EC516 Lab 3 (Fall 2016)

Due Thursday Oct 27, 2016

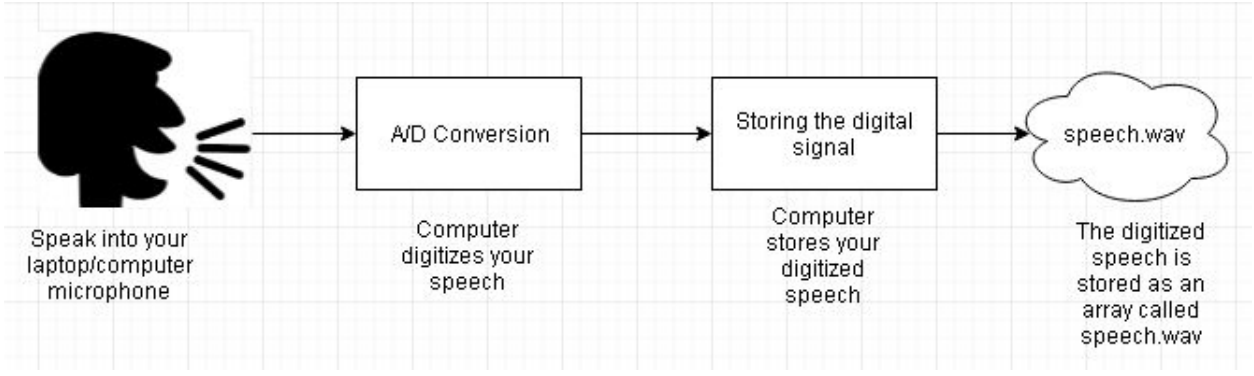
Lab 1

This lab is the third in a series of MATLAB assignments designed to explore Digital Signal Processing from an **alternative patternization** perspective and its importance in computational tasks such as **Learning, Enhancement, Authentication, Detection, Encoding, Recognition or Separation (LEADERS)**. In this particular lab assignment, you will get a sense of the patternization represented by an original speech signal and how that compares to an alternative patternization of the same speech signal. Moreover, you will see how the alternative patternization of the speech signal helps in performing the subsequent task of recognition, which is one of the components of LEADERS.

For the purpose of recognition, one of the alternative patternization is computed by passing the original speech signal through a bank of filters, known as the DFT Filter bank. A DFT filter bank consists of an array of bandpass filters, that separates the input speech signal into multiple components, each one carrying a specific frequency sub-band of the original speech signal (for example 0-300 Hz or 300-600 Hz). The energy of each of these components is considered as the alternative patternization of our original speech signal.

This lab is divided into 6 sections as described below:

a) **<u>Recording your voice(ROV):</u>**

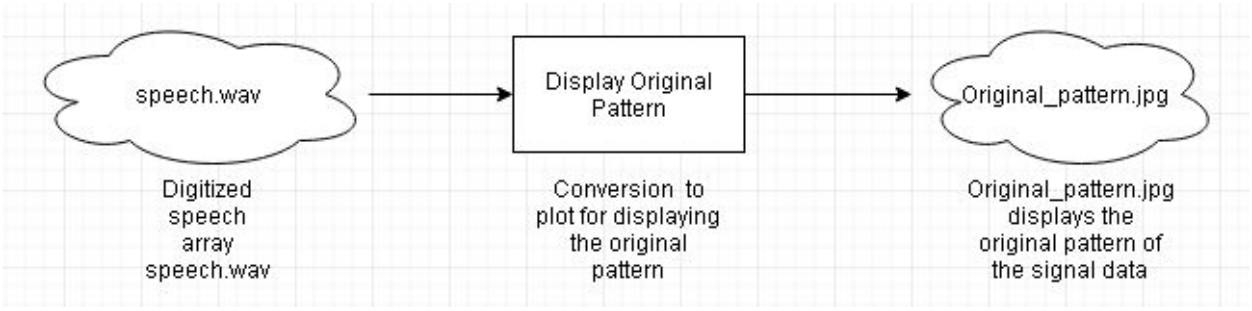


The first step is to record your voice into MATLAB using your laptop/computer microphone. Since our computer can only work on digital data, it digitizes your voice into a digital speech signal and stores it into a file named speech.wav, which is an array of real values, that form a pattern as a function of time.

