

DEVELOPMENT OF MULTI-AGENT SYSTEM OF NEURAL NETWORK DIAGNOSTICS AND REMOTE MONITORING OF PATIENT (p. 4-11)

Natalia Axak

The system of medical diagnostics and remote monitoring based on the example of skin diseases was developed. The diagnostics is carried out by a group of multilayer perceptrons on the basis of processing the images of the explored object and medical registration data. The application of high-performance computing made it possible to carry out remote control of the state of the observed object by the change of its image in real time.

For the implementation of the indicated system, a generalized model of the process of neural network diagnostics and monitoring was developed. The distinctive features of this model are the combination of machine training and agent technologies, which allows, firstly, using results of the remote monitoring for making a diagnosis; secondly, using simultaneously the totality of methods and means of collection, storage, processing, analysis and transmission of a video stream or a single image for solving the problems of decision making based on image processing.

The multi-agent organizational structure of the components of the proposed model was designed. The organizational structure is characterized by the formed aggregation levels, as well as by the possibility to dynamically distribute the roles among the agents. Such organization makes it possible to adapt for managing the following incidents: monitoring the state of health, making diagnosis and medical aid.

Keywords: medical diagnostics, neural network classification, remote monitoring, organizational multi-agent system.

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INFORMATION SYNTHESIS OF ADAPTIVE SYSTEM FOR VISUAL DIAGNOSTICS OF EMOTIONAL AND MENTAL STATE OF A PERSON (p. 11-17)

Anatoliy Dovbysh, Igor Shelehov,
Dmitriy Prylepa, Ivan Golub

The visual method of the recognition of emotional and mental state of a person by his face images was proposed. An input mathematical description of psychodiagnostic system was formed according to the results of the analysis of the left and right hemisphere images of the face of a person. Information synthesis of the system was carried out in the framework of the information-extreme intelligence technologies of data analysis, which is based on maximizing the performance of machine learning. In this case, the effect of the RGB-components of color images on the functional efficiency of machine training of psychodiagnostic system was studied. The proposed method, unlike the existing methods, allows improving the accuracy of psychodiagnosics through the application of the developed modification of entropic criterion, capable to capture the smallest changes in the face images, which occur under the influence of external exciting factors. By the results of the physical simulation it was proved that the RGB-components of a color image of the face of person affect differently the information capability of the system. It was established that the exclusion from the input matrix of the recognition features for the red component of the image improves functional efficiency of psychodiagnostic system. In addition, the exclusion from the RGB-spectrum of the blue and green components do not change the value of information criterion, but they cannot be excluded from this spectrum, since they become informative in the complex. The obtained scientific results are of great practical importance

for determining emotional and mental state of a person, for example, when evaluating his suitability for a profession, ability to perform his functional duties, especially under extreme conditions, etc. Besides, the obtained results allow assessing functional efficiency of correction of emotional and mental state of a patient.

Keywords: optimization, information-extreme intelligent technology, information criterion, psychodiagnostics, training, criteria of functional efficiency.

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DEVELOPMENT OF MCELIECE MODIFIED ASYMMETRIC CRYPTO-CODE SYSTEM ON ELLIPTIC TRUNCATED CODES (p. 18-26)

Serhii Yevseiev, Khazail Rzayev,
Olga Korol, Zarifa Imanova

Symmetric and asymmetric cryptographic algorithms, providing the required level of cryptographic strength are generally used to ensure security in modern communication systems, and error-correcting coding techniques to ensure reliability. The use of asymmetric crypto-code systems enables integrated (with one mechanism) provision of the required levels of reliability, security and efficiency in the processing and transmission of confidential information via open channels of telecommunication systems. The research confirms that their usage provides high performance on the level of symmetric encryption algorithms with BSSH, provable cryptographic strength based on theoretical and complexity problems in arbitrary code decoding (10^{30} – 10^{35} group operations are provided), and reliability through the use of a shortened algebra-geometric code ($P_{\text{out}} 10^{-9}$ – 10^{-12} is provided). A major disadvantage of the use of the McEliece cryptographic system are large amounts of critical data (to provide the required cryptographic strength it is necessary to build a system in the GF (2^{10} – 2^{13})). In order to reduce the volume of key data (public key), we propose to use shortened codes, that enables to reduce the GF (2^6 – 2^8), while maintaining a cryptographic strength level; by introducing the character location entropy at initialization vector.

Keywords: asymmetric crypto-code system, theoretical-code scheme, modified error-correcting codes.

