Biosignals in Epilepsy Research Group

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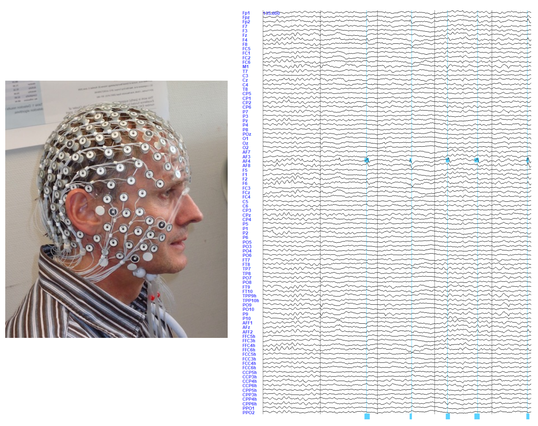
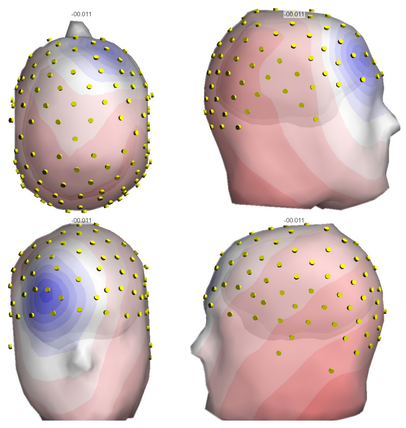
High Density EEG and Electrical Source Imaging

