Linear and nonlinear methods for automatic seizure detection in scalp electroencephalogram recordings

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Abstract

The electro-encephalogram is a time-varying signal that measures electrical activity in the brain. A conceptually intuitive non-linear technique, multidimensional probability evolution (MDPE), is introduced. It is based on the time evolution of the probability density function within a multi-dimensional state space. A synthetic recording is employed to illustrate why MDPE is capable of detecting changes in the underlying dynamics that are invisible to linear statistics. If a nonlinear statistic cannot outperform a simple linear statistic such as variance, then there is no reason to advocate its use. Both variance and MDPE were able to detect the seizure in each of the ten scalp EEG recordings investigated. Although MDPE produced fewer false positives, there is no firm evidence to suggest that MDPE, or any other non-linear statistic considered, outperforms variance-based methods at identifying seizures.