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ON THE TREATMENT OF EEG IN THE DIAGNOSIS OF EPILEPSY IN CHILDREN AND ADULTS

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Keywords: total signal, stochastic resonance, inter-pulse interval, numerical value of the signal, Delta-correlated Gaussian noise.

Abstract. The method relates to medicine, namely to neurology, and is designed to identify the peak-wave complex in the EEG. For this purpose, the stochastic resonance effect in nonlinear systems is used in the analysis of the record. At the same time, the components of the main frequency are isolated from the EEG output signal by filtering. A Delta-correlated Gaussian noise of a given intensity is then added to the selected signal. When the total signal crosses the specified upper and lower threshold levels, a pulse of the standard form is generated. Next, the intervals between pulses for both thresholds are monitored. The density graphs of the inter-pulse intervals are plotted on a logarithmic scale to determine the peak-wave complex. The method allows to increase the accuracy of recognition of the peak-wave complex in the study of spontaneous EEG, as well as to subject the received signals to mathematical processing.

К ВОПРОСУ ОБ ОБРАБОТКЕ ЭЭГ ПРИ ДИАГНОСТИКЕ ЭПИЛЕПСИИ У ДЕТЕЙ И ВЗРОСЛЫХ

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Ключевые слова: суммарный сигнал, стохастический резонанс, межимпульсный интервал, числовое значение сигнала, дельта-коррелированный гауссов шум.

Аннотация. Способ относится к медицине, а именно к неврологии, и предназначен для идентификации пик-волнового комплекса в ЭЭГ. Для этого при анализе записи используют эффект стохастического резонанса в нелинейных системах. При этом из выходного сигнала ЭЭГ путем фильтрации выделяют составляющие основной частоты. Затем к выделенному сигналу добавляют дельта-коррелированный гауссов шум заданной интенсивности. При пересечении суммарным сигналом заданных верхнего и нижнего пороговых уровней генерируют импульс стандартной формы. Далее отслеживают интервалы между импульсами для обоих порогов. Строят в логарифмическом масштабе графики плотности межимпульсных интервалов, по которым определяют пик-волновой комплекс. Способ позволяет повысить точность распознавания пик-волнового комплекса при исследовании спонтанной ЭЭГ, а также подвергать полученные сигналы математической обработке.

The method relates to the field of medicine, namely neurophysiology, neurosurgery, neurology, and can be used to detect peak-wave complexes in computer EEG and diagnosis of epilepsy in children and adults.

The prototype of the claimed method is a method for diagnosing the averaged evoked potential, based on the analysis of extremes at selected recording intervals of the investigated evoked potential. In this case, the characteristic points of the induced potential are determined, which allow to classify the studied records. The presence of decision blocks in the research algorithm allows to significantly reduce the processing time of the record, increase the accuracy of processing.

However, this method is mainly applicable to the study of auditory, visual, somatosensory, etc. evoked potentials and can not be used to detect individual graph elements in the recorded real-time spontaneous EEG, that is, to isolate the

peak-wave complex. In addition, the prototype uses signal analysis based on the visual perception of the expert, that is, the allocation of samples-pictures. This method is not sufficient for further mathematical signal processing, which reduces the reliability of the results.

The inventive method differs from the prototype in that in the analysis of EEG recordings using the effect of stochastic resonance in nonlinear systems, which from the output of the EEG signal by filtering allocate component of the fundamental frequency, then to the selected signal add Delta-correlated Gaussian noise given intensity, at the intersection of the total signal defined upper and lower threshold levels to generate a pulse of standard shape, then keep track of the intervals between pulses for both thresholds and build a logarithmic scale, density charts of inter-pulse intervals, which determine the peak-wave complex.

The method is as follows. Peak-wave complexes are characterized by the presence of a slow wave and its accompanying peak faults (fast components). Tracking the intervals between the moments of crossing the signal (the sum of the regular and noise components) of the threshold level allows you to build a density function of the inter-pulse intervals. These functions build for upper and lower thresholds. Thus, the following sequence of actions can be proposed.

First, the recording of electrical activity of the brain (EEG) on a given channel is selected for processing. It defines the lowest and highest values and these values are called the lower and upper threshold levels of the selected record. The isolation of the fundamental frequency component by filtering is the normalization of the original record in the interval [0,1]. EEG recording in digital form is a sequence of numerical pairs of the form (XI, yi), where the first coordinate specifies the moment of time (measurement number), and the second - the numerical value of the signal at this moment (most often the number of measurements is 512.) Delta-correlated Gaussian noise of a given intensity is added to the selected signal. Next, track the intersection of the total signal (ie. the sum of the regular and noise components) of the specified threshold levels with the generation of a pulse of the standard form, namely, determine the position of the obtained numbers relative to the selected thresholds (determine the number of intersections of the disturbed point of the upper and lower thresholds). The total number of intersections is defined as the sum of such intersections at all points, and then the number of intersections for each point is normalized by the resulting sum. Next, track the intervals between pulses and logarithmic scale plot the density of the inter-pulse intervals (ie, the density of the pulse). intervals between intersections of the perturbed point of the given thresholds).

The proposed method has the following advantages: increases the accuracy and efficiency of detection and identification in the computer EEG of specific pathophysiological markers of epilepsy-peak-wave complexes, increases the differential diagnosis of epilepsy.

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