CRYING REMOVING

# Learning features on crying sections

Before removing the ‘Crying segments’ (CSs), the first step involves differentiating them from the ‘Non-Crying segments’ (NCSs). This is done by supervised learning, using the 37 labeled signals from the current database. The learning phase will enable to determine one or more characteristics differentiating the CSss and NCS, so that an automatically CS detection can be computed. It will be useful when other recordings will be done, enlarging the database.

The labeling of the raw signals, the determination of the characteristics to be used and the K-fold Cross Validation are the three necessary phases before the CSs can be removed.

## Labelling the crying sections thanks to annotators

The first step was to label the signals with CSs and NCSs. This was done by 3 annotators on the entire signal basis. Independently, Lindsay, Arrabella and I listened to the different samples and annotated them on Audacity. The labels were extracted as text files.

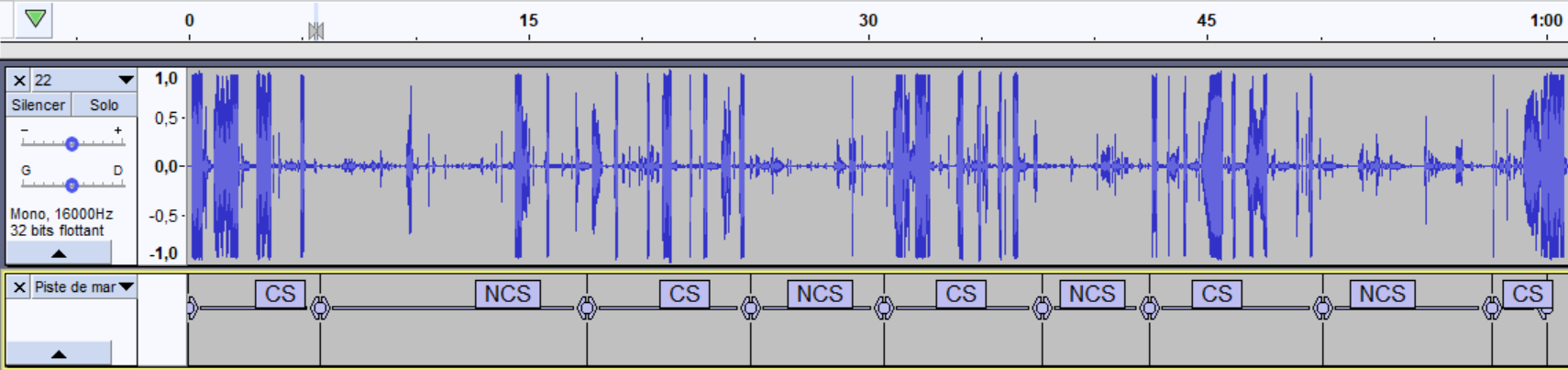


Figure 4: Julie's annotations of signal 22 on Audacity

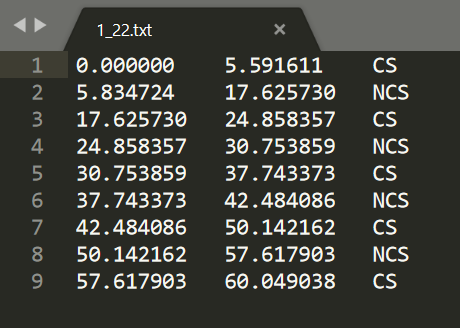


Figure 1: Text file generated by Audacity after Julie's annotations on signal 22

Each text file follows a strict name structure: ObersatorID\_SampleID.txt. Every line corresponds to a CS or NCS, with the beginning and end time of the section (cf figure 5).

These files are read one by one in MATLAB, with the aim of creating a vector of 0 and 1, respectively corresponding to the NCSs and CSs labels. A moving average with a 1-second window and a 25% overlap was applied. The window was chosen based on the duration of CS, which is often 1 second or more.

The level of agreement between the annotators was then measured on each signal using Fleiss’ KAPPA. It is a statistical measure which assesses the [reliability of agreement](https://en.wikipedia.org/wiki/Inter-rater_reliability) between a fixed number of raters when assigning [categorical ratings](https://en.wikipedia.org/wiki/Categorical_rating) to a number of items[[1]](#endnote-1). In the project, three raters (Arabella, Lindsay and I), two categorical ratings (CS/NCS) and sixty items (60 sections of 1 second) were used to find a Fleiss’ KAPPA coefficient for each signal. A KAPPA coefficient equal to 0 means no agreement, while 1 means perfect agreement. The detailed calculation of this coefficient can be seen in annex … . It was implemented on Matlab using a function in the Matlab File Exchange [[2]](#endnote-2) . Mettre sa valeur ici?

Finally, each CS with a 2/3 or 3/3 agreement have been retained. The figure 5 illustrates the final annotated labels of signal 22.

