Electroencephalographic indices of interpolatory type

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Abstract

The information obtained from an electroencephalogram (EEG) of rest is useful to discriminate some normal and pathological brain functions. However, the relations among abnormal EEG, brain functions and disorders are not well known yet. In this work our team propose numerical indices of the signal, coming from the methodology of fractal mathematics and the theory of approximation.

We describe an alternative to the computation of nonlinear dimensions for sampled signals, using a fractal interpolation of the data, instead of the classical methods that use a phase-space model with delay coordinates and that generates a large number of algorithmic difficulties. The method proposed provides a scalar magnitude for every segment of the EEG, named fractal dimension of the trace of the signal that can be used to measure the complexity of the signal.

We apply the previous procedure to the study of EEG recordings of two samples of children: a healthy control group and a set diagnosed with an Attention Deficit with Hyperactivity Disorder (ADHD). The clinical manifestations of the ADHD are characterised by a lack of attention, impulsive cognitive and behaviour styles and by an excessive motor activity. Its incidence is estimated between 3 and 5 % of the school population and one or two children with deficient attention per classroom during the first school years may be observed. By a mere visual inspection of the EEG, no difference was observed in the patient group. The results obtained by our team aim at a lower dimensionality in the patient group. Likewise the dimension is lower in the resting EEG than during the execution of tests of attention.

In the second part, we deduce a method for the computation of Hjorth complexities of any order based on an interpolation of EEG signals by means of polynomial splines. This type of functions is used to find quadrature formulas for spectral moments and to compute the descriptors. We report the results of the algorithms applied to the groups of children described in the first part. Some significant differences in the ADHD children were found as well in this case, on the locations of the frontal area.

Keywords: Electroencephalogram, Fractal Dimensions, Hjorth Parameters, Attention Deficit Hyperactivity Disorder