

ABSTRACT AND REFERENCES

INFORMATION AND CONTROLLING SYSTEM

THE MODEL OF ACCURACY OF A LOCAL RADIO NAVIGATION SYSTEM CONSIDERING UNSTABLE PERFORMANCE OF INDIVIDUAL ELEMENTS

(p. 4-10)

Vitalii Savchenko, Oleh Vorobiov, Roman Mykolaichuk, Alisa Mykolaychuk, Tymur Kurtseitov

A mathematical model of the accuracy of the local radio navigation system was considered, built on the base of a network of pseudolites. It was determined that the key factor influencing the accuracy of determining the vector of status of the consumer is the geometry of the structure.

However, for certain categories of consumers there is a necessity of taking into account a possibility of degradation of the structure because of malfunctioning and possible intentional damage. Existing mathematical models of accuracy do not consider a capacity of change in the topology structure.

It was defined that for the assessment of the accuracy of navigation of specific consumers it is expedient to use a geometric factor that determines the degree of deterioration of finding the location relative to the accuracy of defining the pseudorange from the consumer to the radio-navigation points.

To consider the possibility of failure (destruction) of individual elements of the structure of a local radio navigation system, we introduce a probabilistic model that, on the base of registering the combinations of usable/faulty pseudolites and their relative geometric position, makes it possible to define the process of changing the accuracy of the system. As the main indicator of the accuracy, we use a root mean square deviation of the location definition (the state vector) of the consumer.

As a result of the research we identified and confirmed by simulation that the maximum accuracy (minimum values of geometric factor) can be achieved in the case when a consumer is located in the centre of a regular tetrahedron.

Given the sphericity of the Earth, a minimum value for a ground consumer is achieved when one pseudo satellite is in the zenith and the other three are evenly located in the horizontal plane.

The combination of the base model of accuracy with a stochastic model of reliability/survivability will allow designing spatial structure of local radio navigation systems by the criterion of stable performance.

Keywords: pseudo satellite, radio navigation system, state vector of the consumer, accuracy, navigation parameter, pseudorange.

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DESIGNING ALGORITHMS FOR OPTIMIZATION OF PARAMETERS OF FUNCTIONING OF INTELLIGENT SYSTEM FOR RADIONUCLIDE MYOCARDIAL DIAGNOSTICS (p. 11-18)**Anatoly Dovbysh, Alyona Moskalenko, Vyacheslav Moskalenko, Igor Shelehov**

The influence of the number of complex components of fast Fourier transformation in analyzing the polar maps of radionuclide examination of myocardium at rest and stress on the functional efficiency of the system of diagnostics of pathologies of myocardium was explored, and there were

defined their optimum values in the information sense, which allows increasing the efficiency of the algorithms of forming the diagnostic decision rules by reducing the capacity of the dictionary of features of recognition.

The information-extreme sequential cluster algorithms of the selection of the dictionary of features, which contains both quantitative and category features were developed and the results of their work were compared. The modifications of the algorithms of the selection of the dictionary were suggested, which allows increasing both the search speed of the optimal in the information sense dictionary and reducing its capacity by 40 %. We managed to get the faultless by the training matrix decision rules, the accuracy of which is in the exam mode asymptotically approaches the limit.

It was experimentally confirmed that the implementation of the proposed algorithm of the diagnosing system training has allowed to reduce the minimum representative volume of the training matrix from 300 to 81 vectors-implementations of the classes of recognition of the functional myocardium state.

Keywords: scintigraphy, Fourier transformation, information criterion, machine training, cluster algorithm.

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DEVELOPMENT OF WIRELESS VIBRATION TRANSDUCER BASED ON MEMS ACCELEROMETER (p. 18-24)

Pavlo Oliynik

When monitoring the vibration of heavy rotating machinery, one often has problems with cables of vibration transducers, as those cables are usually long, heavy and prone to damage. This paper is focused on the development of a wireless vibration transducer, based on the MEMS accelerometer, which is free of those problems. Owing to the schematics proposed, developed sensor's power consumption is low, at that analog filtering of vibration acceleration signal is provided. In the paper, spectral analysis based method of frequency response correction is also proposed. That method can be used for measurement of the vibration RMS and power spectra, while using an MCU with low computational power for data processing. The results of the tests conducted show that the transducer developed is well-behaved and that its precision is comparable to one of industrial piezoelectric transducers. So, the transducer developed can be used instead of the industrial transducers mentioned; at that, moving of the machine condition detection process from the high-level system to the transducer level allows one to decrease network traffic and simplify monitoring system as a whole.

Keywords: vibration, MEMS accelerometer, wireless vibration transducer, Wi-Fi, monitoring of rotating machinery.

