DSP LABWORK

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Week 2: **Realization of DFT using MATLAB**

Aim:

To realize Discrete Fourier Transform (DFT) of any Discrete Time Signal.

Software Used:

MATLAB R2020

Pseudo Code:

1. Make a function for finding the DFT of the signal
   - i. Iterate n from 0 to N-1
   - ii. Find the sum of x(n)exp(-j*2*pi*k*n/N) for all values of n
   - iii. Iterate k from 0 to N-1
   - iv. And repeat step (i) and (ii) for each value of k
   - v. Return the result as X(k)
2. Using the function, find the DFT of the given signal
3. Plot the signal x(n) vs n, abs(X(k)) vs k and angle(X(k)) vs k

MATLAB script:

Functon definition of findDFT():

```
function result = findDFT(x)

%This function gets any point sequence as input vector
%and returns its DFT as output vector

    N = length(x);
    result(1:length(x)) = 0;        %it stores the DFT of x

    for k=0:N-1             %for iterating differant values of k
        temp = 0;           %This is where the X(k) will be stored
        for n=0:N-1         %for iterating differant values of n for
                            %the given k
            temp = temp + x(n+1)*power(twiddleFactor(N),k*n);
        end
        result(k+1) = temp;
    end
end
```

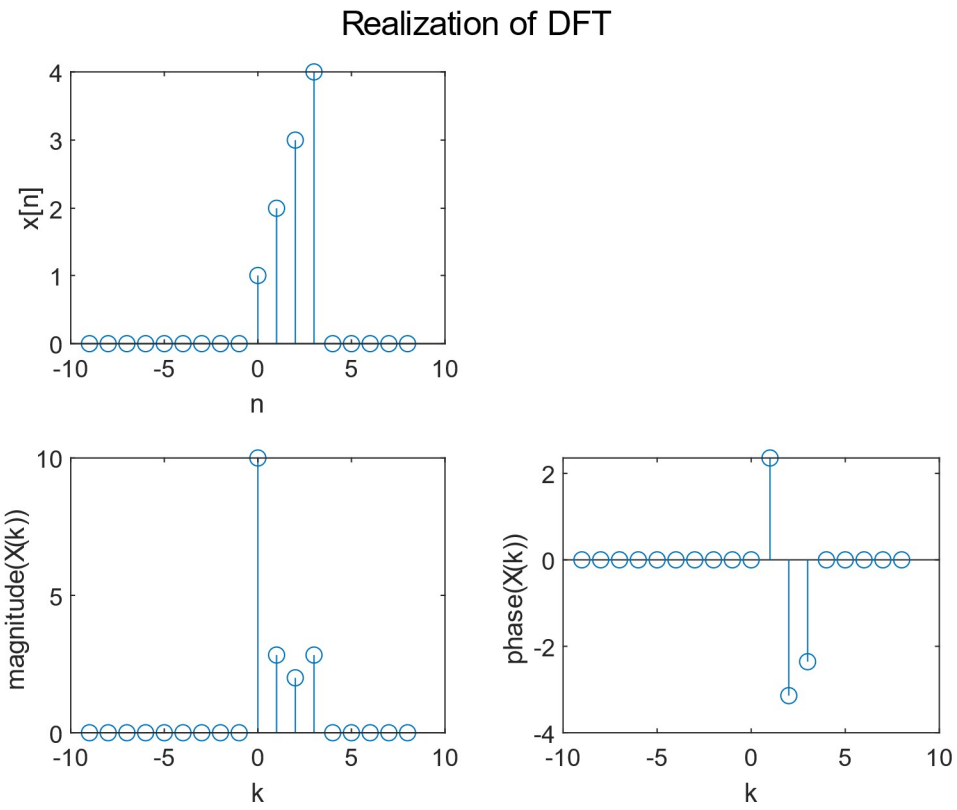
```
function result = twiddleFactor(N)

%This function returns the twiddle factor/ basis function / N th root of
%unity
    result = exp((-j*2*pi)/N);
end
```

The actual script:

```
clc
clear variables

xn = [1, 2, 3, 4];           %Feel free to change xn to any point sequence
xnZero(1:5) = 0;            %5 is the 0 padding for x[n]

%This time samples for x(n)
n = [-(length(xnZero)+length(xn)):length(xnZero)+length(xn)-1];

%These is x(n) formatted for plotting
xnForPlot = [xnZero, xn*0, xn, xnZero];

subplot(2,2,1);
stem(n,xnForPlot);xlabel("n");ylabel("x[n]");

%This is k for X(k)
k = n;
%X(k) evaluated from findDFT function defined in the same directory
xnDFT = findDFT(xn);
%X(k) formotted for plotting
xnDFTForPlot = [xnZero, xnDFT*0, xnDFT, xnZero];

subplot(2,2,3);
stem(k,real(xnDFTForPlot));xlabel("k");ylabel("magnitude(X(k))");

subplot(2,2,4);
stem(k,imag(xnDFTForPlot));xlabel("k");ylabel("phase(X(k))");

sgtitle("Realization of DFT");
```

Result:

Test signal is x(n) = {1, 2, 3, 4}


Realization of DFT
x[n]
n
magnitude(X(k))
k
phase(X(k))
k