University of Brasília

Electrical Engineering Department

Topics in Biomedical Engineering

Exercise 3.29 - Semmlow

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Contents

1 Exercises

1.1 Exercise 3.29:

The MATLAB's code:

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

fs = 1e3; % sampling frequency
N = 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 fig = 1:3
    [s, t] = sig_noise([280,300], -10, 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(3, 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 = 512', '
```

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

According to the Figure 1, it's possible to visualize a signal that contains a combination of 280 and 300 Hz sine-waves with SNR of -10 dB. Despite the three plots, it's notorious the good compromise, in terms of power spectrum representation, of Hamming window between the Rectangular window and the Blackman-Harris window. In the measuring window process, it's necessary to take into account the primary and the secondary lobes of the power spectra. The Hamming window is, definitely, a good approach with the primary and secondary lobes with an intermediate view. In the biomedical context, the Hamming window is widely used, because, in this field of study, obtaining a range of frequencies (such as 0.05 to 0.15 Hz) that expresses a global behavior in the HRV is more important than obtaining a specific frequency.

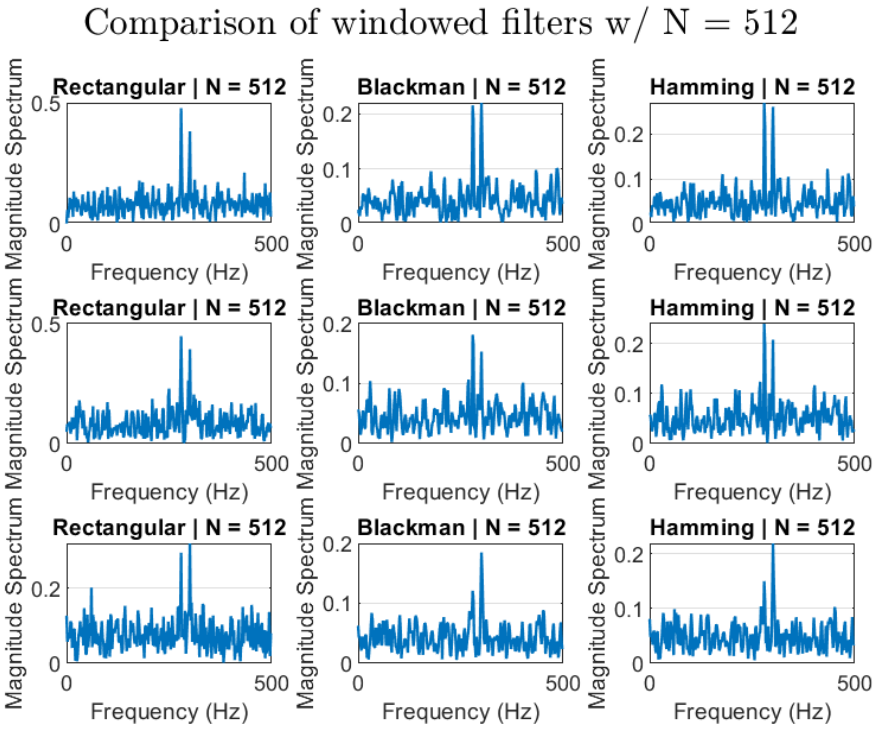

Figure 1: Three comparisons of windowns with N=512