

# FFT Examples - Change the length of the FFT

Plot the frequency representation of the signal  $x[n]$  by using the FFT function.

## Parameters

- $x[n] = \cos(2\pi F_0 n T_s) + \cos(2\pi F_1 n T_s)$
- $F_0 = 1$  [kHz]
- $F_1 = 5.123$  [kHz]
- $F_s = 16$  [kHz];
- $N = [8, 16, 32, 256]$

## FFT Function (reference: "*help fft*")

$Y = \text{fft}(X, n)$  returns the  $n$ -point DFT. If no value is specified,  $Y$  is the same size as  $X$ .

- If  $X$  is a vector and the length of  $X$  is less than  $n$ , then  $X$  is padded with trailing zeros to length  $n$ .
- If  $X$  is a vector and the length of  $X$  is greater than  $n$ , then  $X$  is truncated to length  $n$ .
- If  $X$  is a matrix, then each column is treated as in the vector case.
- If  $X$  is a multidimensional array, then the first array dimension whose size does not equal 1 is treated as in the vector case.

## Clear

```
clc;           % 'clc' clears all the text from the Command Window
clear;         % 'clear' removes all variables from the current workspace
close all;     % 'close all' deletes all figures whose handles are not hidden.
```

## Parameters

```
len = 32;
Fs = 16e3;
Ts = 1/Fs;
F0 = 1000;
F1 = 5123;
N = [8, 16, 32, 256];
```

## Exercise

```
n = 0:len-1;
x = cos(2*pi*F0*n*Ts) + cos(2*pi*F1*n*Ts);

Xf0 = fft(x, N(1))/length(x);
```

```

Xf1 = fft(x,N(2))/length(x);
Xf2 = fft(x,N(3))/length(x);
Xf3 = fft(x,N(4))/length(x);

Xf0 = abs(Xf0);
Xf1 = abs(Xf1);
Xf2 = abs(Xf2);
Xf3 = abs(Xf3);

Xf0 = fftshift(Xf0);
Xf1 = fftshift(Xf1);
Xf2 = fftshift(Xf2);
Xf3 = fftshift(Xf3);

```

## Plot

```

f_ax0 = (-N(1)/2:1:N(1)/2-1)/N(1)*Fs/1e3;
f_ax1 = (-N(2)/2:1:N(2)/2-1)/N(2)*Fs/1e3;
f_ax2 = (-N(3)/2:1:N(3)/2-1)/N(3)*Fs/1e3;
f_ax3 = (-N(4)/2:1:N(4)/2-1)/N(4)*Fs/1e3;

figure
subplot(2,2,1)
    plot(f_ax0, Xf0, '.-')
    grid on
    legend('Xf_0')
    xlabel('Frequency [kHz]')
    ylabel('Magnitude [dB]')
subplot(2,2,2)
    plot(f_ax1, Xf1, '.-')
    grid on
    legend('Xf_1')
    xlabel('Frequency [kHz]')
    ylabel('Magnitude [dB]')
subplot(2,2,3)
    plot(f_ax2, Xf2, '.-')
    grid on
    legend('Xf_2')
    xlabel('Frequency [kHz]')
    ylabel('Magnitude [dB]')
subplot(2,2,4)
    plot(f_ax3, Xf3, '.-')
    grid on
    legend('Xf_3')
    xlabel('Frequency [kHz]')
    ylabel('Magnitude [dB]')

```

