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Importance of Studying Medical Biological Signal and Image Processing Methods Using Modern Technologies

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Abstract: *Many medical studies require long-term monitoring of the patient's condition, which is due to the need to use automated systems for registering biomedical signals (hereinafter referred to as biosignals in the text), process them to assess functional changes in the body, and analyze large amounts of data to formulate a therapeutic process strategy. Biosignals are physical manifestations of the physiological processes of a living organism, which can be measured and measured. it is placed in a convenient form for further processing. The processing of biosignals is carried out to distinguish informative signs for medical diagnostics.*

The article discusses the importance of studying methods of medical biological signal and image processing using modern technologies, analysis and processing of biomedical signals and images. Information in the field of biomedical signal processing is covered using modern algorithms and methods.

Key words: *biomedical signals, images, processing, modern technology, student*

Introduction

In recent years, the emergence of many diagnostic equipment for monitoring human physiological parameters in clinical practice opens up great opportunities for improving medical diagnostic methods. A significant increase in the level of technical development of modern diagnostic systems due to the introduction of equipment and improvement of production technologies has made automated diagnostic systems indispensable in everyday practice. In today's advanced world, some imaging techniques are widely used to detect diseases and provide diagnostic information. Important elements of medical diagnostic systems are primary and secondary converters of biomedical signals that ensure the transformation of physiological processes occurring in the human body into diagnostic information.

The state of a biological object is described by a set of structural data consisting of a set of elements and connections of the object, as well as a subset of their properties. Information about an object is a value that reflects the state of an object in a certain language and is determined by a set of terms (symbols, signals) recorded in a certain environment. Biomedical signals carry information about the physical manifestations of physiological processes (events) of a living organism, which can be measured and presented in a form convenient for processing with the help of computer technologies. An example of a phenomenon can be the work of the heart and the resulting electrical potentials on the surface of the body. The biomedical signal corresponding to this phenomenon is the ECG. Living organisms consist of many interconnected systems. For example, the human body includes nervous, cardiovascular, musculoskeletal and other systems. The methods of studying physiological processes used in modern clinical monitoring devices should ensure the continuity of registration of biological signals with a high diagnostic value of the obtained indicators. A number of biomedical signal research methods widely used in functional diagnostics meet these requirements.

In relation to information technologies in the field of healthcare organization, various digital indicators serve as signals, for example, morbidity, mortality; may also contain information about financial, human and material resources circulating in medical signals, health and related areas of economic activity.

Background: Biomedical signaling is the study of physiological activity in organisms, from gene and protein sequences to nerve and heart rhythms to tissue and organ imaging. Biomedical signal processing aims to extract important information from biomedical signals. With the help of biomedical signal processing, biologists can discover new information and doctors can monitor various diseases. When biological signals appearing in the human body interact with physical bodies (detectors), the latter may have certain changes in their properties, which are recorded by special devices. In humans, the signals are sent to the brain for further analysis. In both cases, signals are recorded. In computer science, registered signals are called data.

The quality of digital medical images has become a serious problem because noise and other factors affect medical photography. Medical images should be clear, clean and noise-free. Denoising in digital medical images remains one of the main areas of research in biomedical signals and images. Image processing can be performed for various purposes: it consists of improving graphic data for human interpretation and processing image data for tasks such as storing, transmitting and receiving graphic data, identifying and identifying objects, and restoring missing areas. Various imaging modalities are widely used in the biomedical field, namely functional magnetic resonance imaging (MRI), computed tomography (CT), ultrasound imaging, and positron emission tomography (PET). Image processing methods include several methods, namely: enhancement, segmentation, selection of object boundaries, pre-filtering method, selection of characteristic points of the object and morphological operations. Segmentation is a process used to eliminate complex processes in images.

The first step in the study of biological systems is the use of special medical equipment to convert the phenomena under study into electrical signals that can be measured. These include electroencephalogram (EEG), magnetic resonance imaging (MRI), positron emission tomography (PET), single photon emission computed tomography (SPECT), magnetoencephalography (MEG) and a number of other methods. The main sources of information about the work of the brain are the results of an electroencephalogram (EEG).

