Deep Learning-based EEG Epilepsy Detection and Analysis

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[*Description*] Electroencephalogram (EEG) is one of the most common and essential medical signal collected by neural scientists for the analysis of nerve diseases. With the rapid development of medical instruments and data collection techniques, EEG analysis has also been witnessed a dramatic progress. One important problem of EEG analysis is epilepsy pattern detection and analysis. Epilepsy is a brain disease generally associated with seizures, deteriorating the life quality of many patients. This internship targets to design effective deployment schemes of modern deep learning techniques on EEG Epilepsy detection, with a focus on real-world applications for neural scientists [1].

This internship is supervised by Prof. Themis Palpanas and his PhD student Qitong Wang from the diNo team at the University of Paris. It also benefits from diNo's collaboration with neuroscientists from the Institut du Cerveau (ICM) and their professional clinical expertise. The selected intern will become a member of diNo, which has world-leading expertise on data series management, indexing, and analysis.

[*Challenges*] The main challenges of the project lie in the complexity of real-world EEG datasets. The seizure and other patterns possess different length, exist across different channels/frequencies, and vary among different patients, deteriorating the performance of most existing heuristic methods. The abilities of deep neural networks in representation learning have the potential to mitigate these problems, since they provide unified latent features extracted from various information. However, their successful deployment demands sophisticated designs on top of neural domain knowledge.

[*Methodology*] This intership will first compare the differences between publicly released datasets and real-world EEG datasets, to profile the dataset charactristics and benchmark algorithm designs. Algorithm design will start with representation learning of convolutional neural networks for epilepsy detection with different lengths. Frequency-domain information will also be involved into the detection procedure, with novel architectures to be designed.

[*Prerequisites*] Excellent Python programming skills, very good knowledge of deep learning frameworks (PyTorch/GPU, etc.) and libraries in data analysis workflow (NumPy, Matplotlib, etc.). Research/project experiments and publications on deep learning or data analysis is a plus.

[*How to apply*] Apply by emailing your CV and transcripts to Prof. Themis Palpanas: themis@mi.parisdescartes.fr

References

[1]. Valerio Frazzini, Stephen Whitmarsh, et al. In vivo Interictal Neuronal Signatures of Human Periventricular Nodular Heterotopia. bioRxiv, 2020.