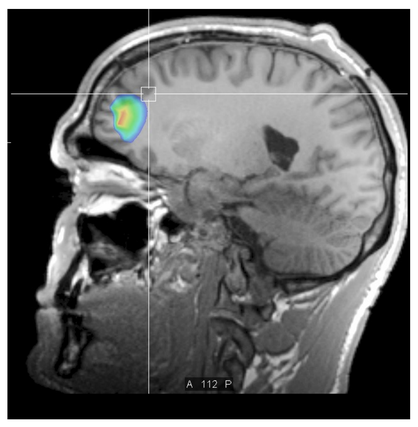
Multichannel Recording



3D Interpolation

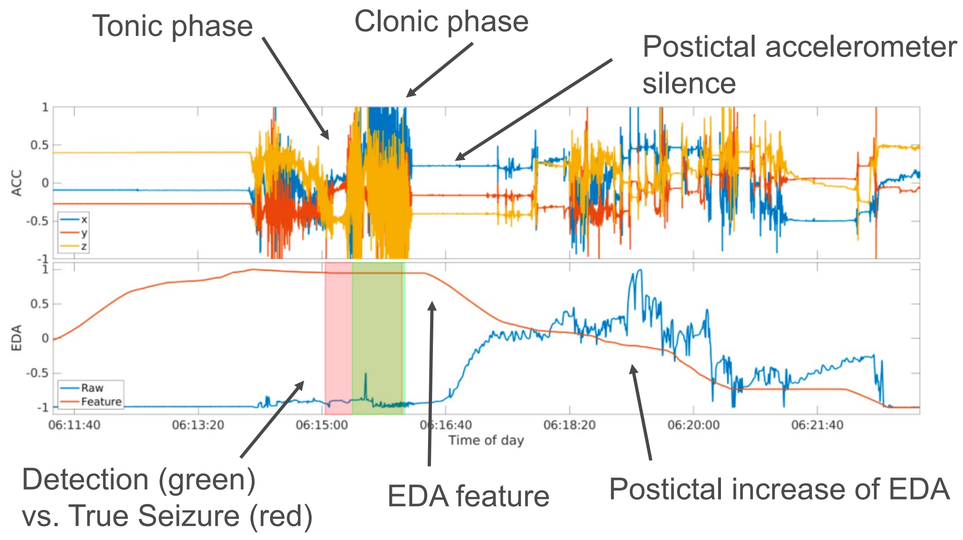


Source Imaging



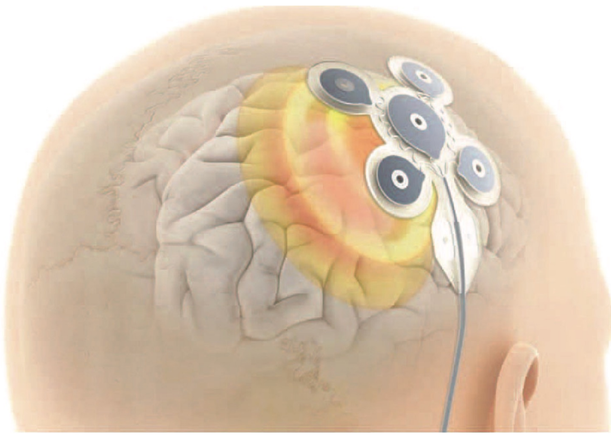
Localizing the sources in the brain for a given voltage distribution in scalp EEG recordings is only achieved by solving the so-called inverse problem. It consists of the forward problem using a volume conductor model of the head and the inverse problem defining the parameters of a model of the sources. Localisation of patterns in the EEG of patients with epilepsy in the interval between seizures and during the initial interval of a seizure can help to describe the location and the extent of the region being responsible for the generation of seizures

Non-EEG-based Wearable Seizure Detection



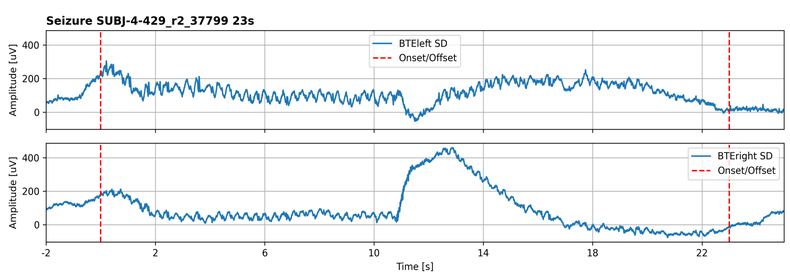
Seizure patterns are not only visible in the EEG but also in many other biosignals like heart rate, skin conductance and movement. In so-called non-EEG-based multimodal applications, simple wearables are used to develop non-stigmatizing seizure detection systems for patients.

Real-time Seizure Detection for Neurostimulation



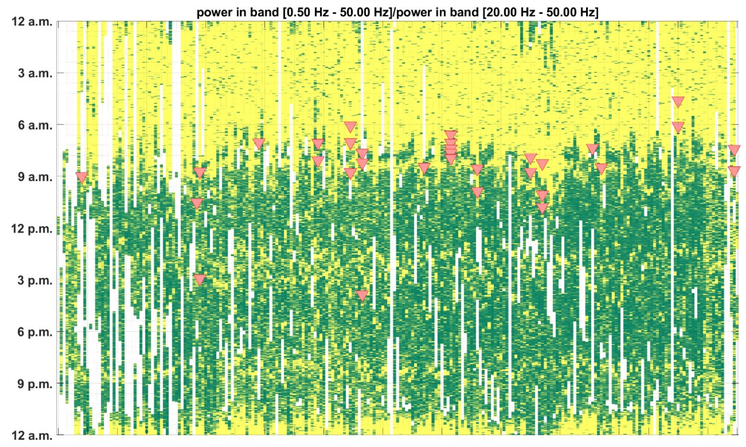
About 30% of epilepsy patients are resistant to treatment with antiepileptic drugs, and only a minority of these are surgical candidates. A recent therapeutic approach is the application of electrical stimulation in the early phases of a seizure to interrupt its spread across the brain. To accomplish this, energy-efficient seizure detectors are required that are able to detect a seizure in its early stages.

