

Lab1 : Spectrogram

Due Mar. 20, 2018

Brought to you by Yi-Wen Liu
Bang-Yin Chen
Yi-Jhe Lee

Objectives: In this lab, you will transform a wave file into a time-frequency plot. Also, the concept of windowing is also introduced. In fact, besides taking related courses, you may have already been familiar with such a format of viewing. Music scores or sheets are common examples. While sweeping a sheet from left to right, different notes or frequencies are indicated to be sung or played in different time. After finishing this task, you should understand more about the analysis of audio.

Tasking description:

1. You are given a MATLAB script to begin with. You will use given equations and functions to implement windows. Later, you are asked to implement a spectrogram using a window of different lengths.
2. Please implement at least three different kinds of windows. Here we provide three windows which are commonly used:

Rectangular window:

$$w(n) = 1$$

Hamming windows

$$w(n) = 0.54 - 0.64 \cos\left(\frac{2\pi n}{N-1}\right)$$

Hann window:

$$w(n) = 0.5 \left(1 - \cos\left(\frac{2\pi n}{N-1}\right)\right)$$

Please use the equation above to implement three different window functions (N=1001).

3. Fortunately we also have `rectwin()`, `hamming()`, and `hann()` function to carry out the work. Please use `help` to see the details. Are the functions derived from different methods the same?

4. Now, let's begin to implement the spectrogram, we have helped a little on your work. What does the figure look like if the windows do not have overlaps? How about 20%? 50%? You can also change the percentage to inspect the differences.

5. If the duration of the window is small, say 0.02 second, what will the figure look like? How about another larger number like 0.2 second? What is the difference? Why?

6. (optional) Note that we also have `spectrogram()` in Matlab. You are welcomed to get familiar with it.

Things to turn in on LMS:

Please turn in the implemented code and a PDF file. The PDF file should contain the brief answers to the questions above. (格式會再公布)

A further question leaving for you:

1. If you want to enhance the resolution in y-axis (frequency domain), what can you do? What side effects may occur?

2. When using different kinds of windows to draw the spectrogram, what differences do you notice? Explain why causes the differences and summarize how to choose a window "properly".