Digital Signal Processing
MATLAB HW3 - q3

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Professor: Dr. Sheikhzadeh Author: Maryam Barazande - 9723016 E-mail: maryambarazande7@gmail.com University: Amirkabir University of Technology
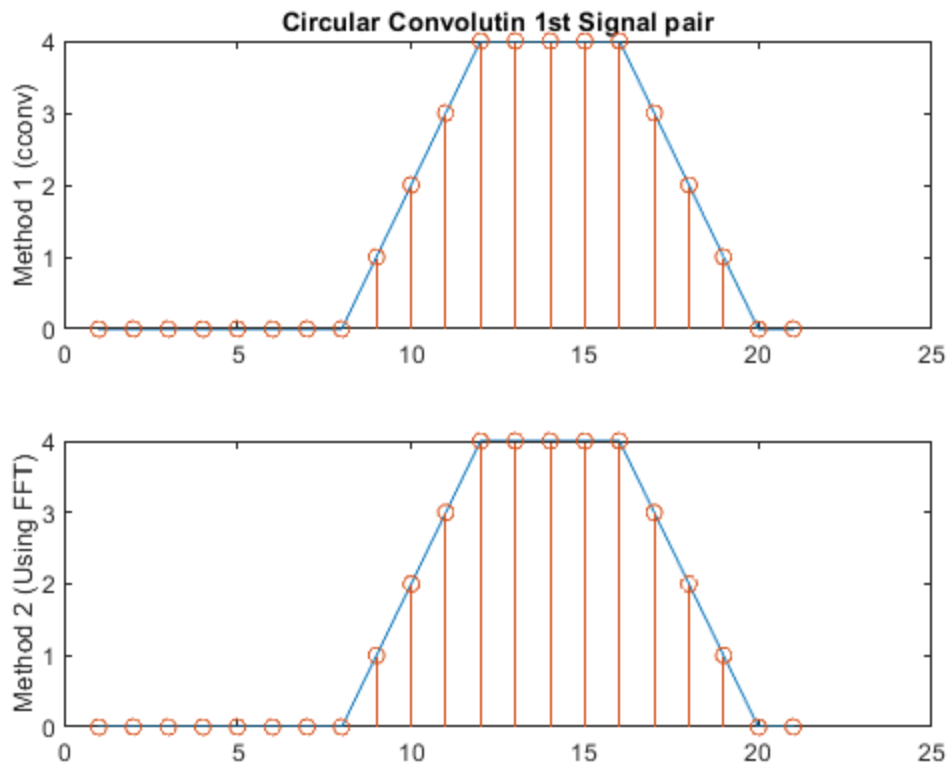
Clear recent data

```
clear; close all; clc;
```

Convolution and DFT

D. DFT Properties

1st Signal pair

```
x1 = [0 0 0 0 1 1 1 1];
x2 = [0 0 0 0 1 1 1 1 1 1 1 1];
N = 21;
% Method 1
cconv1 = cconv(x1,x2,N);
figure(1);
subplot(2,1,1);
plot(cconv1);
hold on;
stem(cconv1);
ylabel("Method 1 (cconv)");
title('Circular Convolutin 1st Signal pair');
% Method 2
Y1 = fft(x1,N).*fft(x2,N);
y = ifft(Y1,N);
subplot(2,1,2);
plot(y);
hold on;
```

```
stem(y);
ylabel("Method 2 (Using FFT)");
```