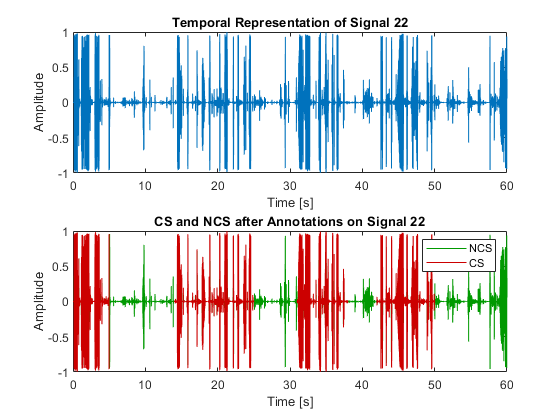


Figure 5: Annotated CS and NCS of Signal 22

## Analysis of differences between CS and NCS

Once the theoretical labeling of the signals has been done, it is necessary to learn how to detect CSs. In order to know which characteristics will be most appropriate for the detection of CSs, a first study has been done. It is based on box plots illustrating the differences between NCSs and CSs on common signal processing characteristics. Power spectrum features as well as MFCC coefficients and LPC coefficients are analyzed (figures ..)

METTRE FIGURES

Spectrograms of some signal parts where crying is present are also generated to compare the frequency differences between NCS and CS. To do so, a small window length was used to have a good time resolution (window=1s, overlap=25%). The spectrogram of the first 15s of signal 22 is in the figure .. below.

