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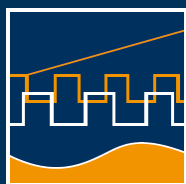
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# COMPUTER IMAGE ANALYSIS FOR NEUROSURGERY REHABILITATION

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## ABSTRACT

Distance access by Internet or relay link from Minsk to other area of Belarus is the progress of rehabilitation by T-therapy after neurosurgery operation provide with the complex spectrum device. For analysis of patients we use a special media for measurement of electroencephalogram (EEG). In Minsk there are specialists who have got a long time experience for analysis and interpretation of EEG that is very important at the time of rehabilitation period. By help a special device included in our unit for rehabilitation and software we can stay in Minsk and make a correction in the procedure for patients in suburb clinics or other areas of Belarus. For this purpose we can distance tune a low frequency, gain of amplifiers, rotate of electromagnetic field and set a time of complex spectrum influence. This method can be extends on other areas of different countries

**Index Terms:** remote access via Internet, post-surgical rehabilitation

## 1. Introduction

Stimulation of intracellular processes in mitochondrial membranes due to the complex spectrum of electromagnetic waves (T-therapy) is activating protective functions of an organism. The results of investigations directed at treating human diseases, including vascular encephalon diseases, and also acceleration of post-surgical rehabilitation process and application of the complex spectrum for stimulating processes in biotechnology are presented in [1].

Application of additive effect of electromagnetic waves of informative levels for stimulating intracellular processes is based on experimentally established facts about exclusion of the so-called threshold or trigger effect in using of T-therapy. It should be noted, that experiments carried out on yeast applying only the sources of millimeter waves (EHF), have revealed the necessity to provide quite a long-term exposure (40 minutes and longer), after which the number of cell division starts to grow. Unfortunately, abroad, experiments on yeast have not been experimentally verified. And only much later, returning to already studied combined effect of EHF and ultra-violet oscillations, interesting results have been obtained on the dynamics of ion permeability via cell membrane [2].

The physical model for the analysis of transmission of electromagnetic energy in infrared or optical ranges can be developed based on the laws of quantum mechanics [4].

Propagation of wave packet through the potential barrier on the membrane surface is determined by the potential energy barrier height. If the quantum energy does not exceed the potential barrier, there is a certain

probability of propagation through the barrier. For a complex spectrum including EHF and infrared oscillations, penetration through the potential barrier is stipulated by nonlinear parametric action.

Nowadays, the problem of treatment of human diseases and follow-up care has become still more important, first of all, due to the deterioration of ecological situation, nervous stresses, especially, in the areas with a raised radiation level after the Chernobyl accident, acceleration of tempo of modern living and other causes [3]. At present, non-drug modes of treatment with usage of electromagnetic waves oscillations sources are being developed quite rapidly both, in CIS countries, and abroad.

As it has already been noted, the process of synchronization of mitochondrial oscillations inside the cell by an external source, makes it possible to activate protective functions.

Recently, in the scientific literature the question on application of terahertz sources of oscillations for treating various diseases has been discussed [8]. Essentially, T-therapy includes the usage of the source of terahertz oscillations available within the range of infrared radiation. At the present stage of electronics development, it became possible to apply in practice terahertz oscillators with using a new class of solid-state devices - resonance-tunnel diodes and transistors (RTD, RTT) [9].

The physical effect of terahertz frequency is based on radiation absorption by various molecules. As oscillations' frequencies in the terahertz range are much higher in comparison with EHF, therefore, the quantum energy essentially increases. Nowadays, the predicted success of disease diagnostics is associated with the development of spectrum analyzers (up to 3 THz) for providing diagnostics of various diseases [8].

For the treatment and follow-up care of patients with a cerebral blood flow disorder, encephalograms (EEG) are widely used, and to analyze its results, high-qualified doctors should be available. Application of remote access via Internet or radio relay links allows one to analyze EEG results in a specialized medical institution with highly skilled doctors available.

## 2. Description of remote access system

For the distance access we use a system like vector network analyzer which traditionally based on the physical transfer of MI (measuring instruments) and the number of calibrating facilities to the metrological service (MS).

