FFT Examples - Gibbs phenomenon

Plot the frequency representation of the sinc signal by using the FFT function.

The sinc signal must be designed considering several lengths.

Don't use the *sinc* matlab function. Compute the sinc manually and pay attention to the ratio 0/0.

Parameters

- $x(t) = \dfrac{\sin(2\pi\, F_c\, t)}{2\pi\, F_c\, t}$
- Length of *n* = [17, 65, 257]
- $T_s = 1$ [ms]
- $F_c = 250$ [Hz]

Discretization of the sinc function

Let's consider the continuous sinc function:

$$x(t) = \frac{\sin(2\pi\, F_c\, t)}{2\pi\, F_c\, t}$$

The discretizazion can be obtained with $t = \mathrm{nT}_s$

$$x[n] = \frac{\sin(2\pi\, F_N\, n)}{2\pi\, F_N\, n}$$

where $F_N = F_c/F_s$ is the normalized frequency.

When you compute the sinc output, you must compensate the NaN value introduced by the ratio 0/0.

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 = [17, 65, 257];
Ts = 1e-3;
Fs = 1/Ts;
Fc = 250;
F_N = Fc/Fs;
```

```
```

Exercise

```
n_lim = (len(1)-1)/2;
n  = -n_lim:+n_lim;
x0 = sin(2*pi*F_N*n) ./ (2*pi*F_N*n);

n_lim = (len(2)-1)/2;
n  = -n_lim:1:+n_lim;
x1 = sin(2*pi*F_N*n) ./ (2*pi*F_N*n);

n_lim = (len(3)-1)/2;
n  = -n_lim:1:+n_lim;
x2 = sin(2*pi*F_N*n) ./ (2*pi*F_N*n);

% NaN Check
x0(isnan(x0)) = 1;
x1(isnan(x1)) = 1;
x2(isnan(x2)) = 1;
```

Plot

```
Xf_0 = fft(x0);
Xf_1 = fft(x1);
Xf_2 = fft(x2);

Xf_0 = mag2db(abs(Xf_0));
Xf_1 = mag2db(abs(Xf_1));
Xf_2 = mag2db(abs(Xf_2));

f_ax_0 = (0:length(Xf_0)-1)/length(Xf_0) * Fs;
f_ax_1 = (0:length(Xf_1)-1)/length(Xf_1) * Fs;
f_ax_2 = (0:length(Xf_2)-1)/length(Xf_2) * Fs;

figure
subplot(3,1,1)
  plot(f_ax_0,Xf_0)
  grid on
  xlabel('Frequency [Hz]')
  ylabel('Amplitude [dB]')
subplot(3,1,2)
  plot(f_ax_1,Xf_1)
  grid on
  xlabel('Frequency [Hz]')
  ylabel('Amplitude [dB]')
subplot(3,1,3)
  plot(f_ax_2,Xf_2)
  grid on
```

```
xlabel('Frequency [Hz]')
ylabel('Amplitude [dB]')
```