Automatic detection and localization of High frequency Oscillation in Paediatric Epilepsy

(HOPE: H2020-MSCA-RISE-2018)

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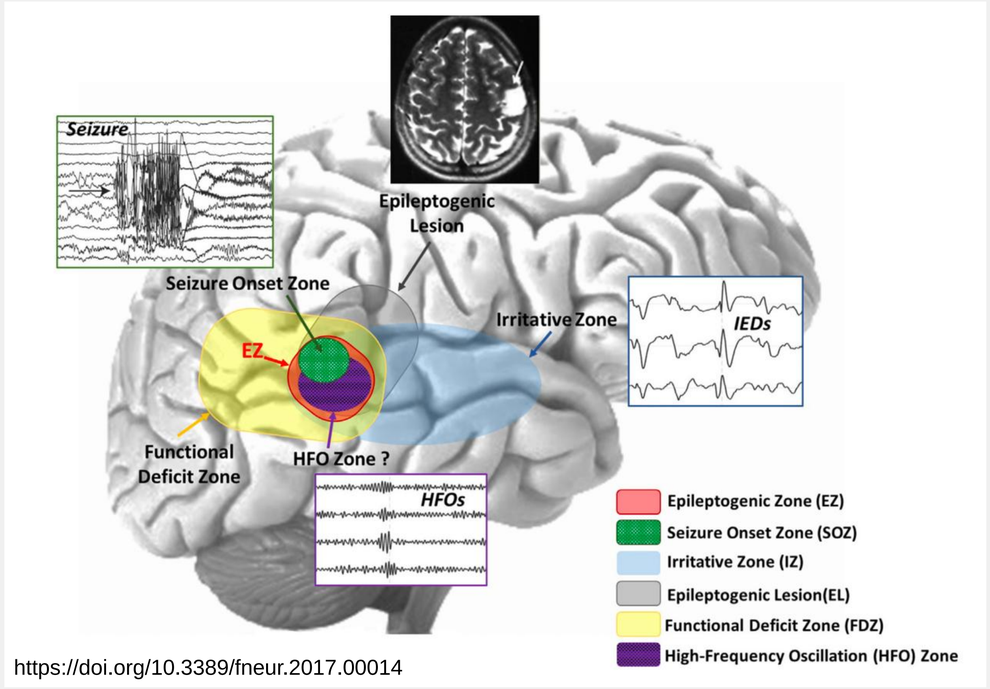
HOPE Project

HOPE aims to develop an integrated technology for the automatic detection of high-frequency oscillations (HFOs) using non-invasive neuroimaging modalities, such as electroencephalography (EEG), magnetoencephalography (MEG). The development of an automatic detection approach will also provide the basis for the development of a neurofeedback platform for the inhibition of HFOs.

State of the art

Epilepsy is a complex and heterogeneous neurological disorder which affects about 50 million people worldwide. Although most of the patients are treated successfully with antiepileptic drugs, about 30% of patients suffer from Medically Refractory Epilepsy (MRE), i.e., they have unsatisfactory control and continue having seizures after treatment. The objective of epilepsy surgery is the complete resection or disconnection of the Epileptogenic Zone (EZ). The EZ is a theoretical construct, and to date, there is no established marker that definitively determines its location and extent. The EZ can only be estimated through a variety of diagnostic tests that point out different cortical zones that are considered indicators of the EZ:



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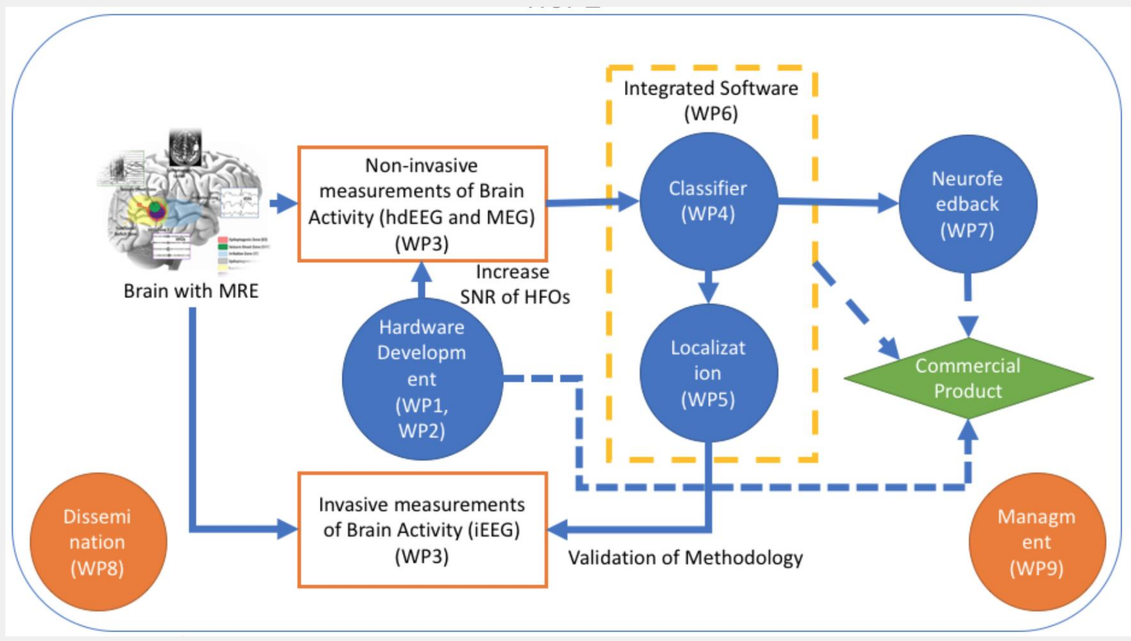
- **Seizure-Onset Zone (SOZ):** the area where the clinical seizures originate on ictal recordings.
- **Irritative zone:** the area of the cortex that generates Interictal Epileptiform Discharges (IEDs) in the EEG or MEG.
- **Epileptogenic lesion:** a structural brain abnormality that is causally related to the epilepsy.
- **Functional deficit zone:** the area of the cortex that is functionally abnormal during the interictal period.

A new approach

Given the lack of an unambiguous marker of the EZ and the limitations of invasive recordings, the pre-surgical delineation of the EZ is complex and not often successful. As a result, a large proportion of patients undergoing epilepsy surgical resection continue to have seizures after the surgery. Besides, epilepsy surgery remains the most under-used of all accepted medical interventions: in the USA, <1% of patients with MRE are referred to epilepsy centers for surgery. To improve the safety and efficacy of the epilepsy surgical treatment, there is an overriding need to identify and validate reliable biomarkers that can determine the extent and location of the EZ with high precision and accuracy.

Project Objectives

The project will advance the technological and computational approach to HFOs identification and its use in MRE beyond the current state of the art. The main mechanism will be staff exchanges with world-leading researchers in hardware and software, applied neurosciences and neurofeedback, dynamic signal processing, clinical assessment of patients with MRE and techno-economic analysis. The project will develop and maintain long-term collaborations between institutions and industry in the EU and establish links with top centers of pediatric epilepsy in the USA.



Impact

- **Advance the science of epilepsy.**
- **Promote the dissemination of new knowledge and techniques among epilepsy professionals.**
- **Inform patients and their families of new options.**
- **Develop methods for better detection and localization of HFOs; with the results provide a better understanding of HFOs nature and their relationship to epilepsy.**

The expectation is that these new capabilities and knowledge will offer a significant improvement in the identification of the EZ with a great impact on the success of the surgery. The neuro-feedback approach is a more speculative effort that may, however, offer novel new ways for treatment that are completely non-invasive.

Project partners

UK: Aston University (Coordinator: Dr. Manousos Klados); York Instruments Ltd; Birmingham Womens And Childrens
Netherland: Stichting Vumc; Universitair Medisch Centrum Utrecht
Greece: Aristotelio Panepistimio Thessalonikis; Polytechneio Kritis; Institoyto Bioiatpikhe Texnologias
Italy: UNIVERSITA DEGLI STUDI DI ROMA TOR VERGATA; BRAINSIGNS SRL
Cyprus: AAI SCIENTIFIC CULTURAL SERVICES LTD
Austria: G.Tec Medical Engineering GMBH
USA: Boston's Children Hospital

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