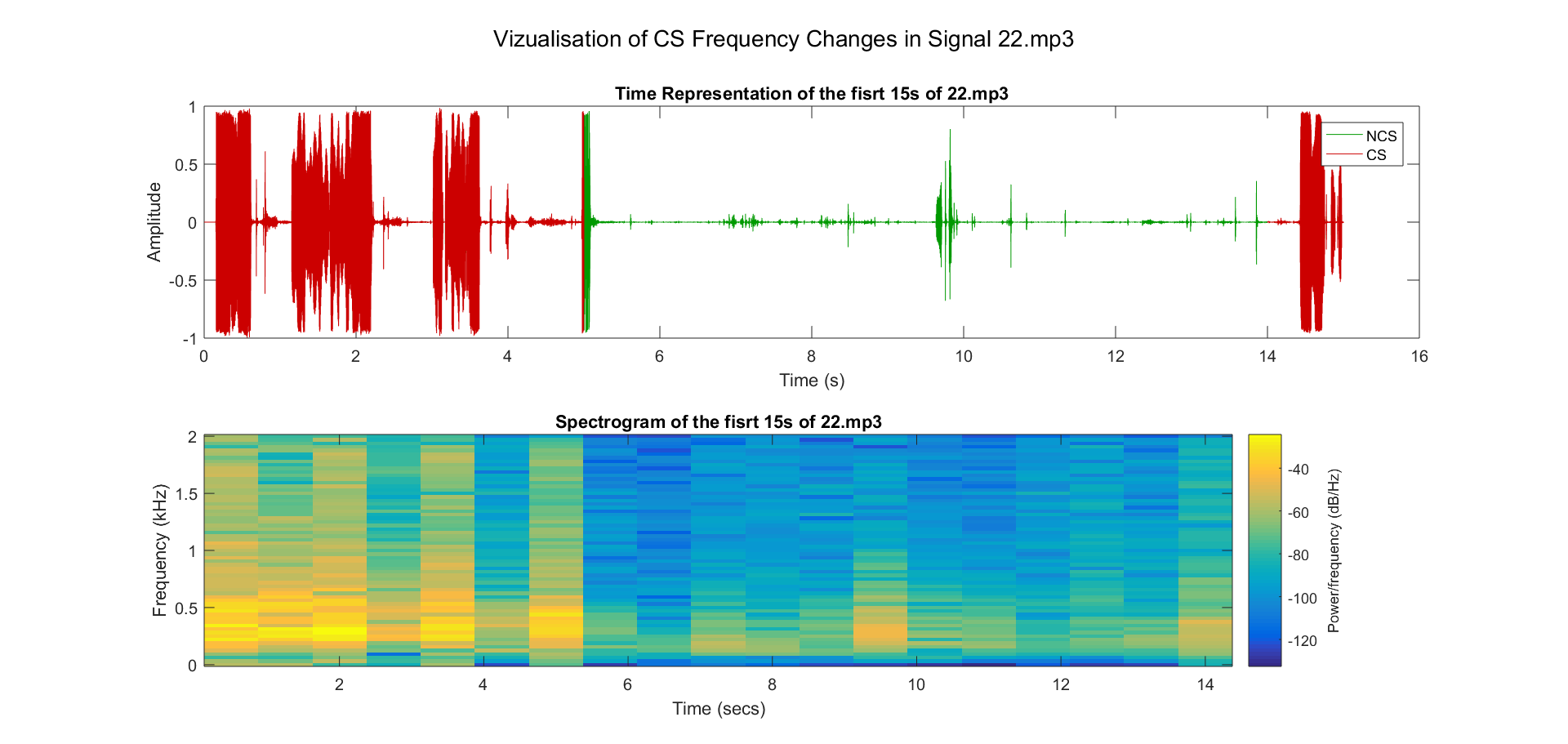
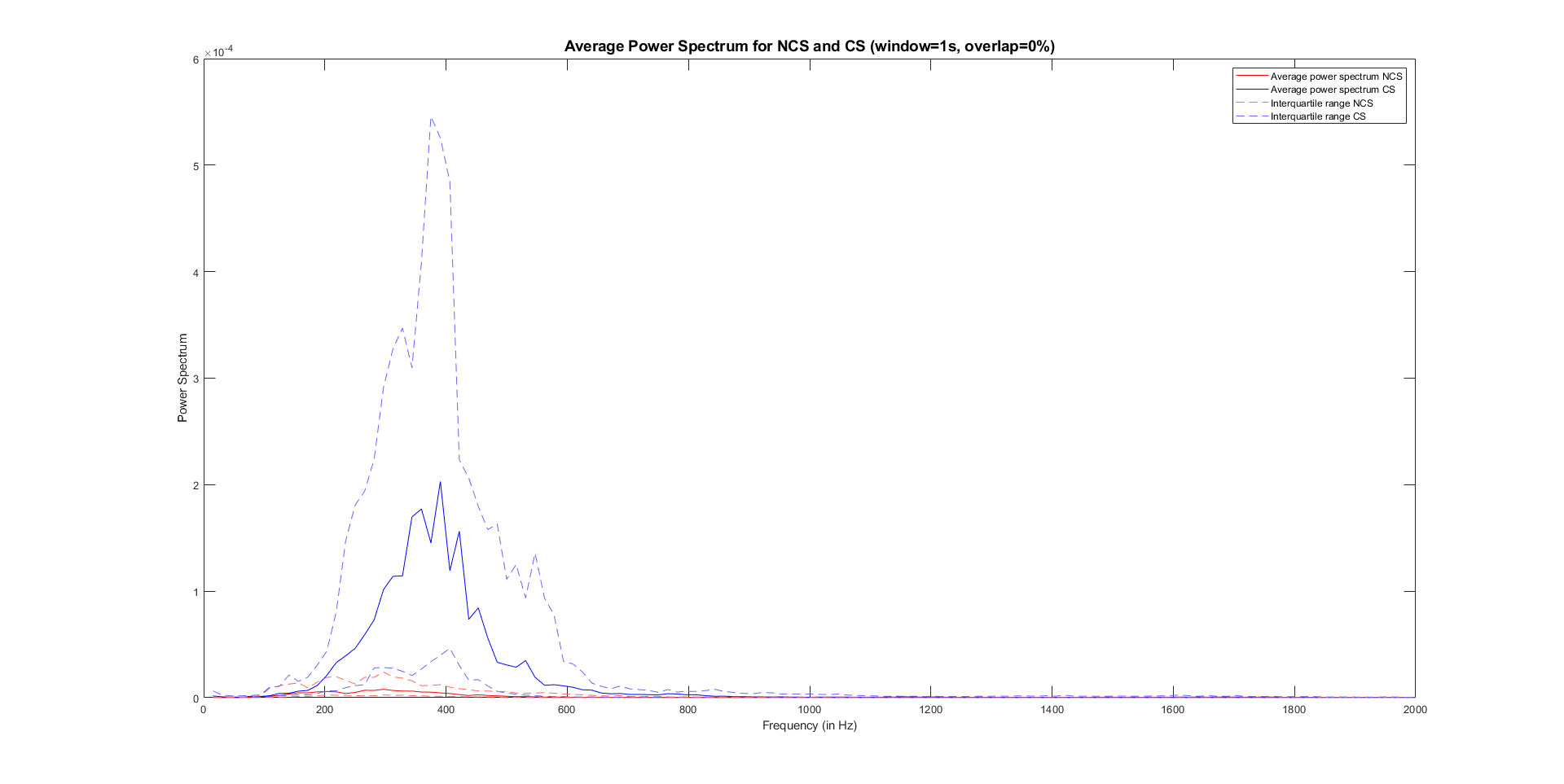


Figure 6: Vizualisation of CS Frequency Changes in the first 15s of Signal 22

Finally, it was decided that the Power Ratio could be enough to differentiate the CS and NCS. Indeed, the difference is …. (cf figure …)



## Cross validation

<https://en.wikipedia.org/wiki/Cross-validation_(statistics)>

Exhaustive cross-validation: Exhaustive cross-validation methods are cross-validation methods which learn and test on all possible ways to divide the original sample into a training and a validation set.

# Removing the crying sections

2 seuils

Cross validation (with leanring base and validation base)

1. <https://en.wikipedia.org/wiki/Fleiss%27_kappa> [↑](#endnote-ref-1)
2. <https://github.com/dgolden1/matlab_fleiss_kappa/blob/master/fleiss_kappa.m> [↑](#endnote-ref-2)