FFT Examples - Noisy signal

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

Parameters

- $x[n] = cos(2\pi F_0 n T_s) + k\, w_k[n]$
- F_0 = 1 [kHz]
- F_s = 16 [kHz];
- k=[1e-8, 1e-6, 1e-4, 1e-2, 1e-1];

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

Y = fft(X) computes the discrete Fourier transform (DFT) of X using a fast Fourier transform (FFT) algorithm

- If X is a vector, then fft(X) returns the Fourier transform of the vector.
- If X is a matrix, then fft(X) treats the columns of X as vectors and returns the Fourier transform of each column.
- If X is a multidimensional array, then fft(X) treats the values along the first array dimension whose size does not equal 1 as vectors and returns the Fourier transform of each vector.

Clear

```
clc;        % 'clc' cleras 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 = 2^10;
F0 = 1e3;
Fs = 16e3;
Ts = 1/Fs;
k=[1e-8, 1e-6, 1e-4, 1e-2, 1e-1];
```

Exercise

```
x = cos(2*pi*F0/Fs*(0:len-1)).';
w = randn(len,1);  % (Row,Col) = (1024,1)

X = zeros(len, length(k)); % (Row,Col) = (1024,5)
```

```
for i=1:length(k)
    X(:,i) = x + k(i) * w;
end

Xf = fft(X);        % (Row,Col) = (1024,5)
Xf_abs = abs(Xf)/len;
Xf_abs_dB = mag2db(Xf_abs);

f_ax = (0:len-1)/len * Fs;
f_ax = f_ax.';
```

Plot

```
figure
plot(f_ax, Xf_abs_dB)
grid on
legend('k(1)','k(2)','k(3)','k(4)','k(5)')
xlabel('Frequency [Hz]')
ylabel('Amplitude [dB]')
```