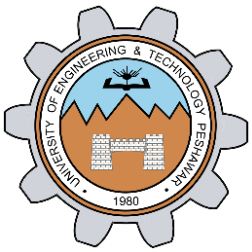
SPECTRAL ANALYSIS OF RANDOM SIGNAL USING MATLAB

LAB # 06



Fall 2023

CSE-402L

Digital Signal Processing Lab

Submitted by: **AIMAL KHAN**

Registration No.: **21PWCSE1996**

Class Section: **A**

"On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work."

Student Signature: 

Submitted to:

Dr. Yasir Saleem Afridi.

Tuesday, December 5, 2023

Department of Computer Systems Engineering

University of Engineering and Technology, Peshawar

CSE 402L: Digital Signal Processing

Demonstration of Concepts	**Poor (Does not meet expectation (1))** The student failed to demonstrate a clear understanding of the assignment concepts	**Fair (Meet Expectation (2-3))** The student demonstrated a clear understanding of some of the assignment concepts	**Good (Exceeds Expectation (4-5)** The student demonstrated a clear understanding of the assignment concepts	**Score** **30%**
Accuracy	The student completed (<50%) tasks and provided MATLAB code and/or Simulink models with errors. Outputs shown are not correct in form of graphs (no labels) and/or tables along with incorrect analysis or remarks.	The student completed partial tasks (50% - <90%) with accurate MATLAB code and/or Simulink models. Correct outputs are shown in form of graphs (without labels) and/or tables along with correct analysis or remarks.	The student completed all required tasks (90%-100%) with accurate MATLAB code and/or Simulink models. Correct outputs are shown in form of labeled graphs and/or tables along with correct analysis or remarks.	**30%**
Following Directions	The student clearly failed to follow the verbal and written instructions to successfully complete the lab	The student failed to follow the some of the verbal and written instructions to successfully complete all requirements of the lab	The student followed the verbal and written instructions to successfully complete requirements of the lab	**20%**
Time Utilization	The student failed to complete even part of the lab in the allotted amount of time	The student failed to complete the entire lab in the allotted amount of time	The student completed the lab in its entirety in the allotted amount of time	**20%**

Dr. Yasir Saleem Afridi

Spectral Analysis of Random Signal Using MATLAB

Objectives:

- To find power spectral density, a measurement of energy at various frequencies.

Tasks:

Provide .m file with detailed comments

Code:

```
clc;
clear;
close all;

%% Data Generation
samples = 1000;
time = 0:1/samples:0.25;
signal = sin(2*pi*50*time) + sin(2*pi*120*time);

%% Adding Noise
% Noise standard deviation
sigma = 2;
noisySignal = signal + randn(size(time))*sigma;

%% Plotting Noisy Time Domain Signal
figure;
plot(time,noisySignal);
xlabel('Time (s)');
ylabel('Signal Amplitude');
title('Noisy Time Domain Signal');

%% Computing Discrete Fourier Transform
NOISY_SIGNAL = fft(noisySignal,251);

%% Computing Power Spectral Density
Pyy = NOISY_SIGNAL.*conj(NOISY_SIGNAL)/251;
freqAxis = 1000/251*(0:127);

%% Plotting Power Spectral Density
figure;
plot(freqAxis,10*log10(Pyy(1:128)));
xlabel('Frequency (Hz)');
ylabel('Power Spectral Density (dB)');
title('Power Spectral Density');
```

