Application of EEG Signal Analysis and Machine Learning on Neonatal Seizure Prediction

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Seizures, sudden bursts of electrical activity in cortical neurons, occur frequently in neonates (1-28 days old) and are a common emergency in the NICU. Timely and proper treatment is crucial in order to minimize brain damage, but neonatal seizures are difficult to detect, as they can manifest themselves in various clinical appearances. The electroencephalogram (EEG), the most reliable way to diagnose and detect seizures, has been extensively used in the detection of neonatal seizures. However, there is little work on whether or not EEG can be used to predict seizures before onset. This paper examines whether a preictal state exists in neonates such that it can be differentiated from normal interictal EEG and ECG. In this study, EEG and ECG features in the time, frequency, and entropy domains were extracted for five-second intervals and a decision tree model was employed to determine if the preictal and interictal states could be distinguished from each other. Results greatly varied by subject, with a sensitivity and specificity ranging from 60% to 80%. During the process, several weightings between EEG channels were tested. The results showed that channels not in the area of seizure origin still held relevant information in discriminating between the two states, and therefore suggested that focal seizures influence the electrical activity of the entire brain.