0.0000i$   
 $-1.4142 - 1.4142i$   
 $-0.0000 - 2.0000i$   
 $1.4142 - 1.4142i$

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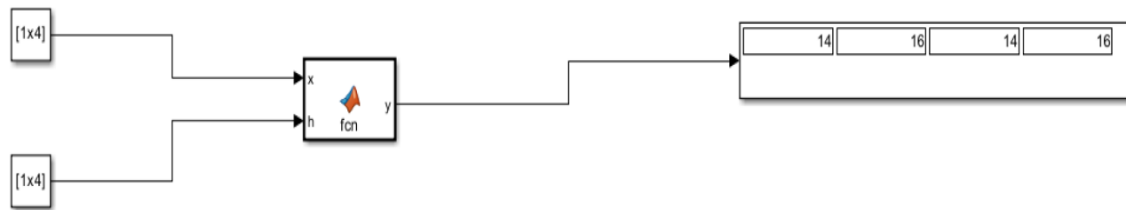


Figure 1: Simulink