University of Brasília

Electrical Engineering Department

Topics in Biomedical Engineering

Exercise 3.17 - Semmlow

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Contents

1 Exercises

1.1 Exercise 3.17:

The MATLAB's code:

```
% exercise 3.17 - Semmlow
clc; close all; clear all;

load short.mat % variable x -¿ 32 points
fs = 1; % sampling frequency
N = length(x); % number of points
f = (0:N-1)*(fs/N); % frequency axis without zero
    padding

N2 = 256; % number points 0 (zero padding)
f2 = (0:N2-1)*(fs/N2); % frequency axis w/ zero padding

X_fft = fft(x); % fft
X_mag = (2/N)*abs(X_fft(1:N/2)); % fft normalized mag

X_fft_zp = fft(x,N2); % w/ zero padding fft
X_mag_zp = (2/N)*abs(X_fft_zp(1:N2/2)); % w/  zero
    padding fft mag

subplot(2,1,1);
plot(f(1:N/2), X_mag, 'b', 'linewidth', 2, 'DisplayName
    ', 'No padding'); % fft mag
set(gca, 'xlim', [0 0.5], 'ylim', [0 0.06]);
xlabel('Frequency (Hz)');
ylabel('Amplitude');
legend('Orientation','vertical','Box','on','Location','
    southoutside');
grid on;

subplot(2,1,2);
plot(f2(1:N2/2), X_mag_zp, 'k', 'linewidth', 2, '
    DisplayName', '256 padding'); % w/ zero padding fft
    mag
set(gca, 'xlim', [0 0.5], 'ylim', [0 0.06]);
```

```
29 xlabel('Frequency (Hz)');
30 ylabel('Amplitude');
31 legend('Orientation','vertical','Box','on','Location','
       southoutside');
32 grid on;
33
34 sgtitle('Zero Padding Effect', 'Interpreter', 'latex');
35 saveas(gcf, sprintf('%s.png', mfilename)); % save image
```

According to the Figure 1, it's possible to note the interpolation effect provided by zero padding. The blue curve, that is a very short signal with 32 samples, is more abrupt in your way because the MATLAB provides a straight line between the points of the array. In contrast, when is used a zero padding of 256 samples, the black curve turns smoother as a result of the interpolation. It's important to mention that this zero padding interpolation don't add new information to the signal neither generates a better resolution of the signal, but only gets a better spectrum visualization.

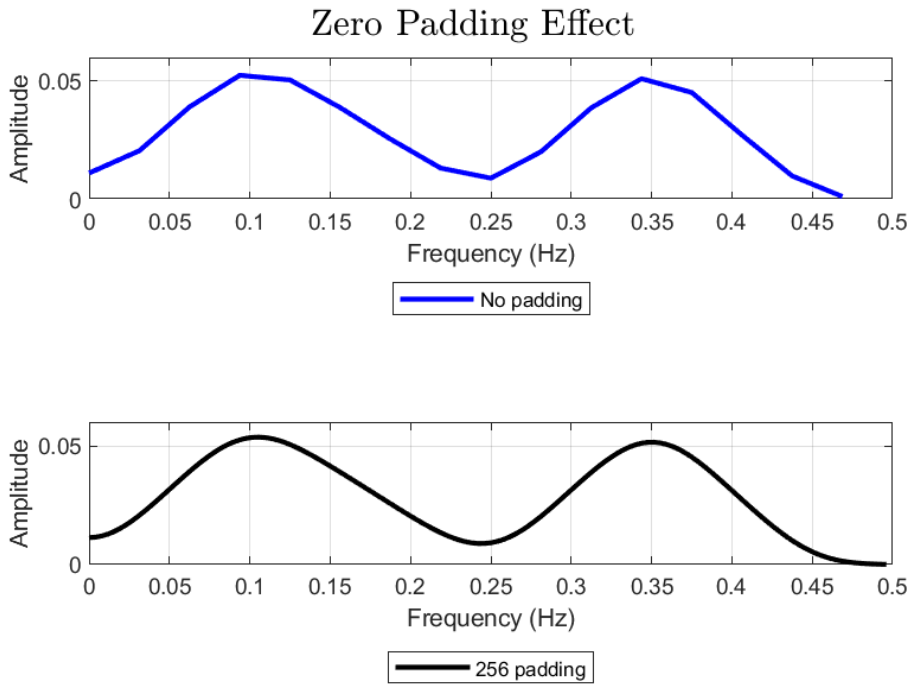

Figure 1: Zero Padding Effect