Universidad Pompeu Fabra
DTIC/Music Technology Group

musIC (music for Cochlear Implants);

an evaluation report on the audio and image signal processing methods of musIC concert

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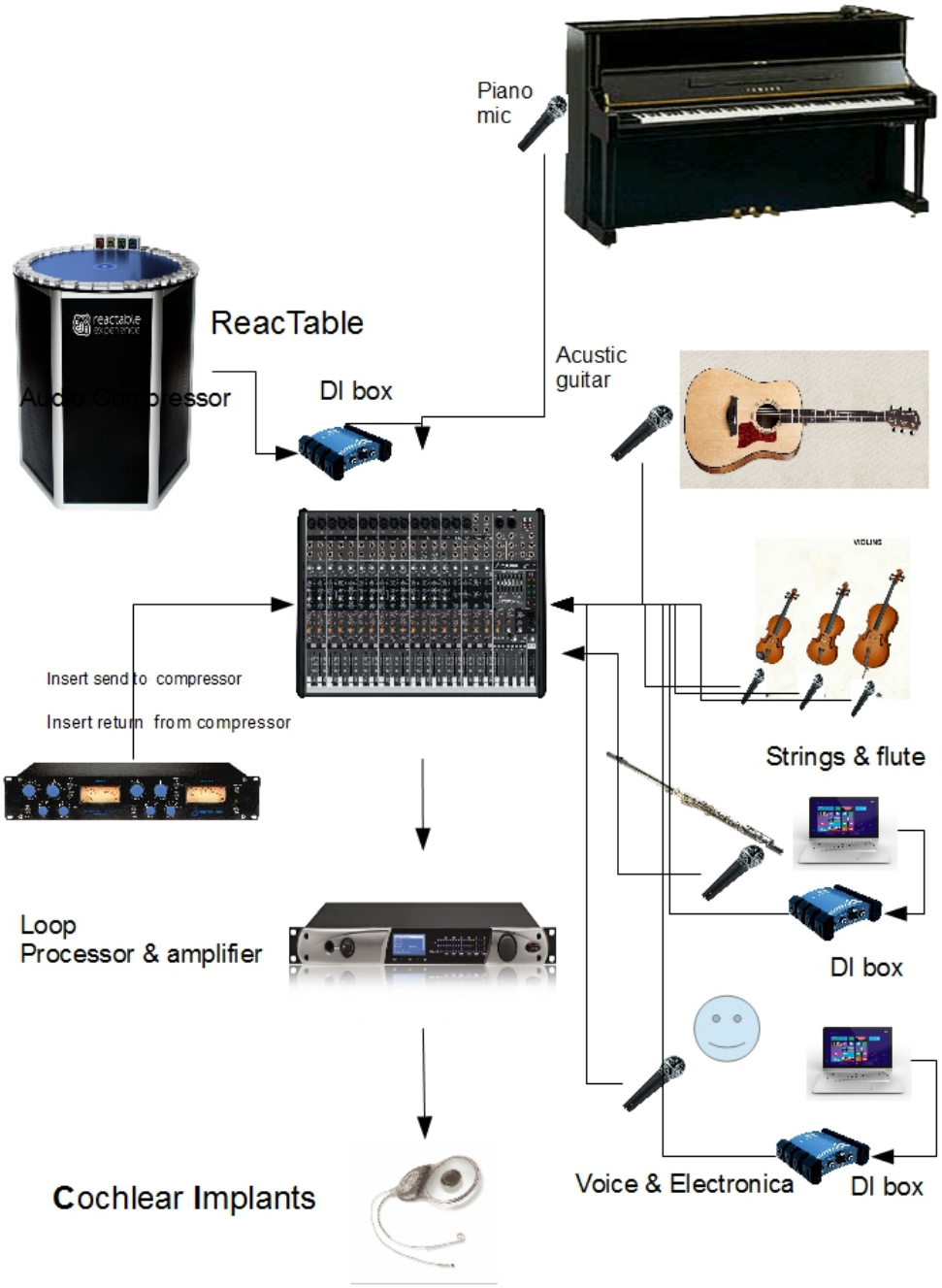
Overview

The concert ¨music for cochlear implants¨ (*musIC*), live music experience was designated either for people with hearing loss or normal hearing people. Various musicians from the area of Barcelona, presented their works and improvised in the same time that music visualizations rapresenting the sound spectra of the musical signals were projected on screen.

