Automatic Seizure Prediction and Monitoring Algorithms and Evaluation for a Single, Strategically-placed, Bipolar Electroencephalogram

Amini, Andrew

Emerging ultra-low power, postage stamp-sized electronics attached to the curvilinear surfaces of the human body promise to revolutionize disease monitoring, prevention,and treatment. This study evaluates the feasibility of such devices applied to sensing human brain signals through a single, bipolar electroencephalogram (EEG), for the purpose of predicting, detecting, and monitoring epileptic seizures and other neurological events. The study was conducted by analyzing over 228 gigabytes (GB) of data collected in 2 separate studies from scalp and subgaleal EEGs of 61 adult and adolescent patients, and by creating machine learning algorithms that target continuous analysis of a single, high-quality signal, as opposed to traditional algorithms which depend on the dozens to hundreds of signals available from today's EEGs. The results demonstrate that, given only a single bipolar sensor, the position achieving the highest accuracy for automatic seizure detection varies widely across patients. In spite of this challenge, the study also demonstrates that a single, strategic position, proximal to the motor strip and straddling the left and right sides of the brain, was able to achieve average accuracies of 99.5% and higher for detecting seizures and other neurological events, across all patients. Most importantly, the developed algorithms were able to predict seizure onset by up to 108 seconds in advance for 98.7% of seizures studied, and to detect at least 2 consecutive preseizure epochs 100 seconds or more in advance for 95% of seizures studied.

Awards Won:

Third Award of $1,000