Analysis of Variability of Isopotential Areas Features in Sequences of EEG Maps

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Summary. The aim of the study was to analyse differences in dynamics of variability of extreme isopotential areas in sequences of EEG maps containing seizure activity episode. Analysis of dynamics of alternating variability of extreme isopotential areas was performed in the three steps: visual examination, calculation of the differencing coefficient and statistical analysis. Results of the study performed on two groups of totally 17 subjects reveal the different dynamics of isopotential areas variability in considered groups of patients.

1 Introduction

Brain Electrical Activity Mapping (BEAM) is a routine method used in electroencephalography (EEG) for visualization of values of the different parameters characterizing the bioelectrical brain activity [1,2,3]. Sequences of maps created in every several milliseconds are very useful for presentation of the variability of constellations in maps. This may have significant meaning in the evaluation of seizure activity due to its dynamics. Evaluation of the changes of consecutive maps requires, however, the quantitative methods.

The aim of the study was to analyse differences in dynamics of isopotential areas variability in sequence of BEAMs containing seizure activity episode.

2 Material and Methods

The present approach concerns the analysis of alternating variability of extreme isopotential areas and estimation of dynamics of these changes in the sequence of BEAM containing seizure activity episode.

EEG recordings were acquired using the system NeuroScan 4.3. The material comprised of 17 subjects divided into two groups (common numbering for both groups). The first group (I) consisted of the 10 clinically healthy

M. Kurzynski and M. Wozniak (Eds.): Computer Recognition Sys. 3, AISC 57, pp. 407–414.
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subjects with the seizure activity. The second group (II) comprised the seven patients with epilepsy [4].

The sequences of 1000 frames of amplitude maps taken from the 10 s EEG record containing the seizure activity episode for each subject were analyzed (Fig. 1). The dimensions of images of those maps were 628×790 pixels in 17 colors scale referred to the 17 ranges of values of electrical potentials in scale from -20 μV to 20 μV. The maps were generated in instances of 10 ms.

Fig. 1 shows the example of images from the sequence of 1000 maps referring to 10 s EEG recorded signal chosen from three periods: before, during and after seizure activity episode for patient no 3 from group II (a) and for patient no 9 from group I (b). Present approach concerns the analysis of the variability and the relationships between areas for the ranges of minimum and maximum potentials denoted as A_{-20} and A_{20}, respectively (Fig. 2).

The analysis of variability of the areas in the sequence of the maps was performed using the normalized histograms of images of the maps and was described in [4].

Figure 3 presents the example of normalized values of the areas for the minimum and maximum potentials (A_{-20} and A_{20}) for patients from both groups for 1000 frames of maps.

The relationship between A_{-20} and A_{20} in sequences of EEG maps was evaluated by alternating changes of the values of areas A_{-20} and A_{20}. Analysis has been performed in three steps:

1. visual evaluation of the alternating variability of the values of areas A_{-20} and A_{20},
2. calculation of the coefficient(s) describing quantitatively the principal factors of the alternating variability,
3. statistical analysis.

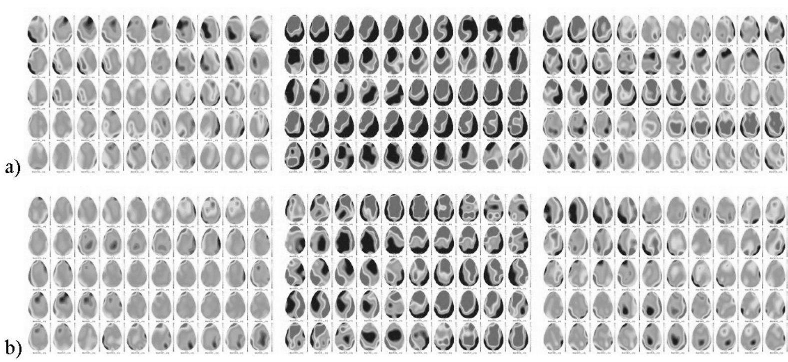

Fig. 1. Selected images from EEG maps sequence containing seizure activity episode for subject no 3 from II group (a) and for subject no 9 from I group (b)