Epileptic seizure detection

DeepHealth

Epilepsy is one of the most prevalent neurological disorders, affecting more than 6 million people in Europe. The unexpected occurrence of seizures conditions the life of patients and their families, which have to face a high risk of accidents and injuries. DeepHealth can provide new tools for continuous monitoring and early-warning in epilepsy.

Towards interpretable models for long-term monitoring

Challenge

Approximately 30% of the patients with epilepsy are drug-resistant, meaning that they have to live with recurring, uncontrollable and unpredictable seizures that put their lives at risk. Long-term seizure monitoring can be performed via the continuous acquisition and analysis of biosignals such as the electroencephalogram (EEG) or the electrocardiogram (ECG). However, the high inter-patient variability in seizure patterns, and the low amount of seizures available per patient for fitting a model makes it a very challenging problem from the data science perspective.

Deep Learning is getting a lot of attention from the biosignal processing community, but it is still hard to get confidence from the medical experts. The main obstacle is the difficulty to interpret and validate the predictions given by Deep Learning models according to the medical knowledge.

Solution

Within DeepHealth, we are pursuing the development of general interpretable models for EEG-based epileptic seizure detection that use a reduced number of channels. This will allow them to be embedded in long-term monitoring wearable systems such as glasses, headbands or behind-the-ear sensors. By using an unusually large filter length in the first layer of the network, we were able to provide an interpretation of the learned EEG patterns, relating them to the common expert knowledge of epileptologists. This has the drawback of a higher computational cost and slower training convergence, but we relied on the EDDL library deployed on the EPFL HPC infrastructure to achieve an efficient training in a dataset with seizures from more than 550 epilepsy patients provided by CHUV.

Benefits

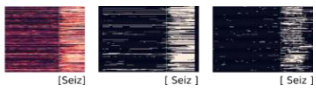
The general model trained with the DeepHealth libraries has been able to provide a seizure detection performance of 87.3% with only 4 EEG channels. This opens the door to a simpler development of personalized models based on this general one, and that can achieve efficient real-time monitoring through wearable devices.

Medical specialty:
Neurology

Use Case:
Epilepsy Monitoring

Site:
Lausanne (Switzerland)

Entity:
EPFL CHUV



Seizure probabilities predicted by the network.
Read our open-access paper.

DeepHealth Project

DeepHealth is a H2020 collaborative project which develops new HPC and Deep Learning techniques applied to large and complex biomedical datasets to support new and more efficient ways of diagnosis of diseases. The technologies developed (EDDLL, ECVL, etc.) have been validated by clinicians on 14 Use Cases like this, providing 14 Success Stories ready to scale to other healthcare institutions.

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https://deephealth-project.eu/

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