INSTITUTO TECNOLÓGICO DE ESTUDIOS

SUPERIORES DE MONTERREY

Analysis of Signals and Systems (Group 01)

Voice Recognition Password – Part 1.

Professor: Leyre Azpilicueta

Team members:

- Héctor Pequeño A01246364

-Isabella Dubón A00824441

-Mauricio Aguilar A01351310

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Objectives

o Record, play, watch, and analyze audio signals.

o Use the Fourier Transform as an analysis tool to help people.

o Familiarize yourself with Matlab and its graphical environment GUIDE.

Exercises

1.- Create a Matlab routine which permits to the user:

a. Using a sampling frequency of 8KHz, record four different words that we want to analyze. You can choose the words you want, and the recording can be of 1 second or several seconds. These words are going to serve as a voice password, so you can think in simple words which are not easy to detect.

• You can use the routine "audiorecorder", looking for the help in Matlab. Use only one channel and 8bits/sample.

b. Using the routine "espectro.m" given in Blackboard, plot the magnitude of the Fourier Transform in dB of each recorded word. In the routine "espectro.m" you will have to identify if the correct units appear in the graphs or if you have to modify the routine to obtain the correct units (dB).

• The routine "espectro.m" given, plots the square of the magnitude of the Fourier Transform versus the frequency in Hz. The input parameters of the routine are the Signals & Systems Analysis – Project#2 3 signal we want to analyze and the sampling frequency.

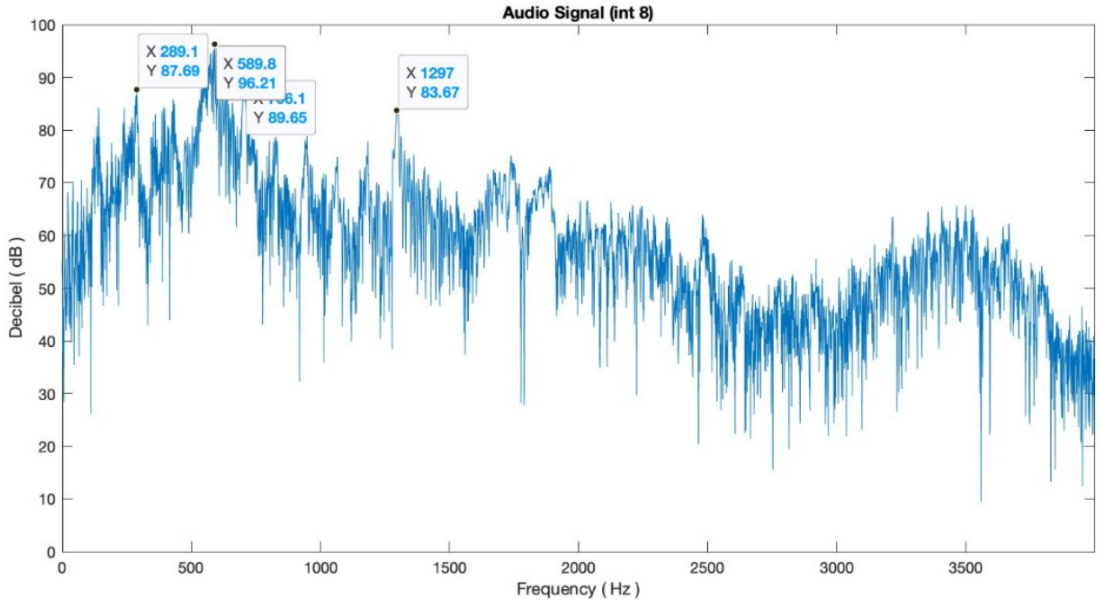
• Do not forget to upload the new version of the routine if you have made any changes in the routine.

