Augmenting EEG Data for Music-Emotion Recognition Using Diffusion Models

TECHNISCHE UNIVERSITÄT DARMSTADT

Proposal for a Master's or Bachelor's Thesis

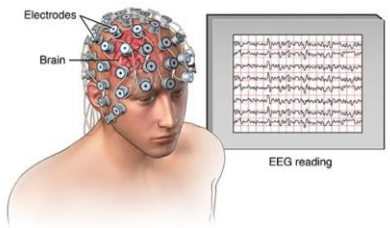
Understanding the neural basis of subjective musical experiences is crucial in music psychology and neuroscience. Electroencephalography (EEG) offers a direct view into real-time brain activity during music listening, shedding light on the neural processes involved in music perception and emotional engagement. The Neural Music Emotion Dataset - Tempo (NMED-T) includes EEG and behavioral data from participants exposed to different musical excerpts, aimed at exploring these neural correlates of music enjoyment. However, the dataset's limited sample size and potential imbalance in enjoyment ratings can hinder the development of accurate emotion recognition models. To address these challenges, diffusion models—a cutting-edge approach in generative modeling—present a promising solution for augmenting the dataset with synthetic EEG data. By leveraging this approach, we aim to enhance the robustness and generalizability of models in this domain. The project includes the following main work packages:

- Literature Review: Conduct an in-depth review of existing studies on diffusion models and EEG signal processing to establish a strong foundation and identify the most effective techniques for data augmentation.
- Data Preprocessing: Clean and prepare EEG data through artifact removal, filtering, and feature extraction.
- Generative EEG Modeling: Develop and implement a diffusion model specifically tailored for generating synthetic EEG data. This step will focus on enhancing the Neural Music Emotion Dataset - Tempo (NMED-T) to improve the robustness and diversity of the dataset.
- Data Augmentation: Augment the data set by artificially generated data points to address sample size limitations and enjoyment rating imbalances, creating a more representative training set.
- Evaluation: Evaluate the consistency of the artificially generated training data set w.r.t. the real-world data.

Requirements:

- Proficiency in machine learning and deep learning techniques, particularly in working with generative models
- Strong Python programming skills
- Familiarity with EEG data analysis is beneficial

Language: English



M.Sc. Keivan Ahmadi
E-Mail: keivan.ahmadi@tu-darmstadt.de
M.Sc. Maik Pfefferkorn
E-Mail: maik.pfefferkorn@iat.tu-darmstadt.de

CCPS Control and Cyber-Physical Systems