Tempo Extraction of Percieved Music using EEG Signal Analysis

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***Abstract*—This paper descibes the process which we would be adapting to demonstrate how the music information retrieval techniques which were originally developed to process audio recordings can be adapted for the analysis of corresponding brain activity data. We wish to extract the tempo of the perceived music which should be identical to the actual recording. In particular, we wish to conduct a case study applying beat tracking techniques to extract the tempo from electroencephalography (EEG) recordings obtained from people listening to music stimuli.**

***Keywords*—Tempo, EEG, Novelty Curve**

I. Introduction

It has been shown that oscillatory neural activity is sensitive to accented tones in a rhythmic sequence rhythmic sequence. Our entire analysis is based on one assumption that the neural activity associated with music perception is synchronized with the actual recordings. or example, if there's a onset in the recoding, there would be an onset in he perceived music as well. We wish to conduct this analysis on the public domain OpenMIIR dataset of EEG recordings taken during music perception and imagination. The biggest challenge involved in this task is the extremely noisy nature of the EEG signal. We would be appying several denoising techniques like PCA, ICA(Blind Source Seperation), SSP based filtering, Wavelet transform denoising,Wavelet Packet Transform, Non-Linear Adaptive filtering,etc. This raises the question whether Music Information Retrieval techniques originally developed to detect beats and extract the tempo from music recordings could also be used for the analysis of corresponding EEG signals. One could argue that as the brain processes the perceived music, it generates a transformed representation which is captured by the EEG electrodes. Hence, the recorded EEG signal could in principle be seen as a mid-level representation of the original music piece that has been heavily distorted by two consecutive black-box filtersthe brain and the EEG equipment.

A. Dataset and Preprocessing

In this study, we use a subset of the OpenMIIR dataset a public domain dataset of EEG recordings taken during music perception and imagination.These stimuli were selected from well-known pieces of different genres. They span several musical dimensions such as meter, tempo, instrumentation (ranging from piano to orchestra) and the presence of lyrics (singing or no singing present). All stimuli were normalized in volume and kept similar in length, while ensuring that they all contained complete musical phrases starting from the beginning of the piece. EEG pre-processing comprised the removal and interpolation of bad channels as well as the reduction of arifacts using techniques like Independent component analysis to remove occular artifacts, etc. The preprocessing involves intense application of probability theory and signal processing since noise is considered as a random variable.

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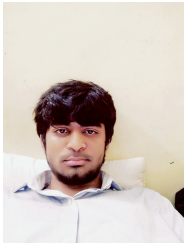
II. Tempo Extraction

We would be employing a novel technique of extracting tempogram [Tempo Histogram] of the signal which comprises of onset detection using spectral analysis and extracting the tempogram from the obtained novelty curve. We would be applying the above mentioned processing on both, the original audio recordings and the EEG signals and the comparing the tempo histograms of both the signals to find the correlation. The processing would be done on the weighted aggregate of the available 64 channels. The weight matrix would be found out by training a convolutional neural network on the channels. For the above mentioned purpose of extracting tempo histograms, we have listed down several techniques like short time fourier transform, Autocorrelation based method, etc. We will be exploring these techniques and will be applying the optimal one in the final implemenatation.



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