Learning Linguistic Representations from iEEG Spectrograms Using Deep Learning

TECHNISCHE UNIVERSITÄT DARMSTADT

Master's Thesis

Understanding the neural mechanisms that govern language production is a critical challenge in neuroscience. Recent advancements in neural recording technologies, such as intracranial electroencephalography (iEEG), offer new opportunities to explore the intricate relationships between brain activity and speech. This project proposes to develop a machine learning model that maps spectrogram representations of neural signals to linguistic content. Using the "Single Word Production Dutch-iBIDS" dataset, which includes neural signals and corresponding audio recordings, we aim to bridge the gap between the spectrograms generated from speech and the underlying neural activity responsible for that speech.

Main Objectives:

- Review existing literature on iEEG, language processing, and machine learning techniques for spectrogram-to-text conversion.
- Convert audio recordings into spectrograms using Short-Time Fourier Transform (STFT) and preprocess iEEG data to generate neural spectrograms.
- Develop a neural network, starting with convolutional neural networks (CNNs), to map spectrogram features of audio recordings to corresponding words or phonemes.
- Utilize pre-trained models like Wav2Vec2 for feature extraction and fine-tune the model to predict words or linguistic features from iEEG spectrograms.

This research seeks to advance our understanding of how brain activity encodes language by building a machine learning framework capable of predicting linguistic features from iEEG data. With applications in neuroprosthetics and brain-computer interfaces (BCIs), this project has the potential to contribute significantly to both neuroscience and AI-driven speech technology.

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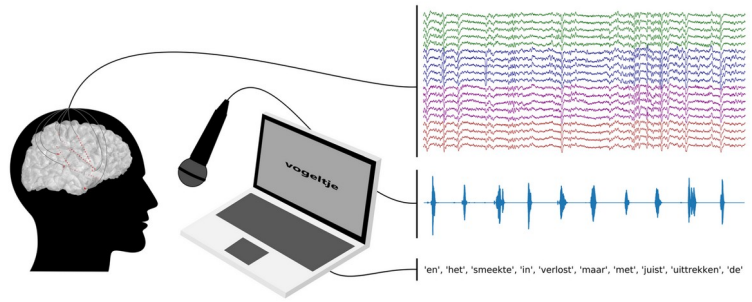
Requirements:

- Proficiency in Machine Learning and Deep Learning
- Strong Python programming skills and ability to manage, preprocess, and analyse large datasets
- Experience with Speech and Audio Processing is beneficial

Language: English



CCPS Control and Cyber-Physical Systems