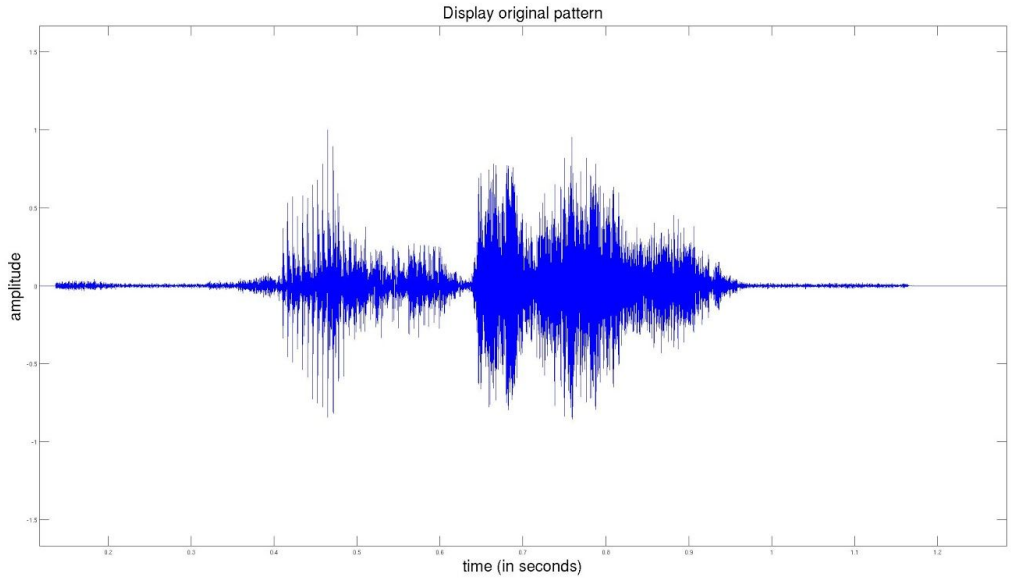
GUI Usage for ROV:

- Download and unzip EC516_Lab3.zip provided to you into your current directory in MATLAB.
- Open and run EC516_Lab3.m provided to you. This will open a GUI named 'EC516Lab3gui'.
- Click on "Start Recording" when you are ready. Speak the word "yes" or "no" into your laptop's microphone and click on "End Recording". Please make sure you do this in a quiet room. Also ensure that your laptop has a microphone and an audio outlet.
- You can now play the file by clicking on the "Play" button.
- You will see that an audio file 'speech.wav' has been created and saved in your current directory.

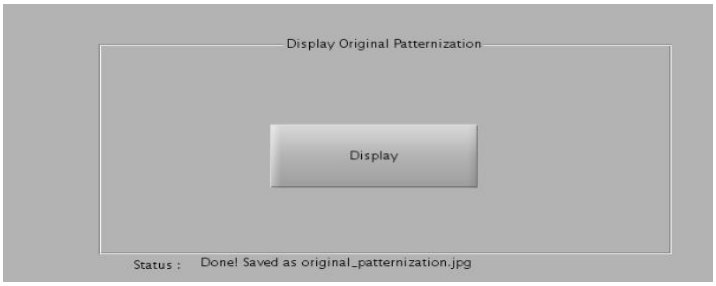
b) <u>Display Original Pattern (DOP)</u>



Now that we have stored the original pattern, we would like to display the original pattern(DOP) of our digitized speech signal (speech.wav). An example of 'original_pattern.jpg' is shown below:

