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HEALTH — PREVENTION: PRINCIPLES AND POSTULATES

Introduction: The main tasks of modern health care are not only in the plane of high-tech treatments, and focus on developing high-tech methods of prevention and early diagnosis of healthy individuals

The purpose of this work is to examine prevention and health as two interrelated and interdependent process.

Methodological approach: stimulation of health reserves.

The main content: Health is seen as information control system, and control – as the stimulation of health reserves. As a measure of health is the body's ability to adapt to the environment. Under the stimulation of reserves we mean a series of control actions that support the body's ability to effectively resist the environmental perturbations. Methodological approach of such stimulation is a set of methods, offering individually-appropriate control actions. These methods are the basis of health improvement and prevention information technologies. The field of the primary and secondary health prevention and their role in maintaining, strengthening and expanding of health are defined. Considering prevention and health as two interrelated and mutually agreed process, the postulates and principles of health improvement and prevention are defined.

Conclusion: The foundation of solving of problems in the field of health improvement and prevention is the unity of the verbal and quantitative approaches that form the basis of preventive health information technologies.

Keywords: health, prevention, reserves, stimulation, adaptation, information technologies.

M.N. Kovalenko, O.A. Kutsyak

THE DIRECT MONITORING OF PATIENT'S SPONTANEOUS BREATHING INFORMATION SYSTEM

Introduction: The necessity and the relevance of patient's spontaneous breathing monitoring is essential due to the fact that critically ill patients on spontaneous breathing cannot do spirometry for respiratory function information gathering. Basically, the monitoring systems realize information gathering through indirect breathing registration and do not represent the pulmonary ventilation parameters. The paper is focused on external breathing function information.

The purpose of the work is to develop the patient's spontaneous breathing monitoring information system with the priority of control of the pulmonary ventilation parameters.

Methods: The method of registration and conversion of airflow volumetric rate as a source of information about patient's respiratory system state, the method of direct spontaneous breathing monitoring of patient, the math statistical methods were used.

Results and discussion: The proposed information system in technical and information aspects implements patient's monitoring of direct respiratory system parameters and is a tool by which the specialist physician controls the patient's pulmonary ventilation state and makes decisions. The software which is written in the IT environment Delphi 7 is asking the monitoring device, carries data gathering, data processing, linearization and patients database formation. For each patient in the database the electronic card is created. The information in the system can be obtained as in the monitoring process and by the completion of the breathing monitoring process. The main business processes in the information direct breathing monitoring system are described.

The system's algorithm, which provides information of the patient's respiratory function state, links the methodological, technical and informational aspects of patient's direct spontaneous breathing monitoring. The measurement limits of the pulmonary ventilation function parameters at direct spontaneous breathing monitoring were calculated.

Conclusion: The direct spontaneous breathing monitoring information system with the priority of ventilation function parameters is the actual question. The proposed direct spontaneous breathing monitoring information system is useful for physicians and helps timely decision of the treatment correction in critically ill patients. The system's algorithm is developed and the characteristic direct breathing function parameters are emphasized. The cases of patient's medicament correct treatment as a result of respiratory system dysfunction and transfer the patient to mechanical ventilation is illustrated.

Keywords: breathing, monitoring, ventilatory function, tidal volume, spontaneous, information system, airflow volumetric rate.

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THE INFORMATION-EXTREME LEARNING ALGORITHM OF THE INFECTIOUS DISEASES DIAGNOSIS SYSTEM

Introduction: The main direction of infectious diseases diagnostics improvement is the development of computerized diagnostic system (CDS) for infectious diseases treatment determining based on ideas and methods of machine learning and pattern recognition.

The purpose of the work is to develop an information-extreme learning algorithm of CDS for determining acute enteric infection (AEI) treatment.

Methods: The CDS learning algorithm is proposed to determine acute enteric infection (AEI) treatment within the bounds of information-extreme intellectual technology (IEIT), which is based on maximization of informational capability of CDS in the process of its learning. The laboratory data of the control group of persons, patients required a combined treatment with the inclusion of colloidal silver (10 mg / L) and patients required treatment with probiotic and colloidal silver on the background of basic therapy formed the training dataset. These patterns were classified using IEIT with parallel-sequential optimization of patterns' binary reference vector coordinates' selection levels.

Results: The practical implementation of the patterns' binary reference vectors coordinates' selection levels parallel-sequential optimization algorithm allowed to raise the accuracy of machine diagnosing under a priori uncertainty and confirmed the effectiveness and reliability of the developed software.

Conclusion: Designed information-extreme algorithm of CDS machine learning for AEI treatment determining on a priori classified training dataset allows to determine optimal patterns' binary reference vectors coordinates' selection levels that provides improving of the machine diagnosis accuracy.

Keywords: pattern recognition, information-extreme intellectual technology, acute enteric infection.

I.I. Yermakova, Yu.M. Solopchuk

COMPUTER MODEL OF HUMAN THERMOREGULATORY SYSTEM DURING IMMERSION

Introduction: Computer models of thermoregulation allow to predict the physiological characteristics and the thermal state of a human during immersion in water to avoid health hazard.