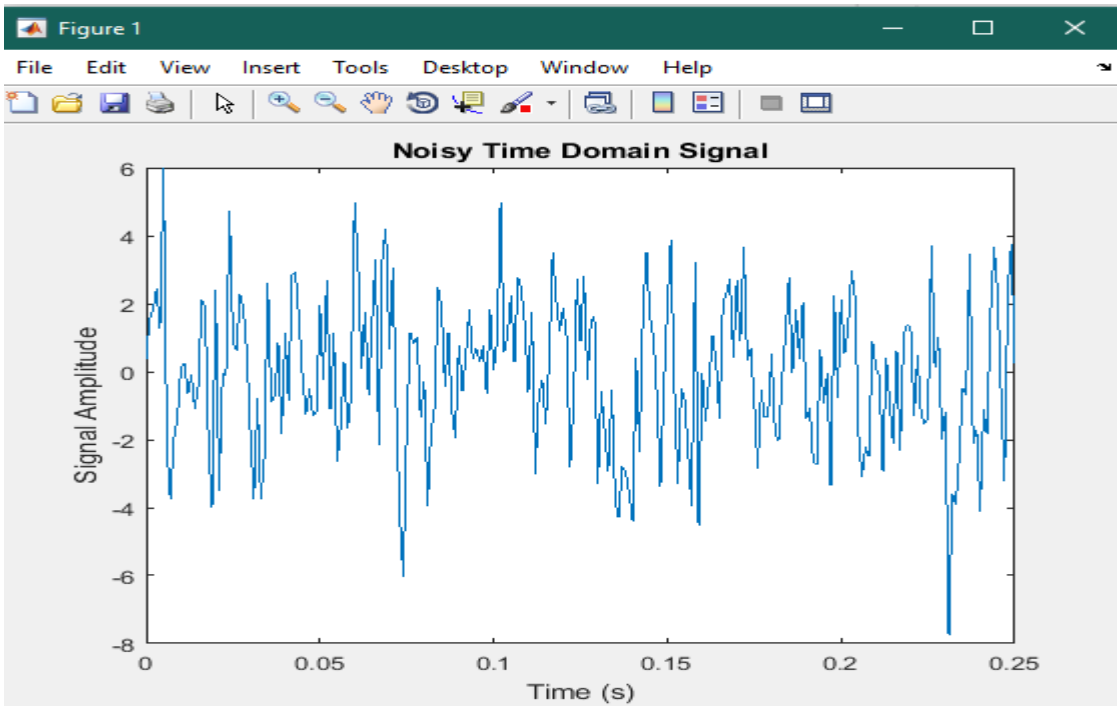
```
%% Computing and Plotting Periodogram
[Pyy2,w] =
periodogram(noisySignal,rectwin(length(noisySignal)),length(noisySig
nal), 1000);
figure;
plot(w,10*log10(Pyy2));
xlabel('Frequency (Hz)');
ylabel('Periodogram (dB)');
title('Periodogram');

%% Zooming In to Show Peaks
figure;
plot(freqAxis(1:50),Pyy(1:50));
xlabel('Frequency (Hz)');
ylabel('Power Spectral Density (dB)');
title('Zoomed-In Power Spectral Density');
```

Step 1: First create some data. Consider data sampled at 1000 samples/sec. Start by forming a time axis for the data, running from t=0 until t=.25 in steps of 1 millisecond. Then form a signal, x, containing sine waves at 50 Hz and 120 Hz.

(Hint: x = sin(2*pi*50*t) + sin(2*pi*120*t

Step 2: Add some random noise with a standard deviation of 2 to produce a noisy signal y. Take a look at this noisy signal y by plotting it. (Hint: y = x + randn(size(t));)

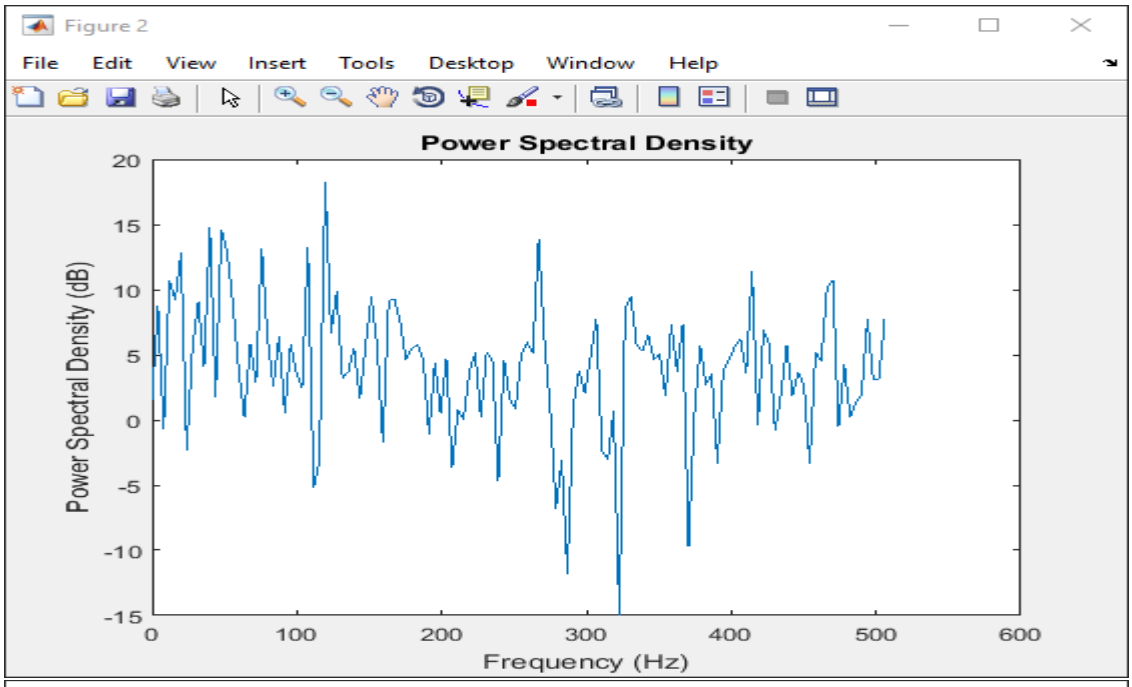
Output:

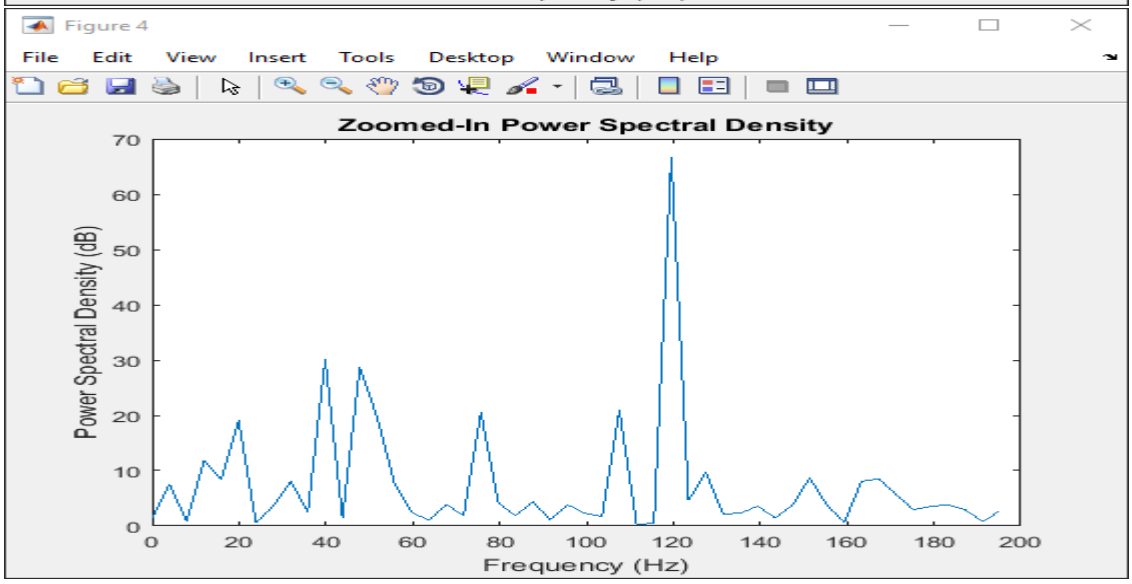


Step 3: Finding the discrete Fourier transform of the noisy signal y (Hint: Y = fft(y,251);)

Step 4: Compute the power spectral density, a measurement of the energy at various frequencies, using the complex conjugate (CONJ). Form a frequency axis for the first 127 points and use it to plot the result. (Hint: Pyy = Y.*conj(Y)/251; f = 1000/251*(0:127);)

Output:

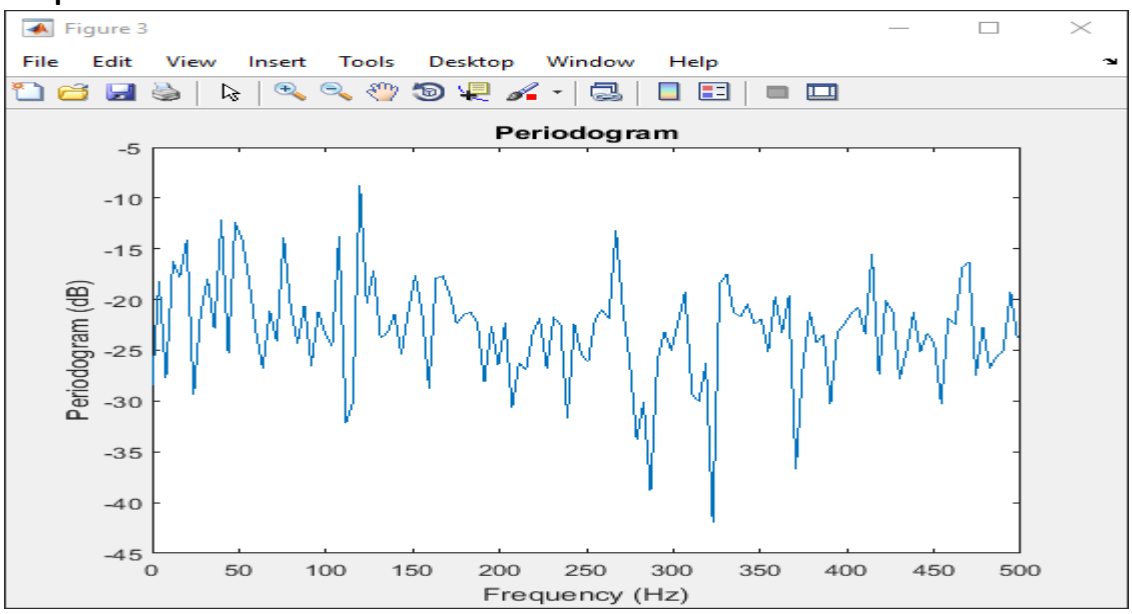




Step 5: Compute and plot the periodogram using periodogram. Show that the two results are identical.

```
[Pyy2,w] = periodogram(y,rectwin(length(y)),length(y),1000)
figure;
plot(w,10*log10(Pyy2))
```

Output:



Reference:

To view my codes, please refer to my GitHub account.

Conclusion:

In conclusion, I have learned how to create periodogram and power spectral densities of signals in matlab.

The End.