Regarding the sound processing , the aim was to map/convert the dynamic range of the individual groups to an appropriate more limited range, for its amplification and adressing via magnetic loop as well as the investigation of music al perception improvement from part of the users. In this topic, we will discuss the implementation of sound processing algorithms used for the visualizations, the dynamics processing, as well as the problems occured and make estimations and conclusions for a possible improvement in a similar approach.

musIC concert Stage Plan & signal flow diagram



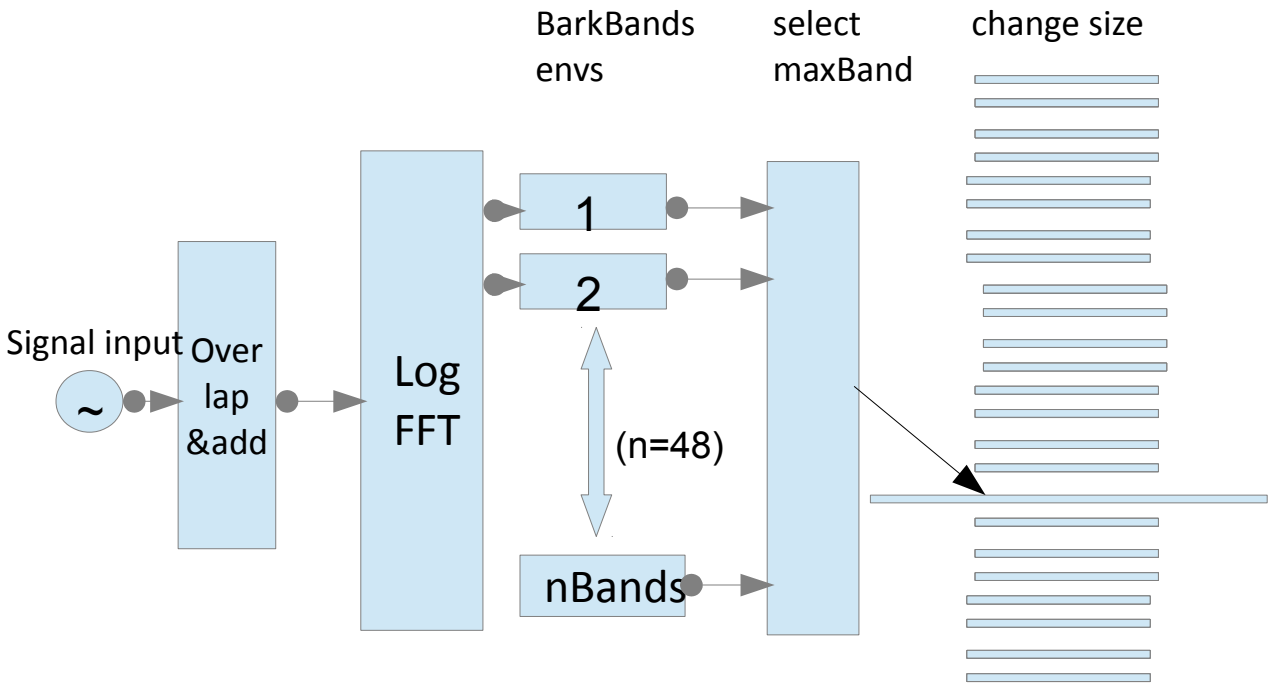
Music visualizations

The visualizations realized for the concert were implemented in *Processing* enviroment. consisted of a set of real time analyzers in two different forms:

1. one prototype 3D cochlea-form texture, with a sphere changing positions on the surface, according to the region at where the band with the maximum energy value (RMS) is located.

2. A linear array of spirally configured slices, rapresenting equivalent bark bands, changing width according to the region at where the band with the maximum energy value (RMS) is located.

The common processing algorythm implemented for this purpose is shown below:



Sound Processing

Due to the limitationed of the Dynamic Ranges that cochlear implant devices are intended to perform within, a compression method was evaluated and applicated onto different audio-signal groups (instrument groups).

The C.I dynamic Ranges limits uproximately up to :

C.I.DR ≈ 10 dB

The approximate Dynamic Range of the Groupped signals equals to :

GDR≈ 60 dB

It can be seen that a compression ratio of **r= y/x =1 /6** is needed

Regarding to the compression parameter values of *Attack* and *Release* time, without having previously measured the auditory's response, empirically chosen values were given as follows :

Attack = 5 ms
Release = 300 ms

while the *Threshold* level was kept to **-18 dBFS**

Problems occured

While a sound check with a CI user showed sufficient results regarding to the compressed signal, the programs recordings showed seriously clipped regions (up to 6dB).

Conclusions

Live sound visualizations resulted were succesfully renedered by applications (Processing). Compression method resulted efficient for the driving of the hall's magnetic loop system The signal routing to compressor was sequencial (INSERT send/return), although a parallel routing was recommended, in order to preserve the signal peaks after the relatevely hard compression ratio. The lack of Auxilliary buses made the effort in efficient.

Discussion

A further study of the music signal aspects in cochlear implants devices is needed to show improvements in perception by cochlear implants users.

References

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