Title: Enabling Large-Scale Epilepsy Monitoring Using Advanced Detection and Compression Strategies

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Abstract:

Epilepsy is defined by the presence of recurrent, uncontrolled seizures. Seizures are electrical "storms" in the brain which result from overactive, highly synchronized electrical activity. One of the most fundamental, and scientifically challenging, aspects of studying epilepsy is the paroxysmal nature of seizures. Seizures occur sporadically and tend to be temporally clustered. Furthermore, seizures often do not manifest with an overt behavioral phenotype, so a robust detection strategy is required to detect them. To overcome this challenge, 24/7 electroencephalography (EEG) monitoring is essential to accurately characterize seizure phenotype. 24/7 EEG monitoring involves the surgical implantation of electrodes into the skull which provides 2-4 continuous data streams of ongoing neuronal activity. Animals are simultaneously video monitored, allowing correlation of EEG and behavioral data. This approach allows robust detection of seizures, as well as other type of physiological and pathophysiological brain activity. While this approach is the gold-standard in the field, it does have two significant complications. First, when recording 24/7 video EEG from a large number of animals, data storage and management rapidly becomes an issue. Second, identifying the occurrence of seizures (which last seconds to minutes) within weeks of EEG data is a daunting analytical challenge. We propose to develop a computational toolset allowing the systematic storage, dynamic compression, and rapid analysis of large scale EEG data. Development of these tools is of critical importance as the Tufts Department of Neuroscience has committed to developing epilepsy research as a core scientific priority. Furthermore, seizures are a co-morbidity of Alzheimer's disease, autism, and occur after traumatic brain injury, making this toolset of great use to a wide range of research groups.