Novel Machine Learning Software for DeNoising and Visualizing EEG Data

Mahendran, Ashwin (School: Dakota High School)

EEGs are an important tool used by clinicians to diagnose neurological abnormalities such as epilepsy, and by medical researchers to map the functions of different components of the brain. However, EEG readings are inherently noisy and lack human interpretability, which makes it difficult for researchers to glean insights from raw EEG signals. In order to address this, I developed a novel software toolkit that researchers can use to extract human interpretable insights from EEG data. In particular, my tool takes as input a dataset of EEG readings measured over time as participants in a study react to a series of stimuli and perform actions in response. The tool begins by training a classification model on this dataset to predict the participant's action/stimuli from the EEG. Gradient-based attribution is used in order to generate a heatmap over EEG channels indicating which parts of the brain are most correlated with a given action/stimulus. These heatmaps are stitched together over time to provide a real-time spatial visualization of neural activation during the study. GradCam is used to visualize temporal relationships in the EEG signal. As a case study to validate the viability of this tool, I used a motor imagery dataset of right/left-hand motion and a vision dataset in which the participant looks at images of numbers. On both datasets, the tool was able to successfully reproduce previously understood brain mappings through visualizations and was able to achieve a motor imagery classification accuracy of 83%.

Awards Won: