SCIENCE AND INDUSTRY

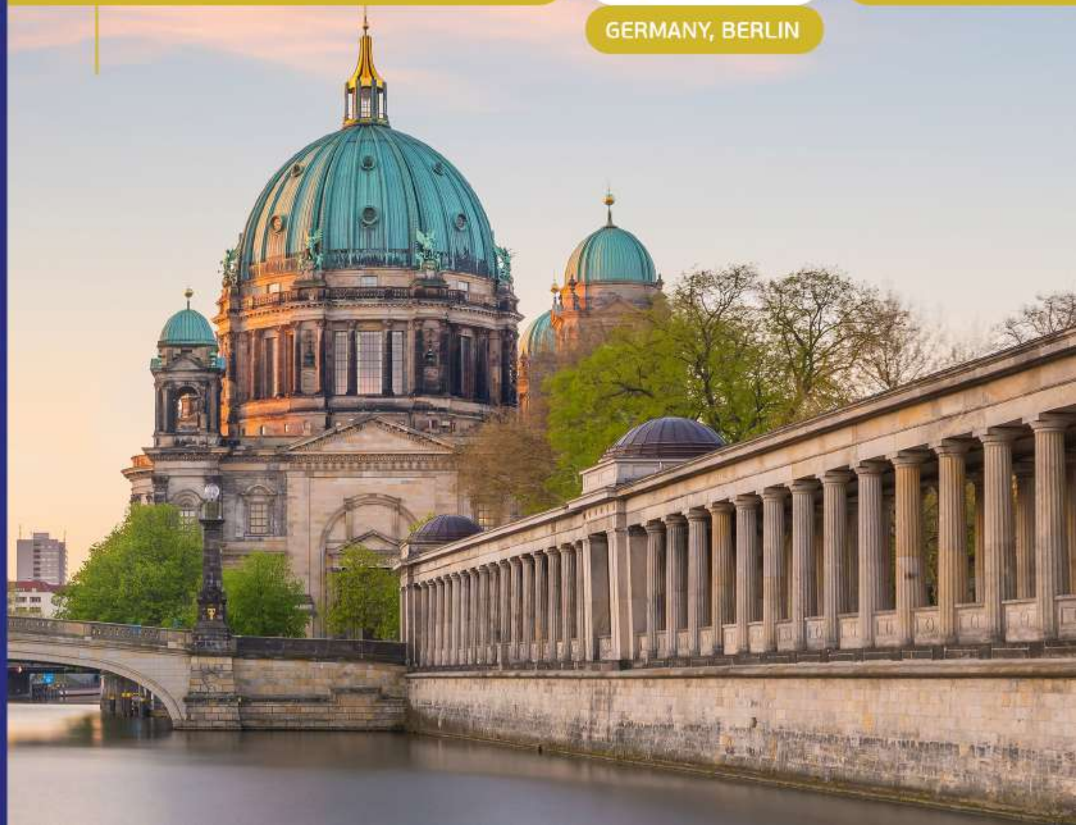
Abstracts of XXXIV International Scientific and Practical Conference

Abstracts of XXXIV
International Scientific
and Practical Conference

SCIENCE AND INDUSTRY

1-2 JUNE

GERMANY, BERLIN



SCIENCE

AND

INDUSTRY

Abstracts of XXXIV International Scientific and Practical Conference
Germany, Berlin
1 – 2, June 2022

Germany, Berlin

1 – 2, June 2022

UDC 001.1
BBK 29

The 34th International scientific and practical conference «Science and Industry» (June 1-2, 2022) Littera Verlag, Berlin, Germany. 2022. 180 p.

ISBN 978-3-9110125-1-5

The recommended citation for this publication is:
Petrov P. Learning Styles and Strategies // Science and Industry. Abstracts of the 34th International scientific and practical conference. Littera Verlag, Berlin. 2022. Pp. 39- 43. URL: http://el-conf.com.ua/.