The purpose of this study is to develop a mathematical model for prediction of dynamic changes of body temperature and important physiological characteristics during water immersion and air environment

Results: Results of computer modeling showed that time of cooling of human body in water depends on water temperature and intensity of physical activity. During afloat with minimum physical activity, blood temperature drops at the rate of -1.5 ºC an hour at water temperature of 20 ºC and -2.35 ºC an hour at water temperature of 15 ºC. High level of physical activity can compensate heat loss and keep blood temperature at normal level and even increase it. Free-style swimming (600 W) at water temperature of 20 ºC raises blood temperature to 37.37 ºC and holds it on at the same level. But during immersion in water temperature of 15 ºC human physical activity of 600 W is not enough to compensate heat loss.

Conclusions: Mathematical model of human thermoregulatory system during immersion is developed. This model takes into account submersion level, environmental properties, intensity and type of human physical activity. The model enables to estimate functional and thermal state of human, survival time and terms of safety stay in water.

Keywords: cooling water, immersion, mathematical model, thermoregulatory system.

T.L. Mazurok

ADAPTIVE CONTROL OF TEACHING BASED ON A SYNERGISTIC APPROACH

Introduction: The paper considers the development of synergistic control model based on individualized teaching system adapts interdisciplinary relations.

The purpose of this article is to develop a means of improving the properties of adaptive control actions on the part of an automatization computer-aided teaching control system based on a synergistic approach and its realization of intellectual technologies, taking into account the characteristics of integrative teaching material.

Results: Determination of the coefficient of integration is the basis for process control to forms competencies. The example confirms practical importance of models of educational material and the interdisciplinary relations model. Software as editor of the interdisciplinary relations created for easy filling the matrix for teacher and the degree of relationships. The results of practical implementation of the neuro-fuzzy system confirm the accuracy of the data.

Conclusions: On the basis of the synergistic approach to teaching model adaptive control of the degree of integration of educational material. Means of intellectual control are used. Computer experiments confirmed the efficiency of the proposed approach.

Keywords: synergetic model of teaching, intellectual means of control, systems of interdisciplinary relations, integrated teaching.

Yu.A. Prokopchuk

FORMAL MODELS OF THE BASIC ENTITIES “VALUE DIGRAPH” AND “STRUCTURAL ENERGY”

Introduction: The present time features a new change of paradigm in complex-systems science. Processes that demonstrate not only nonlinearity, but also self-reference, deep indeterminate recursion, self-construction (self-programming), self-recovery, and self-motion are coming to the front. All these

properties are associated with a wide spectrum of multilevel evolutionary processes, especially cognitive ones, which can certainly be considered as phenomena of the ideal. The notion of the ideal is one of the most important categories in philosophy.

Problem statement: In fact, in natural sciences the ideal is not considered as a rigorous (formal) category. The lack of a consistent scientific theory of the ideal hinders the formulation and solution of applied problems involving the development of intelligent applications, true partner systems, cognitive robotics, and innovative approaches in education.

Purpose: This paper is aimed at constructing interrelated models of the basic ideal entities "value digraph" and "structural energy" and at studying their properties. As assumed by the author, these entities form the basis for strong (ideal) interactions that underlie the development of key cognitive architectures and processes.

Results: Interrelated models of the basic ideal entities "value digraph" and "structural energy" are constructed, and their properties are studied. The peculiarity of action of the structural coherence principle as applied to a value digraph and an arbitrary pattern and the role of structural energy in the value digraph structural instability mechanism are elucidated. A scheme of formation of generalized representations of a pattern is constructed. The role of structural energy in pattern sketch activity fluctuations is revealed. The mechanism of reduction (collapse) of the energetic function of a pattern and the mechanism of anticipation and adaptive resonance in its perception are considered.

Conclusion: The consideration of the model entities "value digraph" and "structural energy" makes it possible to describe ideal phenomena (cognitive dynamics) using the powerful tools of the nonlinear approach and to elucidate the mechanism of action of the principles of limiting generalization, quantum semantics, structural coherence, and adaptive resonance both on the level of a value digraph and on the level of a pattern. The fundamental role of value digraphs in the translation of structural energy inside the self-reference region responsible for cognitive processes is shown.

Keywords: models of ideal processes, cognitive architectures, Paradigm of Limiting Generalizations, structural energy, value and sketch digraphs

D.M. Parkhomchuk, O.V. Vizniuk

MULTIDIMENSIONAL SYSTEMS IDENTIFICATION USING GENETIC OPTIMIZATION ALGORITHMS

Introduction: This paper presents a new method for linear multidimensional systems identification. In contrast to existing methods, which use the fundamentals of linear algebra or mathematical statistics, the identification problem here is

reduced to an optimization problem, which is solved using the genetic algorithm called Differential Evolution. Due to the high resource capacity of the problem the parallel computing technology is used.

The purpose of this paper is to develop and confirm the efficiency of direct optimization methods for multidimensional systems identification.

Results: The error of parametric identification does not exceed the level of 10^{-36}, and the error of structural identification is less than 5%. These results show that the method presented in this paper is stable and meets the quality criteria.

Conclusion: The authors succeeded in reaching their objective. Direct optimization methods are effective for systems identification. Moreover, the modification of Differential Evolution method for parallel computing reduces the computation time from approx. 20 hours to 1 hour.

Keywords: Systems Identification, Differential Evolution, Global optimization, direct varitional methods.