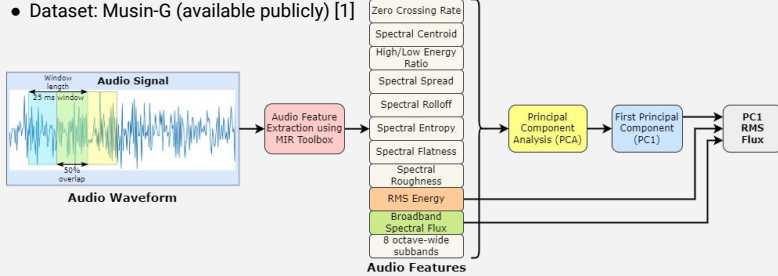


Canonical Correlation Analysis (CCA) Reveal Neural Entrainment For Each Song And Similarity Among Genres

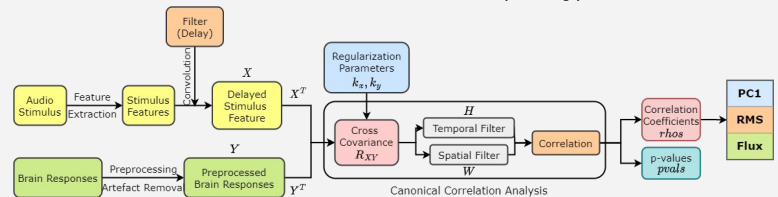
INTRODUCTION

- Features of music can be observed in the brain responses. Correlations between stimuli features and brain responses can be determined by Stimulus-Response correlations (SRC).
- This study focuses on naturalistic music through CCA, Stimulus-Response Correlation method in order to understand the relationship between EEG collected brain responses and music features extracted using MIR tools.
- Dataset: Musin-G (available publicly) [1]

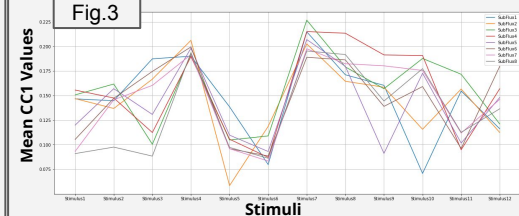
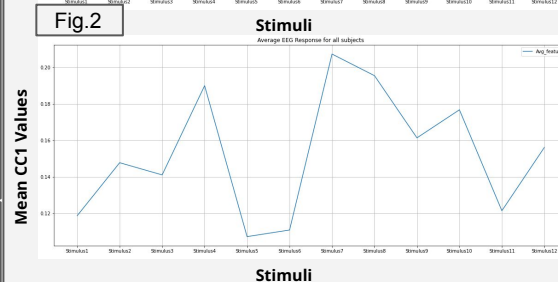


METHODS

- Eighteen stimulus features shown above were extracted and its low-dimensional representation was created using PCA. First component of PCA along with RMSE and Flux was used for further analysis
- CCA is used to find the correlation between the brain responses and music stimulus [2]
- We filter the stimulus features to match the best delay between the brain response and the stimulus
- The CCA model shown below temporally filters musical features while spatially filtering the EEG to learn a multidimensional mapping between stimulus and brain responses
- This results in the correlation coefficients and their corresponding p-values



RESULTS



- Statistically significant correlation between acoustic features and EEG responses with CC1-CC5. CC1 produces the maximum correlation in Fig.1.
- All 3 features were averaged in Fig.2 and then categorized in Table.
- Consistent trend observed in the correlations for the spectral 8 octave-wide flux subbands as shown in Fig.3.
- Formation of 3 groups of genres with similar acoustic features using CCA visualisations.
- Peaks in the correlation values observed for Indian classical and semi-classical genres of music, and also for the New Age type of music may imply a cultural bias.

Song	Song Name-Artist	Genre	Genre Group
1	Trip to the lonely planet	Deep House	Low
2	Sail - Awolnation	Indie	Medium
3	Concept 15 - Kodomo	Electronics	Medium
4	Aurore - Claire David	New Age	High
5	Proof - Idiotape	Electronic Dance	Low
6	Glider - Tycho	Ambient	Low
7	Raag Bihag	Hindustani Classical	High
8	Albela sajan	Indian Semi-Classical	High
9	Mor Bani Thanghat Kare	Indian Folk	Medium
10	Fallin - Dr. SaxLove	Soft Jazz	Medium
11	Master of Running	Goth Rock	Low
12	JB - Nobody.one	Progressive Instr.Rock	Medium

CONCLUSION and FUTURE WORK

- Brain responses can reveal information for similarity among genres.
- CCA can be an effective tool in understanding the relationship between neural response to music.
- Neural entrainment studies could benefit from our methods and results.
- Improving music recommendations in naturalistic scenarios
- The limitations of CCA can be overcome using different correlation methods.

REFERENCES

[1] Krishna Prasad Miyapuram and Pankaj Pandey and Nashra Ahmad and Bharatesh R Shiraguppi and Esha Sharma and Prashant Lawhatre and Dhananjay Sonawane and Derek Lomas (2022). Music Listening - Genre EEG dataset (MUSIN-G). OpenNeuro. [Dataset] doi: doi:10.18111/openneuro.ds003774.v1.0.1

[2] V. Alluri, P. Toivainen, I. P. J'a'askel'ainen, E. Glerean, M. Sams, and E. Brattico. Large-scale brain networks emerge from dynamic processing of musical timbre, key and rhythm. *NeuroImage*, 59(4):3677-3689, 2012.