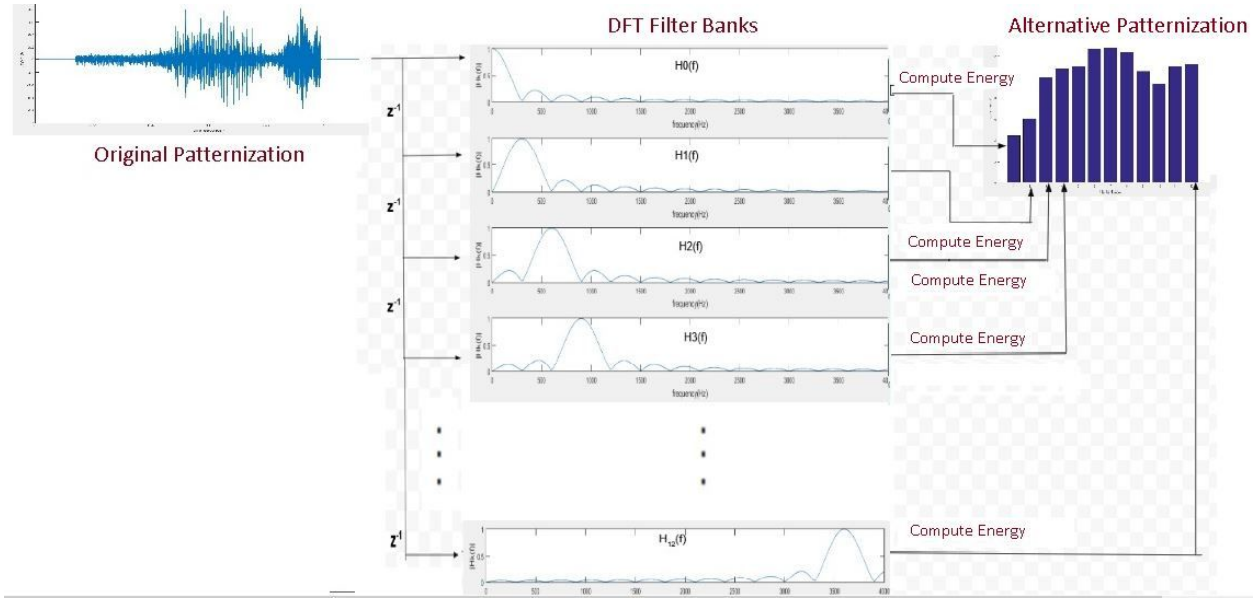


GUI Usage for DOP:



- Click on the “Display Original Pattern” button on the GUI. A plot of the original pattern pops up and this plot will be saved as “original_pattern.jpg” in your current directory.

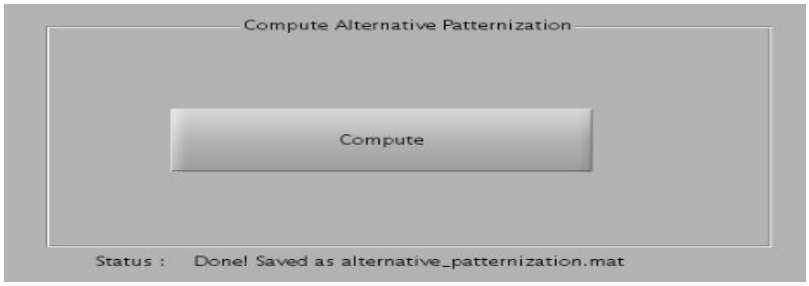
c) Compute Alternative Patternization(CAP) :



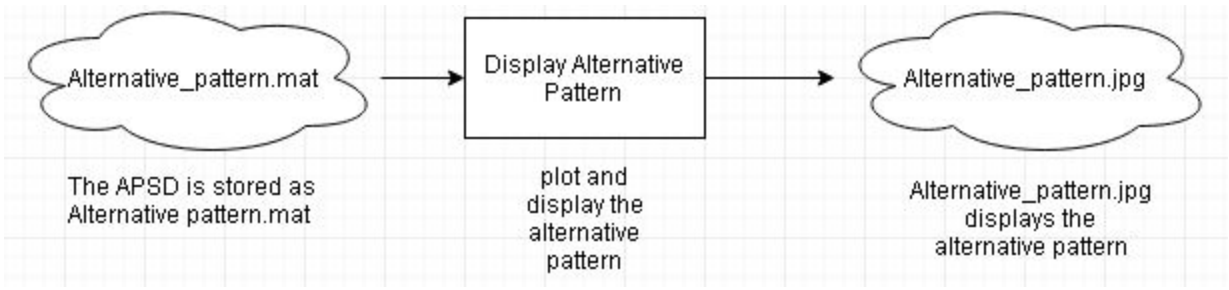
In this step we convert the Original pattern of our speech signal data into an alternative pattern. This process is known as the Alternative Patternization of Signal Data (APSD). The APSD is computed by passing the input speech signal into the DFT filter bank, which separates it into multiple components, each one carrying a specific frequency sub-band of the original speech signal. The energy of each of these components is considered as the alternative patternization of our original speech signal. .

