Lab 9

Fourier Analysis Applications

Spectral Analysis (4 points)

Matlab filename must be `exer01.m`.

Design a Matlab script that plots the spectrum of a signal as a function of time. We will begin with a sufficiently long audio signal $y[n]$. We will divide this signal into L portions $y_w^l[n]$ with $l \in [0, L-1]$, each one with a width of N_w samples. The set of portions $\{y_w^l[n]\}$ can be constructed in 2 ways. In the first case, all samples of $y[n]$ are distributed among non-overlapping portions $y_w^l[n]$ (figure 9.1 top). In the second case, adjacent portions overlap in S_w samples (figure 9.1 bottom).

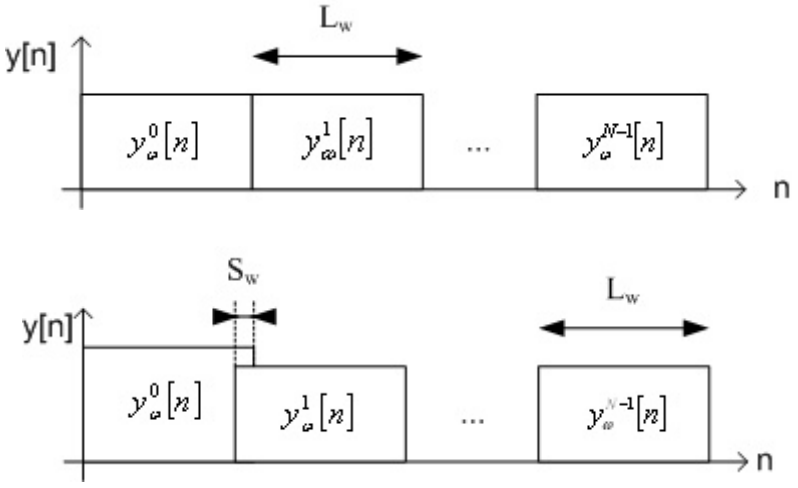

Figure 9.1: Division into disjoint blocks (top) and overlapped blocks (bottom)

Use the same audio file from a previous laboratory session to generate the audio signal for this exercise.

1. Divide signal $y[n]$ into portions $y_w^l[n]$ taking into account the portion width N_w and the overlap S_w. Apply spectral windows to each $y_w^l[n]$ portion.

2. Calculate the FFT of the processed portions of the previous step. Refer to these new portions as $Y_w^l[k]$.

3. Filter the sequence of signals $Y_w^l[k]$ along variable l so that the variation between consecutive spectra is less rapid. You can do that by applying a discrete system of the type $y[n] = \alpha \cdot y[n-1] + (1-\alpha) \cdot x[n]$ where the input signal is the $Y_w[k]$ (bear in mind that Matlab can process not only scalar but whole vectors) Use $\alpha = 0.8$.

4. Display an animation where the consecutive filtered $Y_w^l[k]$ portions are plotted rapidly in a single figure. Display only the positive frequencies of the spectrum.