The downtime provided in compliance with the schedules of metrological studies can be unwanted for MI consumers until MI and calibrating facilities are not available for a consumer. After returning of MI, complementary delays are introduced for restoration of

MI operating mode, checking of their operation, drawing up of documentation and introduction of new calibration data.

Realization of the "remote calibration" using Internet as means of data transmission has been developed as the solution of the problems related to MI transportation, environment contamination, time expenditure and high cost of the existing calibration systems. The additional economic effect is achieved by advancing of the same method of measurement for all MI consumers.

Remote calibration provides the possibility of on-line testing of measurements just by a simple connection to the Internet.

In the system developed by the scientific research laboratory of the Belarusian State University of Informatics and Radioelectronics, EEG designed in the same laboratory are applied, controlled by an external computer via standard GPIB with using of various calibration procedures,

From the point of view of measurement assurance of the measuring system, it is possible to distinguish three main components: calibration facilities, the VNA itself, and software. New possibilities of the developed system make it possible to eliminate the necessity to send periodically MI to MS for conducting metrological tests. Instead of this, on the MI consumer demand, the metrological service sends him calibration facilities, and with the aid of the software directly via Internet carries out the MI calibration, and after that the MI consumer sends the calibration facilities back to the owner. Calibration facilities are the line segments of precision transmission lines, such as coaxial lines, wave guides, etc. The measurements of these calibration facilities carried out by the metrological service by means of the remote access via the Internet allow to estimate their accuracy in full measure. It reduces the expansion of intervals of uncertainty which occur while advancing of the device though the checking chain from the consumer to MS and back.

The data for each MI are saved in the MS database, so when the consumer of MI enters into system of the service, the corresponding data are loaded from the database. After that, measurements are corrected directly in the MI consumer's premises sending the commands and settings via the Internet using the files stored in the database. It allows to effectively determine very small intervals of uncertainty based on the customer's own set of calibrating facilities for metrological studies. Computing procedures of the system are estimating the uncertainty in the measurements carried out by the MI consumer.

The usage of the Internet effectively expands the connection through GPIB of the control computer of MS with the control computer and EEG of the consumer. Now, when to the consumer of MI needs the measurements with the highest accuracy, he can receive the high-precision calibrating facilities by mail from the metrological service. Then the employee of the MI consumer opens the Web-page of the system, loads the specialized software, and makes the connection to the system server. The software is provided to the consumer during the whole process of calibration with using of his own calibrating facilities, and then the measurement of

the high-precision standard facilities received from MS. The software for EEG controls the MI, deciphers the data and corrects them using the calibration database.

The service system of EEG calibration via the Internet is based on the TCP-IP protocol for providing a two-way communication between a server and EEG of the consumer. The data flow between the server and the client includes the measured data and control commands via the vehicle channel for EEG.

EEG software contains the functions enabling to save and display the data files both on the screen and on the paper, to stop or restart the process of measurement. The data are stored on the server, and can be seen on the local computer of the client for using in documents or in the certificates on calibration

Realization of the "client - server" technology in the framework of EEG allows to significantly expand the measurement limits. An occasion arises to control several remote MI from one workplace equipped by the client's unit parts. On remote computers the server software parts is loaded. The following opportunity is to organize the access of several users to one device. That is, on the computer with the connected MI the server part is installed, and at the users' computers – the clients' parts. The EEG client - server mechanism works on the basis of TCP/IP protocol. These can be local networks, connections by means of modems, Internet, any system supporting the TCP/IP standard.

### **3. Application of T-therapy for treatment and rehabilitation of neurological diseases**

The cardinal decision of the problem of a stroke (cerebral circulation disorder) is associated with conducting surgical operations on account of cerebral aneurysm with the subsequent follow-up care of patients [3].

In this connection, a significant reducing of the rehabilitation period and return of patients to their labor activity can be achieved by conducting physiotherapy by the T-therapy method or by the additive effect of the electromagnetic waves' complex spectrum at the informative level, that is, with a rather low intensity.

