University of Brasília

Electrical Engineering Department

Topics in Biomedical Engineering

Exercise 3.28 - Semmlow

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Contents

1 Exercises

1.1 Exercise 3.28:

The MATLAB's code:

```
% exercise 3.28 - Semmlow
clc; close all; clear all;

fs = 1e3; % sampling frequency
samples = [64,512]; % array of samples
windows = 'Rectangular  Blackman Hamming';
windows = string(split(windows)'); % windowed filter
    names
pos = 1; % counter used in for loop to plot

for N = samples
    [s, t] = sig_noise([200,300], -4, N); % signal with
        noise
    filters = [ones(1,N); blackman(N)'; hamming(N)']; %
        filters functions
    f = (0:N-1)*(fs/N); % frequency axis

    for i = 1:3
        subplot(2, 3, pos);
        sf = s.*filters(i,:); % appling filter
        S_mag = fft(sf); % fft
        S_mag = (2/N)*abs(S_mag(1:N/2)); % fft
            normalized mag
        plot(f(1:N/2), S_mag, 'linewidth', 1.1); % only
            positive freqs plot
        xlabel('Frequency (Hz)');
        ylabel('Magnitude Spectrum');
        grid on;
        title(sprintf('%s | N = %d', windows(i), N));
        pos = pos + 1; % ++counter to subplot
    end
end

sgtitle('Comparison of windowed filters w/ N = [64, 512
```

```
    ]', 'Interpreter', 'latex');
saveas(gcf, sprintf('%s.png', mfilename)); % save image
```

According to the Figure 1, it's notorious the difference between 64 and 512 samples in the three types of windows applied to the signal. The 512-samples has a better resolution of the signal spectrum and of the existing frequencies than the 64-samples, this better resolution happens because de sampling frequency is constant and only N changes (Equation 1) and generates a smaller step, f_i, between the N points. The difference of the plotted magnitude spectra of the three windowed filters is slightly, there's only a quite difference between the amplitude value and some points, but certainly there's a difference. The windowed filters (Rectangular, Hamming and Blackman) have their own particularities and the most appropriate varies according to the situation.

$$f_{axis} = (0 : N-1) \cdot f_i, \quad f_i = \frac{f_s}{N} \tag{1}$$

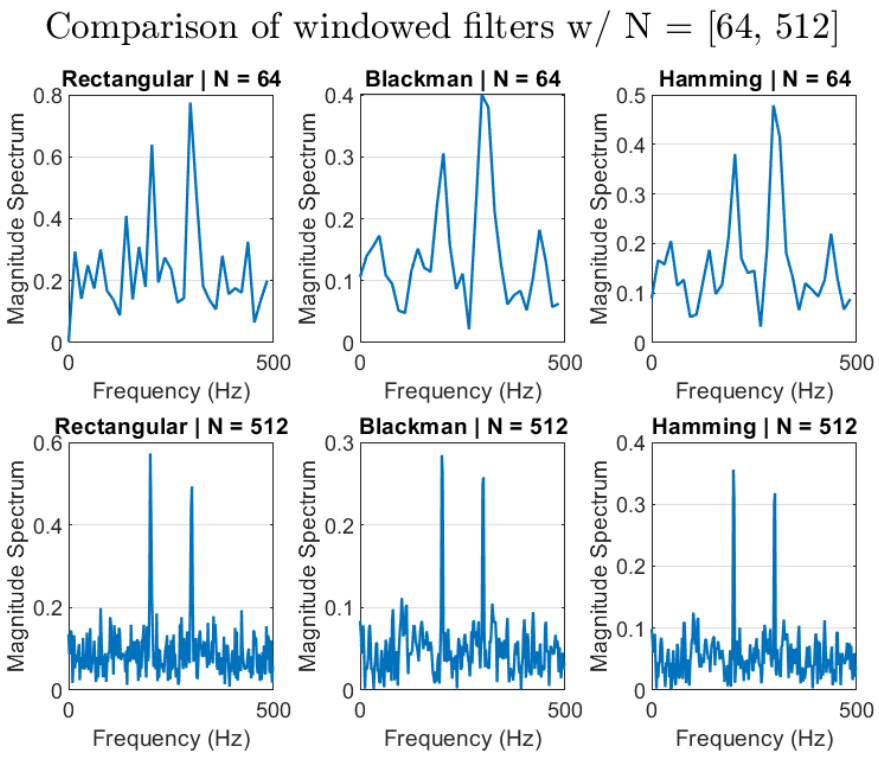

Figure 1: Comparison of windowed filters with different values of N