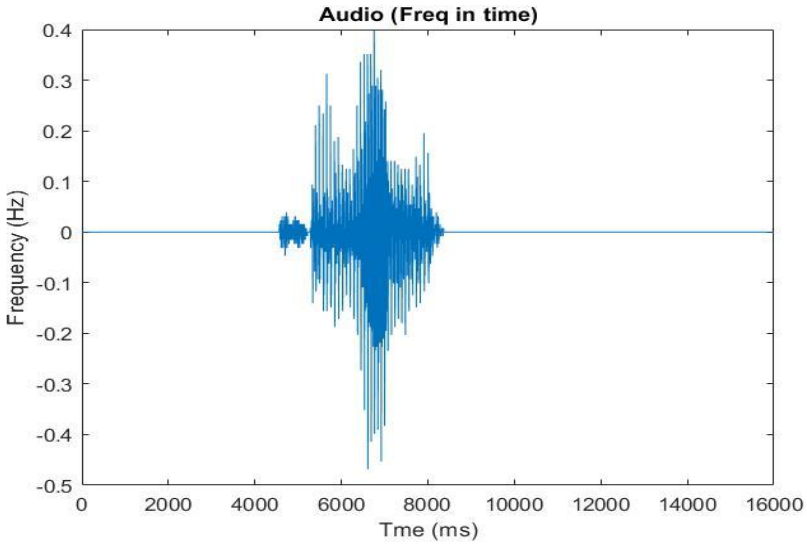
c. Analyzing the magnitude of the plots of the Fourier Transform of each recorded signal (each different word), determine the value of the frequency with the highest magnitude of each sound and put them in a table.

1. First sound: “Isabella”

Fundamental Frequency = F_{left} - F_{right} = 589.8 - 289.1 = 300.7

Harmonic	Amplitude (dB)	Frequency (Hz)
1	95	300.7
2	84	601.4
3	80	902.1
4	79	1202.8