The EEG signal has a number of characteristic rhythms and patterns and a complex composition that are of interest to researchers both in the study of pathologies (eg, epilepsy, schizophrenia) and in the analysis of cognitive processes. Biomedical signals reflecting changes in functional processes in the human body, including the brain, are not discrete, but continuous, therefore, if such signals are converted into a time series using analog-digital conversion, operations performed at the second and third stages of the study of biological systems can be performed.

The second step is to filter and remove signal distortions (artifacts). In many cases, the study of EEG signals is complicated by the presence of parasitic patterns - noise and artifacts caused by external signal sources and processes occurring in the body itself, for example, eye movements, heart rhythms, facial and other body activities.

The third step is to identify events in biomedical signals and analyze their information properties, modeling processes and systems that create biomedical signals. A number of methods for analyzing non-stationary signals in nonlinear dynamics have been developed, for example, Fourier transform, wavelet analysis, which turn out to be very effective in analyzing EEG.

All biologically active processes occurring in the human body are accompanied by the production of various signals - electromagnetic, acoustic, mechanical. Signals in medicine can also be information about a person's condition - for example, his height, body weight, composition of blood and other biological fluids, signals are objective and subjective symptoms of diseases - patient complaints, fever, jaundice, results of physical examinations.

Biomedical data related to healthy people and patients can be organized into the following groups:

1. Quantitative data are parameters; they can be characterized by discrete values: the height of the patient, the concentration of trace elements and biologically active substances in the blood, the incidence of tuberculosis in the population, the number of HIV-infected patients, etc.
2. Qualitative data characters; they cannot be evaluated precisely, although they can be ranked (that is, systematized with conditional points: one point, two points, etc.). Such information includes, for example, the color of the skin, the presence of pain, the quality of a person's life, etc. Qualities that can belong to only two categories (their presence or absence) are called secondary.
3. Static images of human organs or his whole body; they reflect a picture of a human patient, various areas of pathologically changed tissues, often with the help of radiological diagnostics - X-ray, radionuclide, ultrasound, magnetic resonance; for example, pathological changes in chest X-ray, sonogram, brain imaging. Static images include photographs of macro-preparations and histological sections and endoscopic images.
4. Dynamic images of human organs; they are obtained during the continuous registration of moving organs, for example, the heart, lungs (on a monitor or computer hard disk), the study of rapidly changing patterns of passage of radiopaque or radionuclide substances through the body (x-ray examination of the digestive tract, radionuclide examination of the heart).
5. Dynamic data of physiological functions: electrocardiogram, electroencephalogram, curves recorded during the passage of a radioactive substance through the body, etc.

Thus, the registered signals, now called data, can have a different form of display.

The vital activity of the human body is related to the course of a number of processes of an electrical nature in it. These processes are related to the activity of cells that convert chemical energy into electrical energy, as well as the activity of other organs. The human heart generates the strongest electric and magnetic fields in the body. Biosignals can be periodic or rapidly changing. Depending on the type of producing field, it can be biomagnetic signals or bioelectrical signals. In order to evaluate the intensity of biosignals and therefore to choose the appropriate sensor type, it is necessary to consider the bioelectrical and biomagnetic signals of the human body and compare their magnitude and frequency with other known signal sources.

Signal processing is a branch of radio engineering that involves restoration, separation of information streams, noise suppression, data compression, filtering, and signal amplification. The theory of signal processing is a set of mathematical methods that describe the conversion of analog signals using technical devices presented in an idealized form in the theory. For example, the reception of a signal against a background of noise is described in the form of a signal filtering procedure using a filter, the task of which is to minimize noise and interference and minimal distortion of the received signal.

Abstract: Biomedical signal processing is a rapidly developing field. Processing of biomedical signals is carried out for the purpose of identifying informational signs in them or determining diagnostic indicators. In particular, biomedical signal processing plays an important role in biological research and medical practice. In the advanced world, some imaging techniques are now widely used to detect diseases and provide diagnostic information. It is important to acquaint students with the basic methods of calculating the parameters of biomedical signal processing systems, and to familiarize students with the general issues of the correct use of existing mathematical methods and algorithms for the analysis of experimental biomedical data of various physical nature, signal processing methods and the application of these methods to new devices and diagnostic systems. improve design and manufacture and use for medical purposes.

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