GUI Usage for CAP:

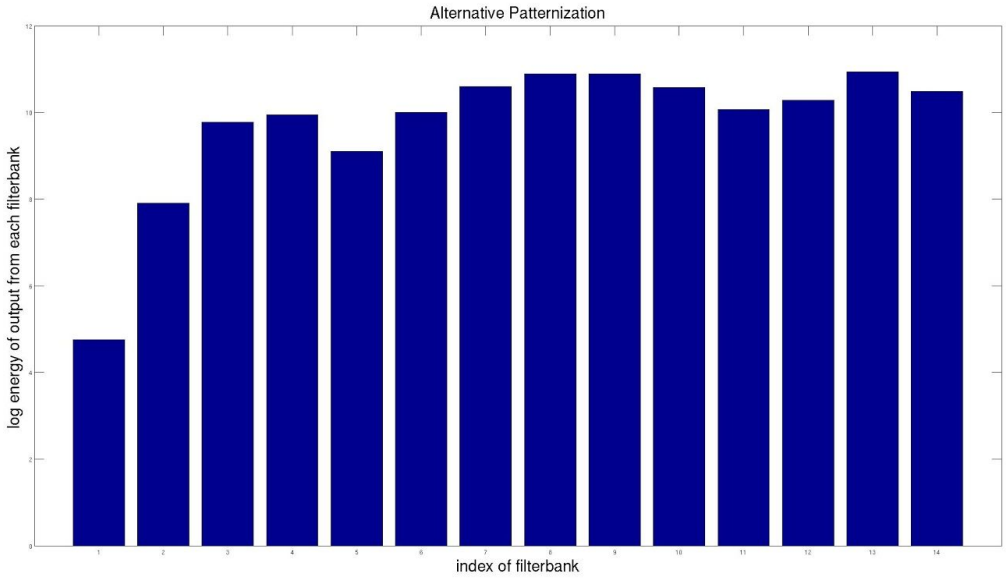
- Click on "Compute Alternative Patternization" on the GUI. You will find a new file 'Alternative_pattern.mat' created and stored in your current directory.



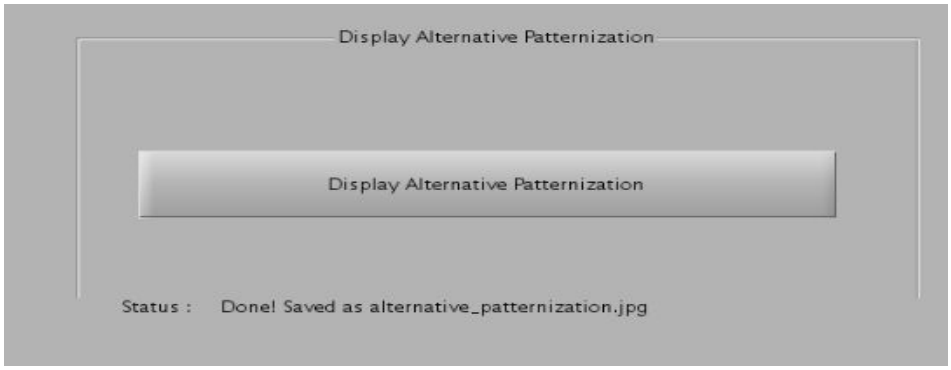
d) <u>Display Alternative Patternization(DAP):</u>



Now that we have computed an alternative pattern, we would like to display the alternative patternization of our signal data. An example of 'alternative_patternization.jpg' is shown below:

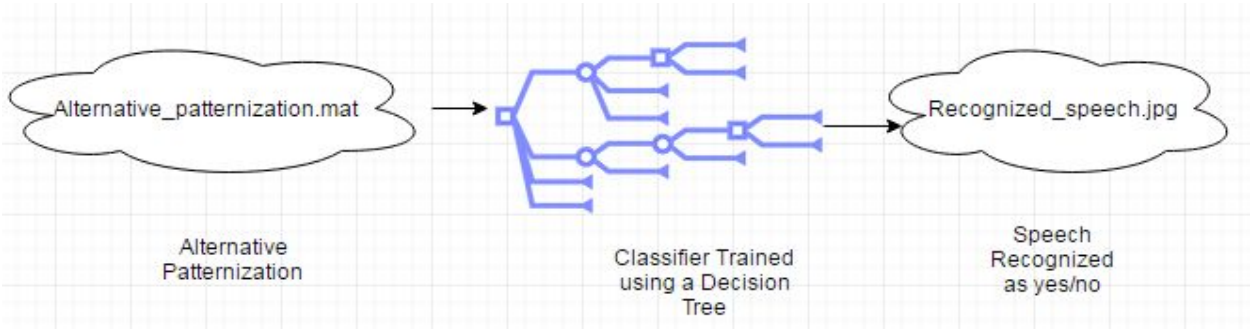


GUI Usage for DAP:



- Click on "Display Alternative Patternization" on the EC516Lab3gui.An image of the alternative patternization will be displayed and saved as 'alternative_patternization.jpg' in your current directory.

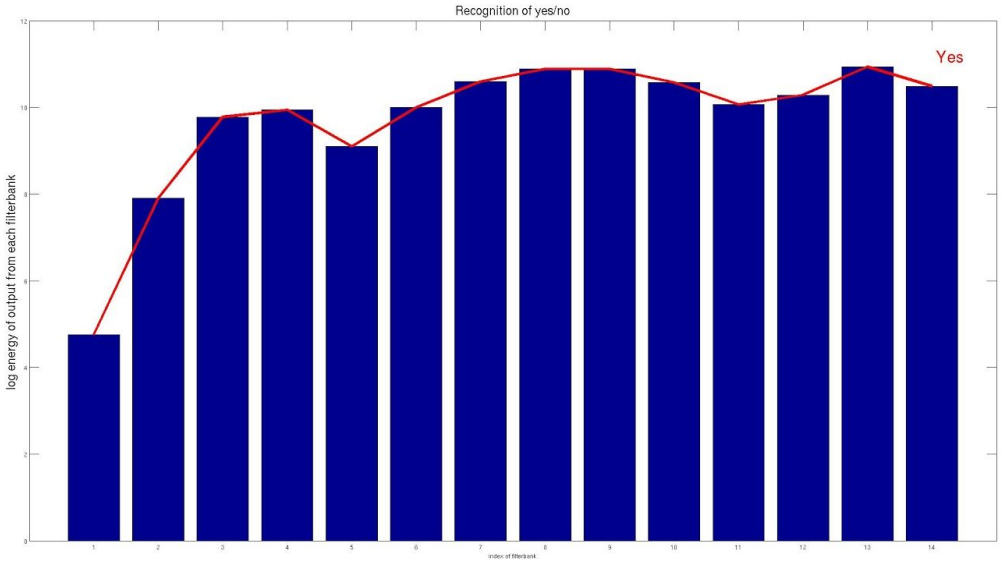
e) <u>Recognition of Yes/No:</u>



GUI Usage for Recognition:

- Click on the "Recognize Speech" button on the GUI. You will find a new file 'Recognized_speech.jpg' created and stored in your current directory.

An example of Figure 'Recognized_speech.jpg' is shown below:



Submission:

1) Perform all the steps from a) to e) for at least 5 recordings of 'yes' and 5 recordings of 'no'. Observe the alternative patternization in each case. Briefly explain the differences you observe in the alternative patternization for the recordings of 'yes' and the recordings of 'no'.
2) Print the 'Original_patternization.jpg', 'alternative_patternization.jpg' and 'recognized_speech.jpg' for any one of the recordings above.