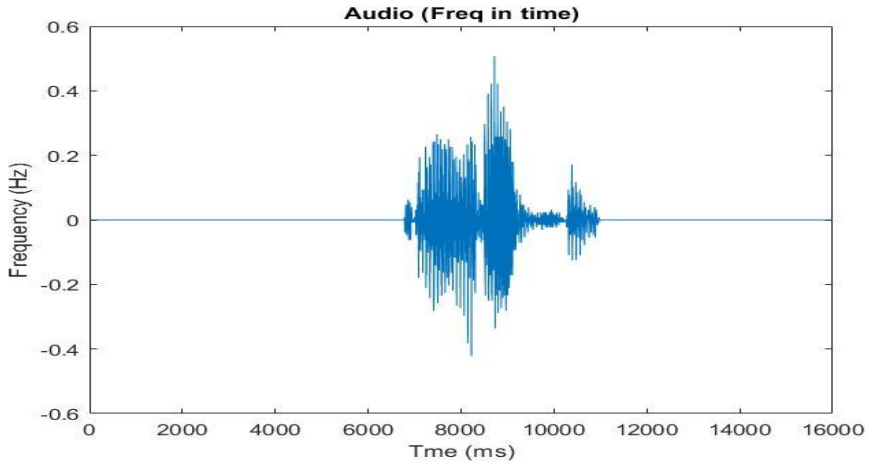


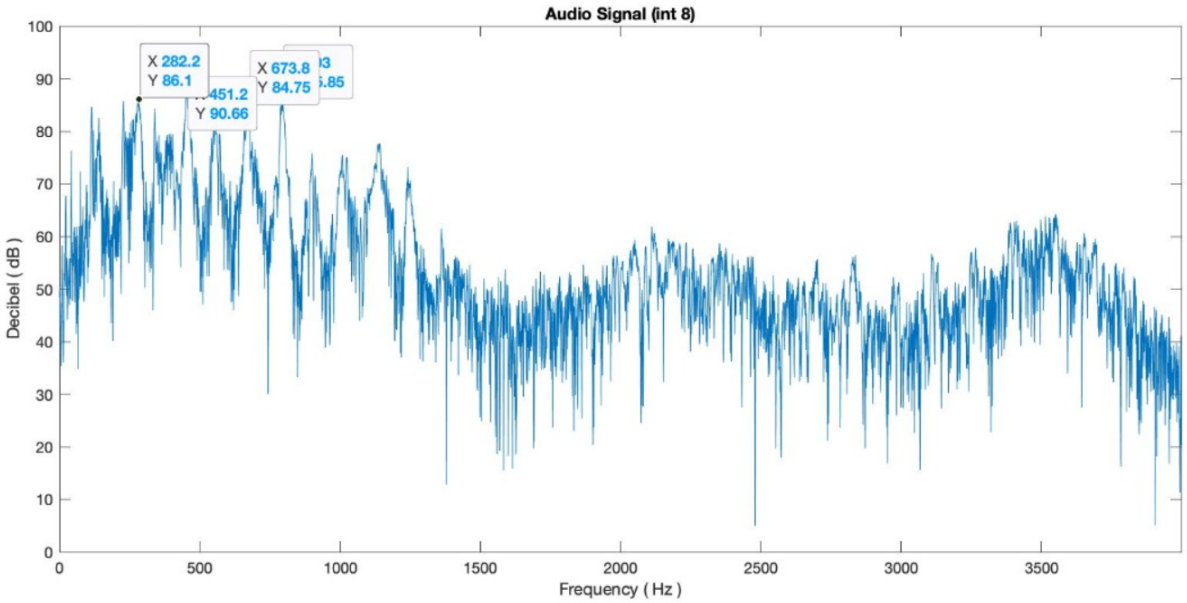


2. Second sound: “Mauricio”

Fundamental Frequency = F_{left} - F_{right} = 451.2 - 282.2 = 162.12

Harmonic	Amplitude (dB)	Frequency (Hz)
1	85	162.12
2	82	324.24
3	78	486.36
4	88	648.48

