Alzheimer’s disease patients classification by using EEG signals processing

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Objective: Alzheimer’s Disease (AD) is the most common form of dementia, for which actually no cure is known [1]. Different studies have shown that AD has (at least) three major effects on electroencephalography (EEG) signals: enhanced complexity, slowing of signals, and perturbations in EEG synchrony [2]. The aim of this work is to achieve an automatic patients classification from EEG biomedical signals involved in AD and Mild Cognitive Impairment (MCI) in order to support physicians in a more correct individual diagnosis.

Materials and Methods: We analyzed EEG signals of 100 subjects aged 44-90 years old (49 patients affected by AD, 37 patients affected by MCI, and 14 healthy controls (HC)). All subjects were characterized by a negative anamnesis for neurological comorbid disease and did not assume therapy that should modify the electrical brain activity. Multi-channel EEG signals were collected by using a monopolar connection according to the 10-20 International System for electrode placements. In order to reduce the EEG background artifacts, the study was designed including the following steps: (i) pre-processing of EEG data, we extracted 180 seconds for each signal, which in turn were partitioned into 6 epochs of 30 seconds; (ii) processing of the EEG-signals by the application the Fast Fourier Transform; and (iii) classification by means of new and well-known machine learning methods, such as DMB (Data Mining Big) rule-based algorithm [3]; Support Vector Machines (SVM) and Decision Tree from Weka (Waikato Environment for Knowledge Analysis). In order to increase the robustness of our classification analysis, we use the cross validation approach.

Results: All three classes (MCI, AD, CT) were homogeneous for age and gender (p > 0.05). A more detailed description of the subject characteristics is reported in Table 1. Decision Tree classifier (J48) outperforms both SVM and DMB in the percentage of correct classification, achieving a 86% of accuracy for the AD identification from HC group, a 88% of accuracy for the MCI identification from HC group, and a 83% of accuracy for the AD identification with respect to the MCI patients. Even specificity and sensibility of J48 were always higher than the ones of SVM and DMB, as showed in Figure 1.

Conclusions: Our results showed that Decision Tree outperformed SVM and DMB in the percentage of correct classification. In future, we will use some ad-hoc tools to perform a more effective EEG pre-processing procedure.

References

Table 1. Descriptive statistics of the sample.