ISSN 2080-5010

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ,
МОЛОДІ ТА СПОРТУ УКРАЇНИ
КРЕМЕНЧУЦЬКИЙ НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ
ІМЕНІ МИХАЙЛА ОСТРОГРАДСЬКОГО

X МІЖНАРОДНА НАУКОВО-ТЕХНІЧНА КОНФЕРЕНЦІЯ

ФІЗИЧНІ ПРОЦЕСИ ТА ПОЛЯ ТЕХНІЧНИХ І БІОЛОГІЧНИХ ОБ'ЄКТІВ

Посвідчення УкрІНТЕІ № 489 від 27.08.2010

Матеріали конференції

0910EA

KREMENCHUK - MAKADI-BAY
P.P.F.T.B.O.
X International Science Conference
2011

Кременчук – 2011

МІНІСТЕРСТВО ОСВІТИ І НАУКИ, МОЛОДІ ТА СПОРТУ УКРАЇНИ
КРЕМЕНЧУЦЬКИЙ НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ
ІМЕНІ МИХАЙЛА ОСТРОГРАДСЬКОГО

МАТЕРІАЛИ КОНФЕРЕНЦІЇ

X Міжнародна науково-технічна конференція
«Фізичні процеси та поля технічних і біологічних об'єктів»

МАТЕРИАЛЫ КОНФЕРЕНЦИИ

X Международная научно-техническая конференция
«Физические процессы и поля технических и биологических объектов»

CONFERENCE PROCEEDINGS

X International scientific and technical conference
«Physical processes and fields of technical and biological objects»

(посвідчення про реєстрацію УкрІНТЕІ № 489 від 27.08.2010)

Кременчук, 4 – 6 листопада 2011 р.

X Міжнародна науково-технічна конференція “Фізичні процеси та поля технічних і біологічних об’єктів”: Матеріали конференції. – Кременчук: КрНУ імені Михайла Остроградського, 2011. – 236 с.

Друкується за рішенням Вченої ради Кременчуцького національного університету імені Михайла Остроградського (протокол ВР № 1 від 27.09.2011р.)

Збірник публікує матеріали, що містять нові теоретичні та практичні результати в галузях природничих, гуманітарних та технічних наук.

Програмний комітет
Михайло Загірняк – **голова**
Володимир Никифоров – **заступник голови**

Члени комітету
Юрій Зіньковський
Олександ Андрусенко
Олександр Єлізаров
Володимир Шмандій
Лхаді Атуї
Володимир Артамонов

Організаційний комітет
Владислав Мосьпан – **голова**

Члени комітету
Мичковський Ю. Г.
Фомовська О. В.
Юрко О. О.
Гладкий В. В.
Міхальчук О. П.

© Автори публікацій
© Оформлення, кафедра “Електронні апарати” КрНУ імені Михайла Остроградського, 2011 р.
ISSN 2080-5010

Відповідальний за випуск Гладкий В.В.

Адреса редакції: 39600, Кременчук, вул. Першотравнева, 20. Кременчуцький національний університет імені Михайла Остроградського, кафедра “Електронні апарати”, к. 1203.
Телефон: (05366) 3-20-01. E-mail: kafea@polytech.poltava.ua, kafea@kdu.edu.ua.

BIOMEDICAL ELECTRODES AND THEIR ELECTRICAL MODELS IN VARIOUS SIGNAL CONDITIONS

Chugui A., Popov A., PhD, Associate Professor
Department of Physical and Biomedical Electronics, National Technical University of Ukraine "Kyiv Polytechnic Institute"

The human body is like a "source" of various electrical signals [1], describing its functioning. Due to the fact that during the life cell potential alternates, every organ generates certain electrical signals that can be detected by various electronic devices. Currently, the most widely used biosignals are: electrocardiogram, electroencephalogram, electrooculogram, myogram and others. Monitoring is an important part of clinical research related to human life. Largely due to the received data one can determine the disease, control its flow, use appropriate methods of treatment and, consequently, preserved human life and health.

Monitoring parameters of human life is the systematic collection and processing of information about the parameters of biological objects, which may be the human organs that can be used to improve decision-making process of their functioning. Monitoring includes the steps of recording, conditioning, inspection, storage, management, etc. Since the signals from the human body are very low (of the order of millivolts and microvolts), monitoring devices must have low noise and very high sensitivity. To achieve the biosignals the biopotential electrodes are to be used, and they play crucial role in signal recording, influencing all further processing and analysis [2-3].

When we consider the problem in more detail, we see that the electrode actually carries out a transducing function, because in the body current is carried by ions, whereas in the electrode and its lead wire it is carried by electrons. Thus the electrode must serve as a transducer to change an ionic current into an electronic current. This greatly complicates electrodes and places constraints on their operation. To get the clear signal we shall examine the basic mechanisms involved in the transduction process and shall look at how they affect electrode characteristics.

The task of the work is examination of the principal electrical characteristics of biopotential electrodes and discussion of electrical equivalent circuits for electrodes based on these characteristics. In the work the results of modeling the electrode-skin contact cell are presented for the case of unusual recording conditions, namely in the presence of high-frequency and high-magnitude corrupting signals. Different types of biopotential electrodes are considered for normal monitoring conditions when used in various types of medical instrumentation systems. The most of work is focused on electrodes used for measuring the ECG, EEG, EMG, and intracellular potentials. The results on measuring and simulation of various elecetrodes are shown on the Fig. 1-2.