The problem of neuro-surgical patients' rehabilitation is quite urgent. It has been previously considered, that there are no therapeutic indications for applying active treatment mode, especially with using of hardware-based physiotherapy, within an early postoperative period due to the possible bleeding in the postoperative period and other complications. They used to apply just drug therapy, massage and exercise therapy. Further studies carried out in the Scientific Research Institute for Balneology and Physiotherapy of the USSR Ministry of Health (at present, the Russian center of the Restorative Medicine and Balneology) had proved the expediency of application of decimeter waves, sinusoidal modulated current therapy (SMT-therapy) by the method of electrosleep, oxygen, radon, carbonic acid gas baths for the additive treatment of patients after operations on account of vascular encephalon diseases. However these procedures were administered after 1-1, 5 months after operation and were not instituted at all with availability of

contraindications to electro-procedures and in case of grave condition of patients.

For the further analysis it should be noted, that only in neurosurgery department of the 5th clinical hospital of the city of Minsk, annually almost 100-120 operations are performed on account of vascular encephalon diseases, including 80-90 operations for cutting off the aneurysm from a cerebral blood flow by clipping or occlusions of the aneurysm cavity, hematoma emptying. As a whole, in the republic the number of patients, who have been operated in neurosurgical departments, amounts to several thousand. A significant increase in the number of patients, who needs rehabilitation, should be taken into account also in Russia, and other CIS countries. In the process of analyzing the patients with neurosurgical pathology who had to undergo the course of physiotherapeutic treatment, it has been established that only 7-10 % from them took physiotherapy, and mainly massage.

The clinical presentation after the surgery depends on lesion focus localization and is revealed by various kinds of neural disorders, including motor, sensitive, referred abnormalities, thus causing the necessity to apply physical factors. As the guiding syndrome for this category of patients is the vascular one, it should be expedient to include into the rehabilitation program physical factors with apparent vasoactive action – combined effect of infrared and millimeter waves' range, and also magnetic fields.

The method of T-therapy proved good for treating such serious diseases as myocardial infarction in the acute period and oncology pathology. Besides, the positive influence of T-therapy has been established on cerebral hemodynamics, on rheological properties and blood coagulation. Biological effect of T-therapy is caused by enhancement of external effects due to parametrical action and their interaction with oscillatory processes in mitochondrion membranes. As shown experimentally, there occurs an increase in protein content and, therefore, activation of protective functions of an organism.

The mechanism of combined effect of infrared radiation (IR), EHF and magnetic fields allows to use them for vascular cerebral pathology [5], thus determining the research of the patients' treatment in the early postoperative period (1-2 weeks) after surgical operation on account of cerebral vascular pathology for studying hemodynamic abnormalities.

The prior examination of the group of patients includes the control of the neurologic state with using the criteria of the cure rate of patients with cerebral vascular pathology, rheoencephalography (REG), ultrasonic dopplerography (ultrasound imaging) of head and neck great vessels, transcranial examination at the Doppler's apparatus, certain hemostasis properties, parameters of lipid peroxidation, lymphocytic-segmental index (adaptive response type), angiography.

Clinical neurological examination was carried out for all patients before and after the treatment course and included examination and questioning of patients with the help of a questionnaire worked out by our specialists.

Doppler-sonography was conducted on the Vasoscan apparatus made by Sonicaid (Great Britain), making it possible to carry out the spectrum analysis of Doppler

signal by fast Fourier transformation and computer signal processing.

Cerebral blood flow has been evaluated by the method of rheoencephalography (REG). Rheographic index and waves' amplitude have been calculated.

Magnetic-resonance tomography and angiography have been carried out on the device of " Picker " company with the magnetic field capacity of 1,0 tesla.

The data obtained in the course of the studies by the specified methods made it possible to come to a conclusion about a positive response to the rehabilitation effect of T-therapy and significant decrease of the rehabilitation period.

Taking into account the above-stated, application of the method of T-therapy and engineering output of appropriate devices could be considered a priority line of development in the high technology area.