Non-invasive Low-Channel EEG Seizure Detection



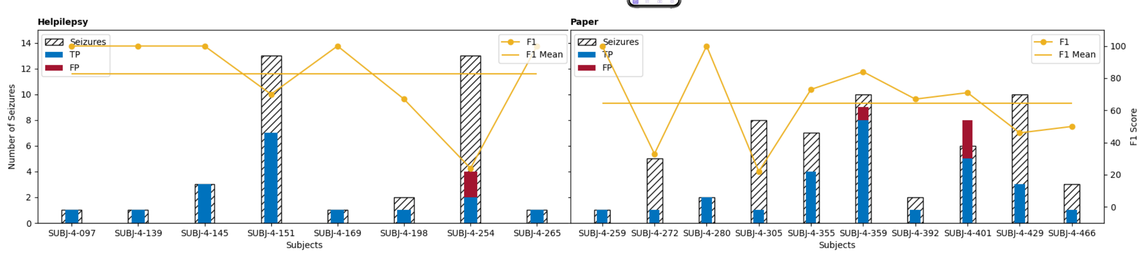
Generalized seizures without motor symptoms, so-called Absences, cannot be recognized by patients, but the information about their frequency is very helpful for diagnostics and therapy management. Low-channel EEG from small wearables, attached behind the ear, are used to detect this specific seizure type automatically.

Subcutaneous Long-Term EEG Seizure Monitoring



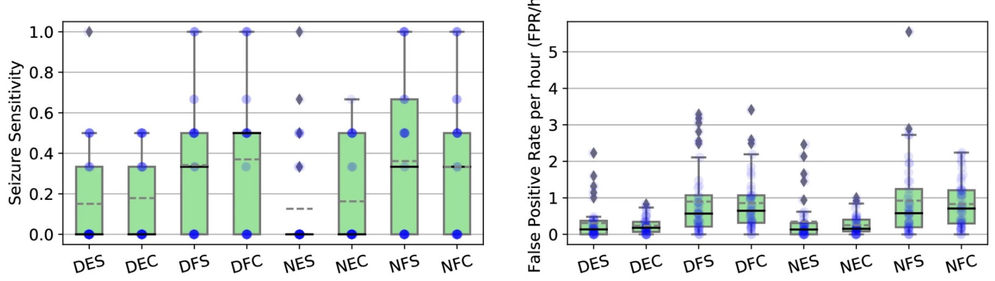
Subcutaneous implants can record low-channel EEG over months or years. This cutting-edge technology enhances our understanding of patients with focal epilepsy, enables in-depth analysis of their seizure cycles and facilitates the development of seizure forecasting models. Further implant's signal quality is studied over extended time horizons.

Digital Seizure Diary Analysis



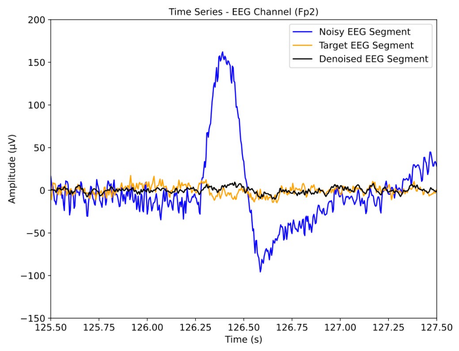
Still, the state of the art in non-hospital seizure documentation is a paper-based seizure diary, kept by the patient oneself. It's well known that up to 50% of all seizures are missed due to seizure unawareness. To which extent apps can serve as as a better tool in this regard is subject of the current research. Also reference values for automated seizure documentation systems or clinical trials are assessed.

Scalp EEG Seizure Prediction



The uncertainty surrounding the occurrence of the next seizure event has a profound impact on the lives of patients with epilepsy. Scalp EEG based prediction is in the focus of research already for a few decades but without reaching the level of being applicable for a wide range of patients. Our research aims at improving seizure prediction by using deep learning and introducing ideas from the theory of concept drifts to seizure prediction.

Scalp EEG Artifact Removal



The amplitudes of EEG signals are in the range of a few μV, making them susceptible to contamination from technical and biological noise sources. Linear filters are not an optimal solution due to the spectral overlap between brain waves and noise. Therefore, we are attempting to utilize deep learning methods to mimic or surpass signal separation techniques for multichannel signals