The new circuit model for the skin-electrode contact cell is developed (Fig. 3) and its performance is investigated. The frequency response of the proposed electrode model is presented on the Fig. 4.

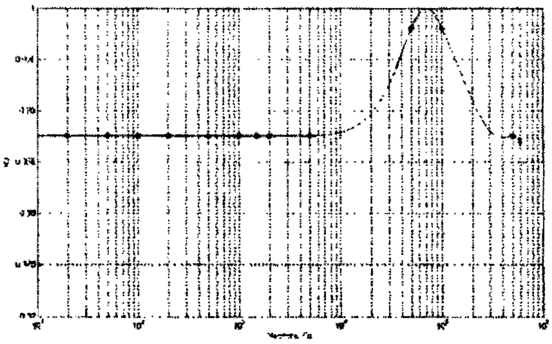


Fig. 1. Measured frequency response

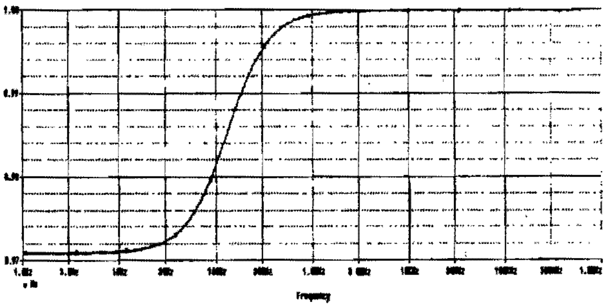
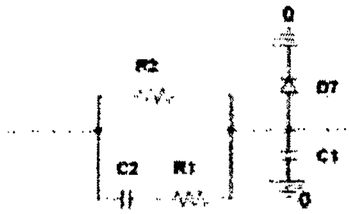


Fig. 2. Simulated frequency response



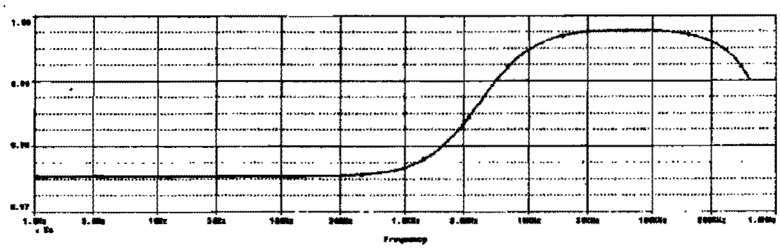


Fig. 3. New equivalent model

Fig. 4. Simulated frequency response of a new model

REFERENCES

1. Franks, W. Impedance Characterization and Modeling of Electrodes for Biomedical Applications / Wendy Franks, Iwan Schenker, Patrik Schmutz, and Andreas Hierlemann // IEEE Transactions on biomedical engineering. - 2005. - Vol. 52, №7, - P. 1295-1302.
2. Biopotential Electrodes, Material from M. O'Donnell, U. Mich. and Webster
3. Govind Patel , S. Effect of Electrode Surface Area on Thresholds for AC Stimulation and Ventricular Fibrillation / Shivani Govind Patel and Robert A. Malkin // IEEE Transactions on biomedical engineering. - 2007. - Vol. 54, №10, P. 1829-1836.

WAVELET ANALYSIS OF AUDITORY EVOKED POTENTIALS

Krashenyi I.; Popov A., PhD, Associate Professor
Department of Physical and Biomedical Electronics, National Technical University of Ukraine "Kyiv Polytechnic Institute"

Among the complex objective methods used to diagnose hearing loss in infants, from newborn period, registration of auditory evoked potentials (AEP) is of particular importance [1, 2]. To identify the characteristics of AEP visual analysis methods for identification and detection are primary used, which is not convenient and very subjective, leading to possible mistakes and uncomparable results. Employing of automated techniques for AEP analysis could be useful for this purpose.

Thus researcher needs to choose optimal method of signal processing to analyze the quality of hearing [2]. The purpose of this study was to create a new method based on continuous wavelet transform for detection of V wave in auditory evoked potentials.

Auditory Evoked Potential signals are transient electrical biosignals produced by various regions of the human brain in response to auditory stimuli (such as a periodic repetition of "clicks"). The absolute latency of wave V has received the most widespread clinical attention in differential diagnosis in estimating hearing sensitivity. The importance of wave V is due to its robust character and reliability under varying measurement condition and due to its predictability with decreasing stimulus intensity. An increase in latency with decrease in the stimulus intensity is common to all neural system; that is, neural firing becomes less frequent as the magnitude of the stimulus decreases.

In this work a new method of localization of V wave in AEP using wavelet analysis [3] is proposed.

As mother wavelet Morlet mother function [3] is used. This mother function is selected in this approach because of shape similarity with wave V. The algorithm based of the proposed technique was implemented in MatLAB. During testing program 65 pairs of AEP signals have been processed. Among the 65 pairs - 40 pairs of signals, which are determined visually as hearing, and 25, in which the lack of hearing was visually defined. Of the 40 pairs of signals, which is determined visually hearing, in 33 our approach gave correct results. And out of 25, which visually defined as the lack of hearing, the program has identified the lack of hearing in 20. In the work standard measures of sensitivity, selectivity and specificity were defined. The technique has sensitivity 82.5 %, selectivity – 86.84 %, a specificity – 74.74 %.