In the up-to-date medicine, veterinary medicine and biotechnology the search of new methods of treatment is a permanent process. Traditional methods of treatment based on application of pharmaceuticals, frequently have serious consequences because of complications.

T-therapy was recognized due to its obvious advantages:

- has no epiphenomenon
- reduction of the treatment period
- enhancement of efficiency of the treatment
- improving the treatment quality
- T-therapy allows to discard medicinal preparations

- treatment of diseases tones up an organism

T-therapy is efficiently used for:

- vertebral osteochondrosis and musculoskeletal system abnormalities treatment
- healing from abused drug-dependence and nicotine-dependence
- prostatitis treatment
- cervical erosion treatment
- gastric ulcer and duodenal ulcer treatment
- normalization of functions of abdominal salivary gland and thyroid

The number of cured diseases is constantly increases.

In veterinary medicine, T-therapy allows to provide an efficient treatment for mastitis, endometritis, stomachic diseases and others.

Recently application of biotechnological methods for treatment of diseases in people and animals is being rapidly increased. The method of T-therapy has allowed to considerably increase embryos engraftment while their transplantation, makes it possible to improve immunoresistance [5].

The complex spectrum of electromagnetic waves due to the effect on mitochondrial membranes of cells has allowed to substantially intensify the processes in biotechnology [10]. Practical results have been obtained in the process of studying the effect of 54 GHz frequency EHF oscillations on the yeast culture used in baking of bread [11].

The usage of the complex spectrum of oscillations of T-therapy has considerably expanded the field of application in the biotechnology cycle of controlled breeding of animals [10]. Of great value is the development of methods of preservation of oocytes in the

biotechnological process of their development and fertilization [11]. Due to the complex spectrum of electromagnetic waves it has become possible to increase the survival rate of oocytes by a factor of 4-5, thus allowing to get a significant amount of embryos for the subsequent transplantation.

Transplantation of embryos is the way to obtain from an individual a big progeny with improved genetic properties. Thus, from good-milk cows, in their life cycle, it is possible to get up to 100 and more embryos. With transplantation of these embryos into the cow with ordinary yield of milk, calves are born with a high genetic potential and high immunological state, conserved within the whole life period.

Great expectations are associated with cultivation of stem cells, which enables to obtain a whole organ of living organisms. And in this aspect, application of methods of T-therapy is expedient for stimulating intracellular processes. After solving ethic problems, the use of such a technology will allow to cure a series of severe diseases, including Alzheimer's sclerosis, (the former president of the USA, R.Reagan, died of in 2004).

In advanced countries, similar researches are carried out quite intensively. Unfortunately, taking into account high closed character of non-medication methods, the number of open publications is rather small. However the level of conducted researches is rather high and includes application of up-to-date engineering achievements, as reported by participants of international scientific conferences.

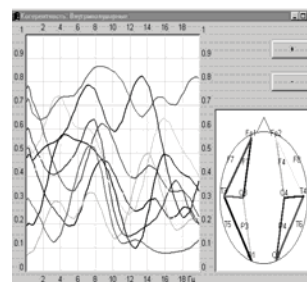
The technological level of the " Tera " device exceeds in quality the known devices for EHF therapy due to the original technique of combined effect of the complex spectrum and an original diagnostics unit installed in the same case; the registered patents of the Republic of Belarus and Russian Federation are available [5,6,7].

Analogs of similar devices are not manufactured, though studies in the given field are being conducted.

Based on the carried out researches, patents of the Republic of Belarus and the Russian Federation have been taken out for the mode of treatment, diagnostics and the device for treatment. The priority of invention belongs to BGUIR.

Environmental safety of application of the treatment device is provided by quite low levels of intensity of fields and corresponding informative effects. The electrical safety of the device is provided by the specific design approach.

#### 4. Example of head brain neurophysiology characteristics according to the electroencephalography data



On the Fig. presented coherent EEG analysis for the patient C., 49 years old, in the early post-surgery period after the operation on account of vascular encephalon disease denotes the decrease in the coherence level in front and central parts, which was received from the suburb clinic and analyzed in Minsk.

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