Collection of scientific articles published is the scientific and practical publication, which contains scientific articles of students, graduate students, Candidates and Doctors of Sciences, research workers and practitioners from Europe, Ukraine, Russia and from neighbouring coutries and beyond. The articles contain the study, reflecting the processes and changes in the structure of modern science. The collection of scientific articles is for students, postgraduate students, doctoral candidates, teachers, researchers, practitioners and people interested in the trends of modern science development.

e-mail: el-conf@ukr.net
homepage: *http://el-conf.com.ua*

УДК 159.942:612.821.1:519.21 Технічні науки

MATHEMATICAL MODEL OF EEG-SIGNALS AT PSYCHO-EMOTIONAL INFLUENCE

Khvostivskyy M.O,
Associate Professor of
Biotechnical Systems Department
Fuch O.V.,
Postgraduate student of
Biotechnical Systems Department
Khvostivska L.V.,
Senior Lecturer of the
Radio Engineering Systems Department
Ternopil Ivan Puluj National
Technical University,
Ternopil, Ukraine

Abstract: *the thesis presents the structure of the EEG signal of a person under psycho-emotional influence and substantiates his mathematical model for the development of methods, algorithms and software for its processing.*

Key words: *EEG signal, psychoemotional influence, mathematical model.*

The process of monitoring the level of psycho-emotional state of a person against the background of stressful situations in medical practice uses various methodological and biological studies (skin electroplating, plethysmography, electroencephalography, electro-cardiography and questionnaires) in conjunction with computer tools. Such monitoring makes it possible to determine the psycho-emotional stability of people in different stressful situations depending on the conditions of their professional activities and complexity.

Scientists Konstantinidis E., Bratsas C., Pappas C., Papadelis C. [1], Melnikova T.S., Lapin I.A., Krasnov V.N. [2], Shpenkov O., Tukayev S., Zima I. [3] and a number of others indicate the feasibility of using electroencephalography to monitor the psycho-emotional state of EEG (electroencephalographic) signals.

Computer electroencephalographic systems and their software, which is implemented on the appropriate methods and algorithms of processing, are used for registration and processing of EEG signals. The core of such methods and algorithms is a mathematical model of EEG signals, which determines their structure and mathematical computational capabilities.

The process of EEG signal registration was carried out at the Biotechnical Systems Department of Ternopil Ivan Puluj National Technical University using the computer system Neurocom (manufacturer "XAIMedica"). Experimental implementations of EEG signals of people under psycho-emotional influence through the visual analyzer are shown in Fig.1.

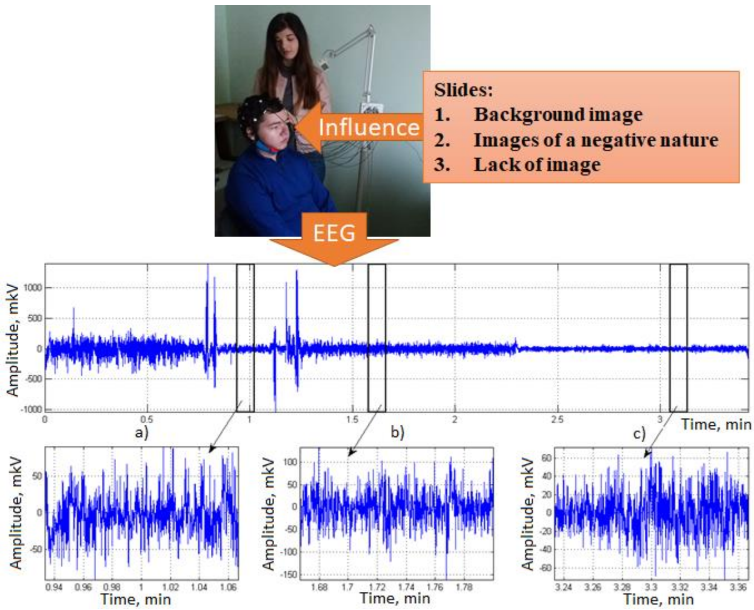


Fig. 1. Implementation of the EEG signal (lead F1):
(a) zone of calm, (b) zone of negative impact, (c) zone of recovery

Process of adaptation of the nervous system to variations in psycho-emotional exposure is reflected in the form of variations in the parameters of the period, phase and frequency of the EEG signal, including its components alpha, beta and theta waves, throughout the observation period. Therefore, it is advisable to consider the EEG signal within a separate sample T_m, namely in the time zones of the sliding window (Fig. 2)

