Study on epilepsy biomarker and prediction of surgical outcomes

Epilepsy is one of the common neurological diseases. Patients who showed resistance to the medication require surgical resection of the epileptic focus, from which the unnecessary electrical activity spreads and produces seizures and other pathological symptoms. However, the determination of the focus is difficult, time-consuming, and somewhat subjective that relies on the doctors' experience. Therefore, more robust and objective techniques for diagnosing epileptic foci and predicting surgical outcomes are desired. We are collaborating with neurosurgeons in the National Center/Hospital of Neurology and Psychiatry (NCNP) to develop such intelligent algorithms. We are mainly working on the electrocorticogram (ECoG) data of the patients with epilepsy, which is a pre-resection, semi-invasive examination of electrical activity recorded on the surface of the patient's brain (not the non-invasive scalp EEG). We incorporate advanced medical signal processing with classic machine-learning and/or novel deep-learning methodologies to the ECoG data. Our first project was recently published at the end of 2021, in which we succeeded in automatically and accurately detecting the epileptic biomarker signals from the ECoG signals. Further study will tackle the investigation of pathological epileptic signal network and its relationship with the prognostics, the automatic detection of another type of epilepsy-specific biomarkers, and the prediction of surgical outcomes based on the determined biomarker properties. You can develop an excellent skill in brain electrical signal processing and learn state-of-the-art machine-learning techniques for medical diagnosis.

Suggested readings:

Takayanagi, Y., Takayama, Y., Iijima, K., Iwasaki, M., & Ono, Y. (2021). Efficient Detection of High-frequency Biomarker Signals of Epilepsy by a Transfer-learning-based Convolutional Neural Network. *Advanced Biomedical Engineering*, 10, 158-165.