LAB 2 - OBJECTIVES

In this lab, we will study short segments of a signal in both the time and frequency domains. When examined over long time periods (e.g. seconds), the frequency spectrum of speech is very complex. However, when looked at over relatively short time periods (e.g. 25ms), speech waveforms are often nearly periodic. Thus, their frequency spectra often contain only a few dominant components. However, these dominant components change over time, as the speech sounds change.

In this lab, we will take a relatively long speech signal (2 seconds) and break it up into a number of smaller intervals, which we will call frames. We will examine the signals within different frames using the Fourier series, and the goal of this lab is to give you an idea of

1. How we can use the amplitude spectrum to visualize the distribution of the signal energy over different frequencies.

2. How this amplitude spectrum changes for different signals.

3. How nearly periodic signals can be approximated by using only a few of the most important frequency components.

To achieve the above goals you will complete four tasks:

In task 1, you will get an overview of the frequency analysis for a speech signal. We will divide the speech signal into shorter frames. We will then examine the frame with the highest power from the given signal, and see how well it can be approximated by using only the four most important frequency components as the frame length changes.

In task 2, you will work on code that splits the input signals into frames, computes the power of each frame, and extracts the frame with the highest power.

In task 3, you will use the Fourier series expansion to compare the frequency content of different frames. You will also find the most important frequency components in each frame, and extract their frequency indices, amplitudes, and phases.

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In task 4, you will approximate the waveform within one frame by using one, two and four of the most significant frequency components, which you found in task 3. We will compare the original and the approximate signal quantitatively by calculating the Normalized Mean Squared Error (**NMSE**).