

ANNOTATION

Dissertation work on the topic: “**Neural network analysis of electrocardiosignals for the diagnosis of myocardial infarction**” submitted for the degree of Doctor of Philosophy (PhD) in the specialty 6D071600 – «Instrument engineering»

ALIMBAYEVA ZHADYRA NURDAULETOVNA

Relevance of the research topic. According to the World Health Organization, mortality from cardiovascular diseases (CVD) it has long held a leading position in the world. But in Kazakhstan, people die from diseases of the circulatory system almost twice as often as, for example, in European countries. The most life-threatening is myocardial infarction (MI). Due to the severe course and high mortality (the total mortality in the acute, acute and subacute periods of MI is about 30%), timely diagnosis of this disease is one of the urgent problems of modern healthcare.

Currently, despite the variety of statistical, mathematical methods and computer tools used for processing cardiographic information, the task of improving the accuracy of methods and means of analyzing the electrocardiosignal (EX) for the diagnosis of MI remains urgent in this field of research. The existing classical methods and diagnostic tools do not meet the modern requirements for the accuracy of IM diagnostics. Considering the existing imperfect devices and diagnostic systems for MI, as well as the human factor, it is obvious that there is a need to create a method to support decision-making with increased accuracy of diagnosis of MI, which can help the doctor.

Purpose of research. The aim is to increase the accuracy of cardiographic information processing tools based on neural network analysis for the diagnosis of myocardial infarction.

Research objectives. Methods of machine learning theory, digital signal processing theory, systems theory and system analysis, cardiology and diagnostics are used to solve the tasks in the work.

The subject of research. The subject of the research is methods of processing cardiographic information for the diagnosis of myocardial infarction, methods of preparation of initial data, structure and algorithms of neural network training

The scientific novelty.

1. A technique of neural network analysis of the EC is proposed, which expands its functionality, consisting in a sequential neural network analysis of the transmural of myocardial infarction first, then direct and reciprocal signs of myocardial infarction, and allows forming a diagnostic conclusion about the presence of MI.

2. Logical functions have been synthesized for the decision support system for the presence of myocardial infarction and the preparation of a diagnostic

conclusion on the localization of MI based on the proposed technique of neural network analysis of EX.

3. The structure of the method for supporting the decision-making on the presence of myocardial infarction is proposed and justified, implementing the proposed methods and allowing to bring the possibilities of preclinical processing of cardiographic information closer to the level of clinical examinations of the heart.

Practical significance of the work. 1. Предложенные методики обработки кардиографической информации могут быть использованы при построении новых средств кардиодиагностики.

2. Методика обработки кардиографической информации и нейросетевого анализа ЭКС на основе предварительного выделения отдельных сегментов кардиоцикла, их нейросетевом анализе, расширяет функциональные возможности доклинической обработки кардиографической информации, позволяет точнее локализовать инфаркт миокарда и место повреждения миокарда.

The main findings of the defense

1. The technique of neural network analysis of ECS, which consists in the isolation and joint neural network analysis of direct and reciprocal signs of myocardial infarction of individual elements of the cardiocycle, providing a fundamental opportunity in terms of mass examination with a probability of up to 99.7% to determine the localization of MI. (RF Patent No. 2704913).

2. Decisive rules for drawing up a diagnostic conclusion on the localization of MI based on the analysis of neural network outputs.

3. The structure of the method of decision support for the presence of myocardial infarction, which allows to implement the developed approach to the processing of cardiographic information and used as a basis for the construction of new means of cardiodiagnostics.

Reliability and approbation of results. The main results of the work were presented at 6 international and scientific and technical conferences and forums, including "IEEE at the 12th International Conference on the Application of Information and Communication Technologies", AICT2018 (Almaty 2018); "XX International Conference of Young Specialists in Micro/Nanotechnology and Electronic Devices", EDM 2019, (Novosibirsk 2019); "SHLYANDINSKY Readings – 2019" at the XI International Scientific and Technical Conference" (Penza 2019); annual national scientific and technical conference "SPbPU Science Week-2019" with international participation (St. Petersburg-2019); The approbation took place at the international forum "Commercialization of technologies as a tool for integrating education and business" (Nur-Sultan-2019); at the International Scientific and Practical Conference "Satpayev Readings-2018" (Almaty 2018).

Researcher's personal contribution. The main results submitted for defense were obtained by the author himself. The results published jointly with other

authors belong to the authors in equal shares. The results of other authors used in the course of the presentation contain references to the relevant literature.

Publication of the main results of the dissertation research. The main conclusions of the work are presented in 15 publications, including 2 articles in the journal included in the Scopus database (percentile 48%, 43%), 2 articles at international conferences included in the Scopus database, 4 articles in publications recommended by the RCSC RK, 1 patent for a utility model of the Russian Federation, 1 patent on the Eurasian copyright, 5 articles in other publications.

Structure and volume of dissertation work. The work consists of an introduction, two chapters, a conclusion, a list of sources used and appendices. The total volume of the work is 115 pages, the work contains 55 figures, 15 tables, 3 appendices, a list of literature from 122 titles.

Brief description of the dissertation research.

The introduction presents the relevance of the research topic, the purpose, the subject of scientific work, the tasks set before the creation of research work, research methods. The scientific novelty of the research work and its practical significance are described. The approbation of research results and publication of research results are also shown.

In the **first chapter**, the existing methods and means of processing cardiographic information for the diagnosis of myocardial infarction were described and their critical analysis was carried out. The shortcomings of existing methods for detecting myocardial infarction and the development of new methods for processing cardiological information are substantiated and revealed. Using machine learning methods, parameters of myocardial infarction were given, electrocardiosignals were analyzed using machine learning methods, and a research method was chosen. A complete description of neural networks and their types is presented. A brief analysis of neural networks is given and the neural network method for analyzing electrocardiosignals was chosen.

In the **second chapter**, a method is proposed to detect myocardial infarction using neural network analysis of electrocardiosignals. The characteristic of the stages of the principle of operation of the proposed method is given. There is a detailed description of each stage of the proposed method, and what work was done at each stage is laid out in stages. The structure implementing the proposed methods is proposed and justified, which allows to bring the cardiological information capable of making a decision about the presence of myocardial infarction to the level of clinical research.

In conclusion, the obtained results and conclusions of the dissertation research are presented, plans for further work in the chosen direction are reflected.