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A MODEL DEVELOPED FOR TEACHING AN ADAPTIVE SYSTEM OF RECOGNISING CYBERATTACKS AMONG NON-UNIFORM QUERIES IN INFORMATION SYSTEMS (p. 27-36)

Valeriy Lakhno, Hennadii Mohylnyi, Volodymyr Donchenko, Olha Smahina, Mykola Pyroh

The study presents results aimed at further development of models for intelligent and self-educational systems of recognising abnormalities and cyberattacks in mission-critical information systems (MCIS). It has been proven that the existing systems of cyberdefence still significantly rely on using models and algorithms of recognising cyberattacks, which allow taking into account information about the structure of incoming streams or the attackers' change of the intensity of queries, the speed of the attack, and the duration of the impulse.

A mathematical model has been suggested for the system module of intelligent identification of cyberattacks in heterogeneous flows of queries and network forms of cyberattacks. The model recognises heterogeneous incoming flows of queries and any possible change in the query intensity and other parameters of a targeted cyberattack aimed at a MCIS.

Simulation models, which had been created in MATLAB and Simulink, were used to research the dynamics of changes in the states of the subsystem of blocking queries in the process of detecting cyberattacks in a MCIS. The probability of solving the problem of recognising cyberattacks in heterogeneous flows of queries and network forms of cyberattacks is 85–98 %, depending on the type of the cyberattack. The results of the modelling allow selection of ways to counter and neutralize the effects of the impact of such targeted attacks and help analyse more sophisticated cyberattacks.

The suggested model of recognising complex cyberattacks if attackers use non-uniform flows of queries is more accurate, by 5–7 %, than the other existing models.

The developed simulation models enable a 25–30 % decrease in the setup time for projects of cyberdefence systems, including SIRCA for CIS or MCIS.

Keywords: recognition of cyberattacks, intelligent systems, cyberattack pattern, non-uniform/heterogeneous flows of queries.

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THE ANALYSIS OF METHODS FOR DETERMINING DIRECTION OF ARRIVAL OF SIGNALS IN PROBLEMS OF SPACE-TIME ACCESS (p. 36-44)

**Naors Y. Anad Alsaleem,
Mykola Moskalets, Svitlana Teplitskaya**

The analysis of methods for estimation of the signals direction of arrival based on the analysis of the directional characteristics of the antenna array according to the criterion of maximum and minimum level of the incoming signal is conducted. It is shown that the minimum methods are more accurate in comparison to the maximum methods. Considering the direct functional connection of the amplitude-amplitude-phase distribution of signals over the array elements with the value of signals direction of arrival, the technique allowing estimation of the field distribution vector together with an estimate of the array weight vector, which showed the computational complexity of the procedure, is presented. A number of superresolution techniques have been analyzed. The results of methods modeling with numerical estimates of resolution have shown that the resolution of these methods allows their implementation in the problems of space-time access under strictly limited conditions. The analysis of the signal arrival estimation algorithm using the sum-differential directional pattern with the definition of the direction finding by means of the equisignal zone is conducted. It is shown that this method seems to be

one of the most constructive and applicable to the problems of space-time access.

Keywords: space-time access, direction pattern, direction finding, superresolution, weight vector.

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DESIGNING THE TECHNOLOGY OF EXPRESS DIAGNOSTICS OF ELECTRIC TRAIN'S TRACTION DRIVE BY MEANS OF FRACTAL ANALYSIS (p. 45-54)

Oleksandr Babanin, Vladislav Bulba

The object of this study was the development of technology of the express diagnostics of the traction drives of electric trains. Its base was obtaining, processing and fractal analysis of vibroacoustic signals, which makes it possible to forecast the period of service of this unit in between planned maintenance works. We carried out the research into the failures of equipment of electric trains in operation, which showed that the share of defects in the traction reducers is the most significant and amounts to 41,2 % of the total number of failures in the carriage part. The method of selection of acoustic components (samples) was created, which makes it possible to separate them from the complete vibroacoustic signal. Its characteristic peculiarity is initial link to the time interval, determining final duration, as well as selection of a number of cyclically repeated components with each rotation of the large gear of the traction drive. Based on the wavelet conversion of detailing coefficients with high content of noise components, we used the method of denoising vibroacoustic samples with the help of soft thresholding. As the diagnostic parameter, the fractal Hurst index is proposed. The process of its determining is described and the maximum ranges of its change from the point of view of persistence are found.

Accordingly, the Hurst index's matching one or another range makes it possible to tell the presence or absence of defect in the traction drive, which can be later on, during a regular maintenance, categorized and removed. Thus, the application of the comprehensive technology of the express diagnostics makes it possible to promptly assess the technical condition of the traction drives of electric trains and to forecast their working capacity in between the planned types of repairs.

Keywords: vibroacoustic signal, tooth alignment, the Hurst index, sample, traction drive, express diagnostics, electric train.

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