Digital Signal Processing
Seminar 2

Elimination of narrowband interference (sound of clarinet) in the human voice record

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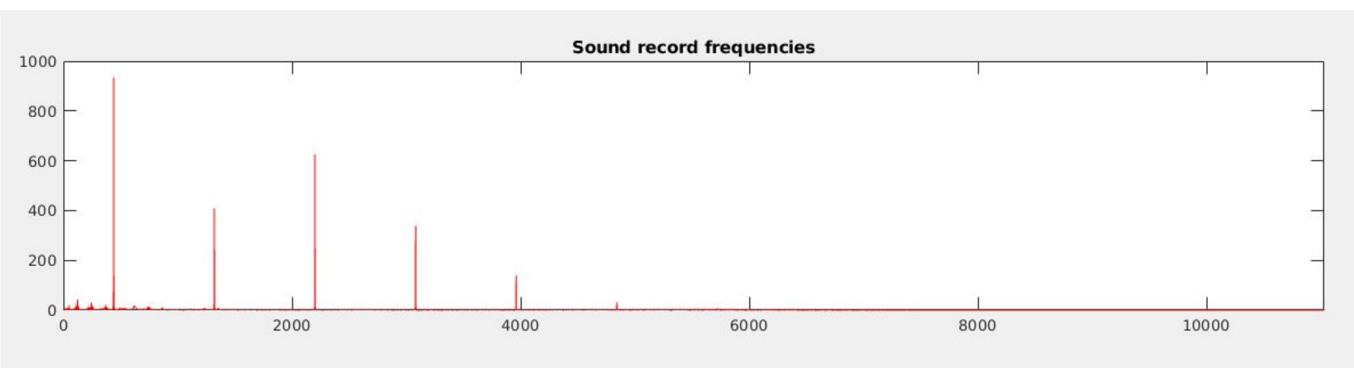
1. Introduction

The sound record '*1.danes_je_lep_dan_klarinet_22050.wav*' contains a sound of human voice and clarinet. These two signals are mixed (the clarinet sound occupies a much smaller part of the frequency spectrum) and we want to filter exactly those parts where it is located. To accomplish that a narrow bandstop filter is used. The filter also affects the frequencies of the human voice but because the range is small, after hearing we do not notice any difference.
The main goal of this seminar is to filter the sound of the clarinet as much as possible, while preserving the sound of the human voice.

2. Methods

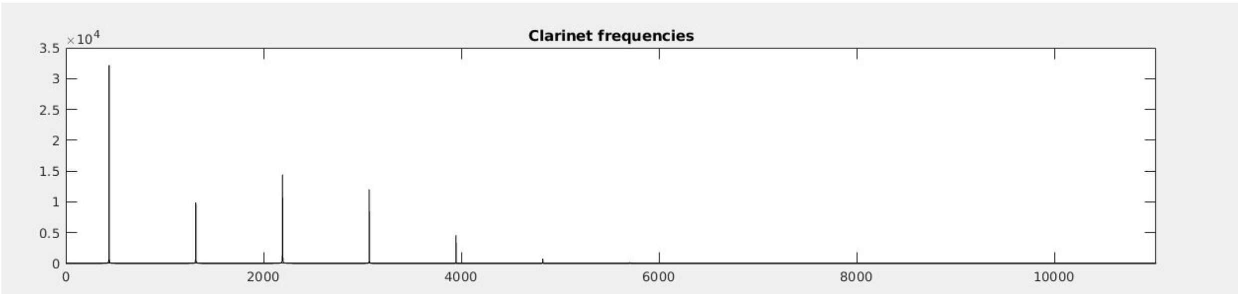
Filtering of the sound record was done using MATLAB and *bandstop* command. *'Bandstop'* takes three arguments: the signal, the bandstop interval, and the sampling frequency. To determine which frequencies belong to the clarinet and need to be filtered a Fourier transform of the signal was needed. The amplitude spectrum from the Fourier transform shows us of which frequencies the signal is composed.



Because we know that clarinet sound is synthesized using the following equation:

$$y(n) = cos(\omega * n) + 0.375 * cos(3 * \omega * n) + 0.581 * cos(5 * \omega * n) + 0.382 * cos(7 * \omega * n) + \\ + 0.141 * cos(9 * \omega * n) + 0.028 * cos(11 * \omega * n) + 0.009 * cos(13 * \omega * n),$$

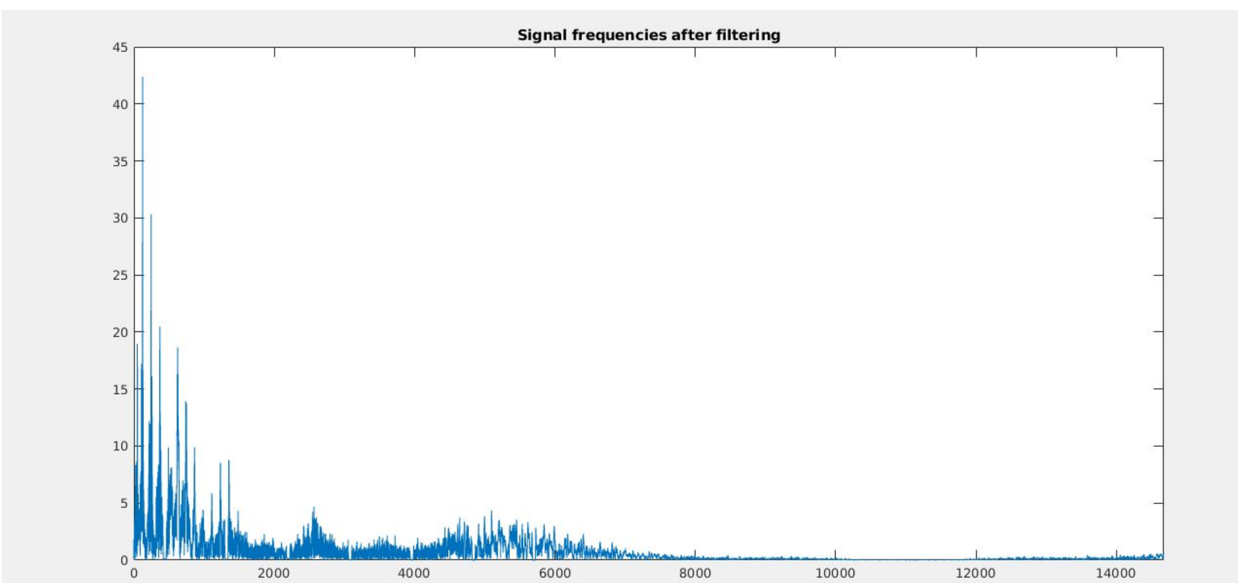
We generate a signal with the base frequency of 438.5 Hz(the one with the highest amplitude, and get the following amplitude spectrum.



After we double-checked we know which frequencies belong to the clarinet, and we filter them in the range [frequency - 25, frequency + 25]. Filters are applied serially one after another.

3. Results

After filtering the output is written in ‘filtered.wav’ file. The Best results were accomplished with bandwidth +/- 25 of the clarinet frequency, if the number was lower, we could still hear the clarinet and, if the range was longer the human voice sounded muffled. On the whole the filter works good and only a small artefact from a clarinet is left unfiltered.



4. Discussion

As mentioned above, after filtering we could still hear a quiet clarinet sound, this can be avoided by using a different command that helps us modify the transition band and lower the stop band riffle, so no clarinet sound is heard.