Variational autoencoders-enabled high-fidelity reconstruction and effective anomaly detection in EEG data

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Electroencephalography (EEG) is a multi-channel time-series that provides information about the individual brain activity for diagnostics, neuro-rehabilitation, and other applications (including emotions recognition).
With the recent success of artificial intelligence in neuroscience, a number of deep learning (DL) models were proposed for classification, anomaly detection, and pattern recognition tasks in EEG. Two main issues challenge the existing DL models for EEG: the large cross-subject variability and the variability of the models training effectiveness depending on the characteristics of the input data.
In this talk, I will discuss the most relevant issues to obtain high-fidelity reconstruction of EEG recordings, highlighting the most relevant and successful related work. Then, I will show how we reached almost perfect reconstruction with our hvEEGNet model (based on variational autoencoders, preprint available here). Finally, I will discuss the impact of our work, with special attention on the importance of bringing together domain knowledge and machine learning competences.
High-fidelity reconstruction can enable several applications in neuroscience and neurorehabilitation, and at the end of this talk you will be listening about some of them (from brain-computer interface to anomaly detection and transfer learning).