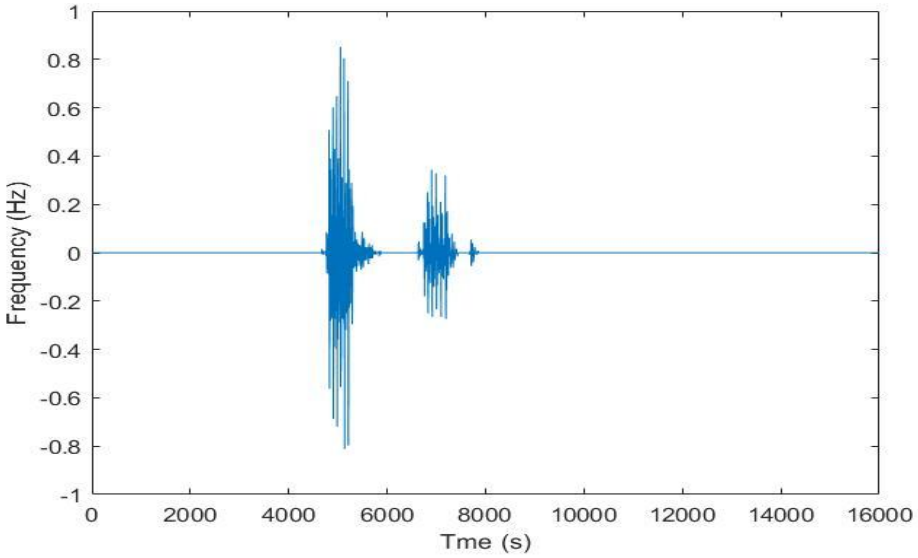


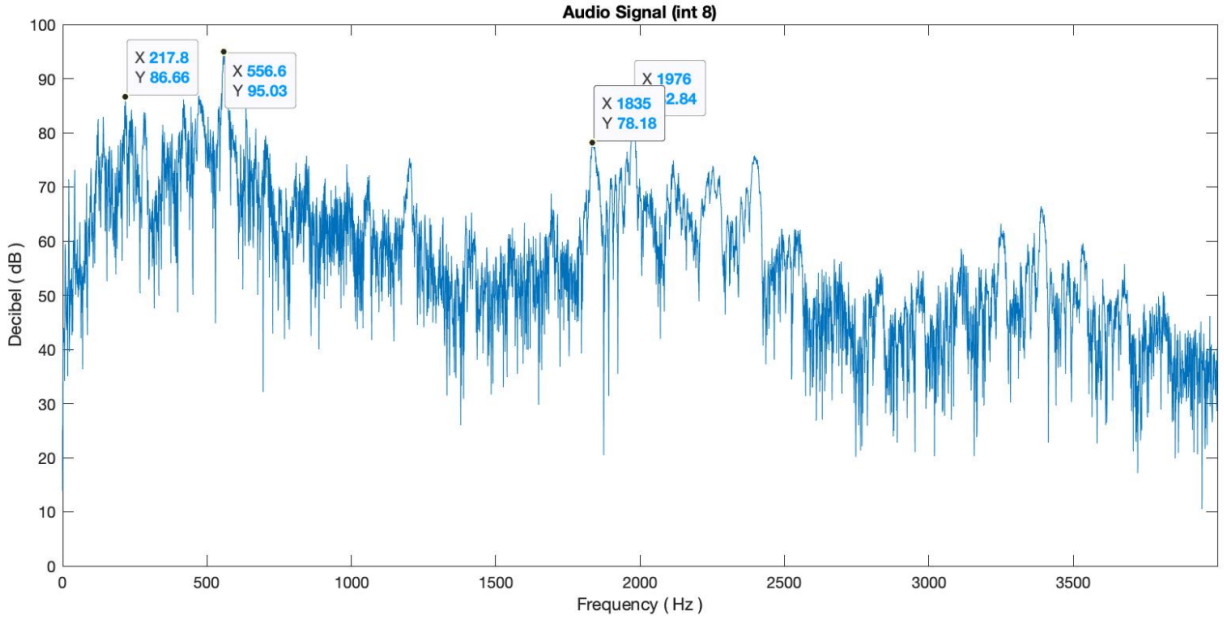


3. Third sound: “Hector”

Fundamental Frequency = F_{left} - F_{right} = 556.6 - 217.8 = 338.7

Harmonic	Amplitude (dB)	Frequency (Hz)
1	86	338.7
2	82	677.4
3	63	1,016.1
4	54	1,354.8

