

ABSTRACT

The Relevance of Various Non-linear Techniques and Low Frequency Visual Stimulation in Characterizing EEG Signals

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The electroencephalogram (EEG) is a record of brain electrical activity. Improvements in detection of resting EEG changes can expand its utility in clinical investigations. In this research EEG from groups of normal and alcoholic subjects were recorded while at rest, listening to music, engaging in reverse counting and while being presented with flash stimulation. Electrodes were placed on the scalp according to the 10 - 20 EEG system of electrode placement. EEG recordings were obtained using a 'Cadwell Easy Reader' machine. Tsallis-like information measures, wavelet, spectral, Lyapunov exponent, coarse-grain correlation dimension and principal component dimensional analyses were all utilized to determine whether significant differences could be detected between EEG recorded at rest and EEG recorded while subjects were presented with stimuli. The ability of the above analytical procedures to detect dynamical changes was demonstrated by constructing three different Henon-like vectors and defining specific changes in the evolution of these Henon-like vectors. One-way ANOVA tests were used to determine whether changes in the evolution of these Henon-like vectors were reflected in significant changes in measures derived from the above analytical techniques. Results indicate that coarse-grain

correlation dimensional analysis detected significant changes in the evolution of all three Henon-like vectors while Tsallis-like entropy and Lyapunov analysis techniques detected significant change for only 1 vector. Results also show that 3 of the above analytical techniques were able to detect significant differences between EEG from normal and alcoholic groups when 20Hz flash stimulation was employed. In addition, 11 out of 17 subjects showed significant $P300$ amplitude decrease for VEP estimated during 2Hz stimulation when compared to similar VEP amplitude estimated during 1Hz stimulation.

Keywords: Resting EEG; VEP; Flash stimulation; Lyapunov exponent; Tsallis-like entropy; Correlation dimension; Principal component; Henon-like vectors; Wavelet analysis; Spectral analysis.