2nd Signal pair

```
s1 = [0 0 0 0 0 1 1 1 1 1 1 1];
s2 = [0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1];
N = 21;
% Method 1
cconv2 = cconv(s1,s2,N);
figure(2);
subplot(2,1,1);
plot(cconv2);
hold on;
stem(cconv2);
ylabel("Method 1 (cconv)");
title('Circular Convolutin 2nd Signal pair');
% Method 2
Y2 = fft(s1,N).*fft(s2,N);
y2 = ifft(Y2,N);
subplot(2,1,2);
plot(y2);
hold on;
stem(y2);
ylabel("Method 2 (Using FFT)");
```
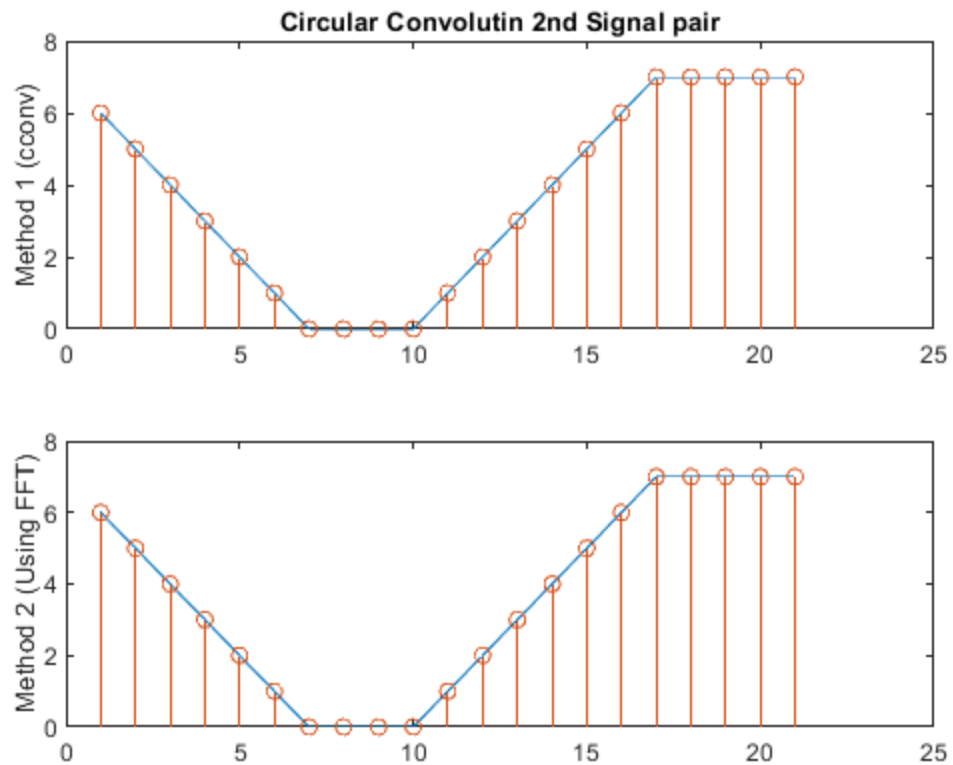
A. cflip function

```matlab
function cflipped_sig = cflip(sig,N)
Len = length(sig);
sig = [sig,zeros(1,N-Len)];
y1 = zeros(1,N);
y2 = zeros(1,N);

if N >= Len
    for i = 1 : N
        y1(i) = y1(i) + sig(N+1-i);
    end
else
    j = Len - N;
    for i = j+1 : N
        y1(i) = sig(i);
    end
    for i = 1 : j
        y1(i) = sig(i) + sig(i + N);
    end
    for i = 1 : N
    y2(i) = y1( N - i + 1 );
    end
end
if N >= Len
    cflipped_sig = y1;
else
    cflipped_sig = y2;
end
end
```

B. cshift function

```matlab
function cshifted_sig = cshift(sig, m)
Len = length(sig);
m = mod(m,Len);
for i =1 : m
    y(i) = sig(Len-m+i);
end
for j = 1 : Len-m
    y(j+m) = sig(j);
end
cshifted_sig = y;
end
```

Circular Convolutin 2nd Signal pair

C. Circular Convolution

```
function output_sig = cconv(sig1,sig2,N)
Len1 = length(sig1);
sig2 = cflip(sig2,N);
y = zeros(1,N);
v = zeros(1,N);

for i = 1 : Len1
    v(i) = sig1(i) ;
end

for j = 1 : N
    h = cshift(sig2,(j-1)) ;
    y(j) = v * (h') ;
end
output_sig = cshift(y,-1) ;
end
```

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