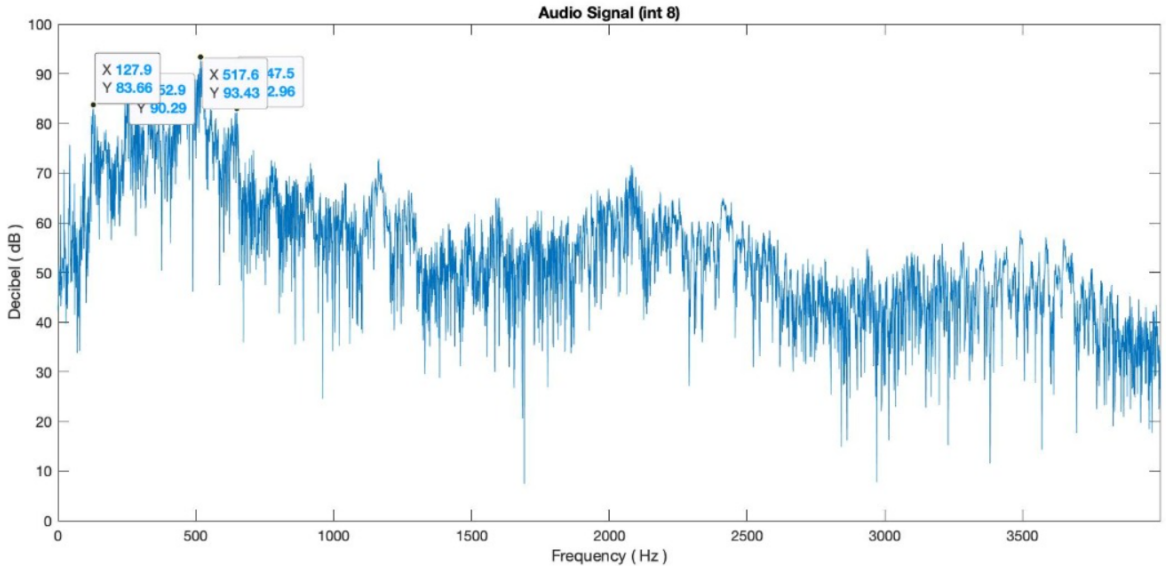


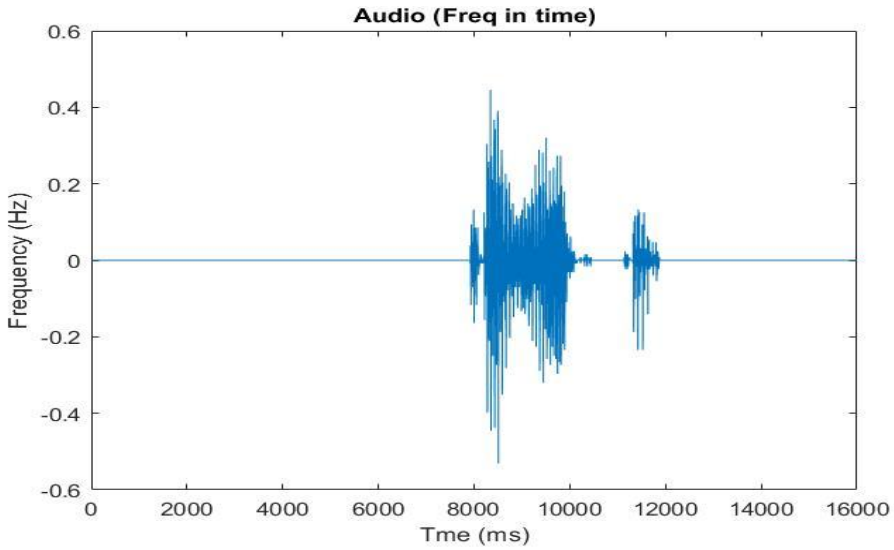


4. Fourth sound: “Proyecto”

Fundamental Frequency = F_{left} - F_{right} = 352.9 - 127.9 = 225

Harmonic	Amplitude (dB)	Frequency (Hz)
1	77	225
2	86	450
3	73	675
4	64	900





d. Repeat the experiment for all the members of your group. Do not forget to label all the axes with the corresponding units in all your graphs. In the routine “espectro.m” you will have to add the units in dB if they do not appear in the graphs.

e. For each recorded sound, incorporate in the report the time and frequency graph, for each member of the group.

f. Plot the results in four different graphs (different words versus the fundamental frequency). (Do not forget to label all the axes with the corresponding units because this graph is the most important data to be analyzed later).

g. Repeat the points a) to c) but with higher and lower sampling frequency. What are the differences in the frequency with the highest magnitude or the fundamental frequency? What can you conclude about the sampling frequency? How can you obtain the best sampling frequency? Explain with your own words with a reasoned criterion.

h. What can you conclude about the different sounds you have chosen and the results you have obtained? Explain with your own words with a reasoned criterion.

3.- Create a Matlab routine which permits the user to know the fundamental frequency of each one of the words you have recorded.

4.- Explain with your own words the conclusions you can obtain from the results of this Project. Undoubtedly, the study of signals is indispensable for the development of real world applications such as this one that helps people with motor disabilities or simply makes life easier through a new tool that employs signals. Furthermore, we can conclude the great versatility the Matlab tool has, since we could develop a vocal tract model that could be the starting point of a more complex program that fully controls a computer by human voice. The possibilities are almost limitless. Analyzing variables such as frequency, time, decibels and employing the Fourier transform are essential to develop such program and make good use of it.