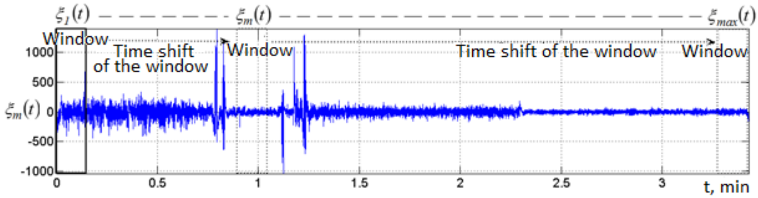


Fig. 2. Scheme of EEG signal presentation under psycho-emotional influence:
m is the number of the sliding window, *max* is the maximum number of the sliding window, $\xi_m(t)$ is the implementation of the EEG signal in the time zone of the *m* -th sliding window

According to this scheme (Fig. 2), the structure of the mathematical model of the EEG signal under psycho-emotional influence has the form:

$$\xi_m(t) = \xi(t) \cdot \chi_{D_m}(t), t \in \mathrm{R} \quad (1)$$

where $\xi_m(t)$, $t \in D_m$ - time zone implementation of the EEG signal with a period T_m within the *m* -th sliding window D_m;

$$\chi_{D_m}(t) = \begin{cases} 1, \text{якщо } t \in D_m \\ 0, \text{якщо } t \in D_m \end{cases}$$ - indicator function that sets

time limits D_m *m* -th sliding window:

$D_m = [m \cdot \Delta t, m \cdot \Delta t + S_w)$ - time range of the *m* -th sliding window, $\Delta t = \mathrm{const}$ - the magnitude of the displacement step of the sliding window in time space.

Within the sliding window, the EEG signal under psycho-emotional influence (Fig. 3) is presented as a random process with repetitive characteristics in time space (periodically correlated random process). This type of process is provided with methods and means of detecting harmonic (periodic) components of alpha, beta and theta waves in the structure of the EEG signal with the frequency parameter f_m in the time zone of the m -th shift window.

The model of the EEG signal in the time zone of the m -th sliding window as a random process with repetitive characteristics in time space is given by a mathematical expression:

$$\xi_m(t) = \sum_{k \in Z} \xi_{mk}(t) e^{i2\pi f_m kt}, \qquad (2)$$

where $\xi_{km}(t), k \in Z$ - k -*th* random component of the EEG signal $\xi_m(t)$ in the time zone of the m -th sliding window;

$e^{i2\pi f_m kt}$ -harmonic (periodic) components of the m -th EEG signal;

f_m - frequency of detection of the EEG signal component.

The mathematical model of the EEG signal of such a structure (2) has tools for signal processing in the detection of harmonic components, which is important in detecting changes in the signal structure before, during and after psycho-emotional effects on humans.

References:

1. Bratsas C., Papadelis C., Konstantinidis E., Pappas C. Towards emotion aware computing: An integrated approach using multi-channel neurophysiological recordings and affective visual stimuli. IEEE Trans. Inf. Technol. Biomed. 2010. Vol. 14, No. 3. P. 589-597.

2. Melnikova TS, Krasnov VN, Lapin IA, Andrushkevicius SI Daily dynamics of EEG characteristics in circular depressive disorders // Mental health. 2009. № 12. P. 43-47.

3. Shpenkov O., Tukaev S., Zima I. Changes in brain activity in

the gamma range when listening to rock music with low bass. Visn. KNU. T. Shevchenko. Biology. 2018. №1 (75). P. 27-32.

УДК 681.511.2 Технічні науки

FEATURES OF AUTOMATIC CONTROL OF THE PROCESS OF HEATING THE COOLANT IN THE PROCESS FURNACE

Chyhur Ihor,
Ph.D., Docent
Ivano-Frankivsk National Technical University of Oil and Gag,
Ivano-Frankivsk, Ukraine

Abstract*. The analysis of the technological process of heating the coolant in the technological furnace in order to create an automation system. The input and output parameters are analyzed, and the ways of solving the problem of automatic control of the technological object are outlined.*

Keywords: *technological furnace, control, parameters, automation.*

The objects of the oil and gas industry are equipped with various technological objects, which have different purposes, but at the same time have common features in terms of automation of technological processes.

Typical technological objects, widely used in industry, are technological furnaces designed for fire heating, evaporation and overheating of liquid and gaseous media, as well as for high-temperature thermo-technological and chemical processes. Technological furnaces are distinguished by technological, thermal, structural and other features.

One of the main classification features of industrial technological furnaces is their purpose. Thus, a large group of furnaces used as raw material heaters is characterized by high productivity and moderate heating temperatures (200-400 ° C) of hydrocarbon media (fig 1).