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METHOD OF STUDYING CORROSION PROCESSES OF METAL ELECTRODES BY SURFACE VOLTAGE FLUCTUATIONS (p. 24-29)

Yurii Striletskyi, Victor Rovinskyi, Olga Yevchuk

The way of study of corrosion processes on the surface of the metal electrode based on the results of observations of voltage fluctuations on it is proposed.

The signal processing device for voltage measured on the surface of the metal electrode is developed. The device comprises a differential amplifier, bandpass filter and amplifier with controllable gain. The method of testing of the developed device is described. The research of the electrical noise voltage of the steel electrode immersed in an electrolyte solution is performed. The occurrence of the spectral component at the frequency of 10–12 Hz during a series of experiments was observed. The search for sustainable criteria for evaluating the presence of corrosion processes in the studied surface area revealed that the most informative parameter in the study of voltage fluctuations associated with corrosion processes on the surface of the metal electrode is the shape of probability distribution of instantaneous values of voltage and evaluation of information entropy. The shape of the probability distribution can be a source of additional information on the progress of electrochemical reactions on the surface because dry electrode signal distribution law was similar in shape to normal. Changing the shape of this distribution with the introduction of additional local maximum shows the influence of extraneous input sources, which can be an electrochemical reaction. Information entropy estimation of instantaneous signal values at lower settlement expenses made it possible to distinguish between the results of different experiments. The changing information entropy of instantaneous values; means the changed properties of the sources of electrical signals on the surface of the investigated electrode. The research enables to carry out external monitoring of corrosion processes on the inner surface of metal pipes.

Keywords: electrochemical corrosion, electrical noise voltage shape of probability distribution of instantaneous signal values, information entropy of instantaneous signal values.

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DESIGN OF ADAPTIVE SYSTEM OF DETECTION OF CYBER-ATTACKS, BASED ON THE MODEL OF LOGICAL PROCEDURES AND THE COVERAGE MATRICES OF FEATURES (p. 30-38)

Valeriy Lakhno, Svitlana Kazmirchuk, Yulia Kovalenko, Larisa Myrutenko, Larisa Zhmurko

The results of the research aimed at the further development of detection models of cyber threats, as well as of common classes of anomalies and cyber-attacks in mission critical computer systems (MCCS) are presented.

It is shown that one of the promising directions of synthesis of adaptive systems of detection and prevention of cyber-attacks is the application of models of logical procedures of detection, based on the coverage matrices of features of anomalies, threats and cyber-attacks within the known and new classes of the MCCS intrusions. The model of detection of cyber-attacks, anomalies and threats to MCCS was designed, which is based on the application of learning samples in the form of matrices of features and elementary classifiers for each of the modeled classes.

The studies on minimization of the number of training samples, represented in a binary form of discerning features were carried out. The program “Threat Analyzer” was developed which allows automatic generation of dimensions of training matrix of features of anomalies, cyber threats, or cyber-attacks, without requiring the participation of experts.

It is shown that for the object detection within known classes of cyber threats, attacks, anomalies, the usage in the training matrices of representative sets of 3-4 features long allows maximizing the effectiveness of the algorithm, reaching up to 98 %.

Keywords: adaptive system of detection of cyber threats, features of a cyber- attack, logical procedures, elementary classifier.

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DEVELOPMENT OF ALTERNATIVE DIAGNOSTIC FEATURE SYSTEM IN THE CARDIOLOGY DECISION SUPPORT SYSTEMS (p. 39-44)

Anatoly Povoroznyuk, Anna Filatova

The trend towards an increase in the production of Ukrainian digital electrocardiographic telemetry systems such as transtelephonic digital 12-channel electrocardiograph complex “Telecard” identified the need to create intelligent automated cardiac decision support systems. The basis of these systems is the morphologic analysis of electrocardiograms, which represent biomedical signals with locally concentrated features.

The system of alternative diagnostic features based on the method proposed by the authors of the morphological analysis of biomedical signals with locally concentrated features to provide additional graphical information in the diagnosis of one of the most common cardiac arrhythmias - ventricular arrhythmia is developed. Representation of the electrocardiogram in two-dimensional space of alternative features, as well as hodograph is proposed. Differences between the ECG-hodographs for normal ECG and ECG with different arrhythmias of right and left ventricles, as well as multifocal ventricular arrhythmia are analyzed. It was found that a graphical representation of an electrocardiogram in the alternative feature space allows the physician to visually perform the classification of different types of ventricular arrhythmia, which in combination with the classical analysis of ECG on the time axis increases the reliability of diagnostics.

Keywords: alternative feature space, electrocardiogram, premature ventricular contractions, hodograph.

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DEVELOPMENT OF INFORMATION TECHNOLOGY OF TASKS DISTRIBUTION FOR GRID-SYSTEMS USING THE GRASS SIMULATION ENVIRONMENT (p. 45-53)

Tetiana Filimonchuk, Maksym Volk, Ihor Ruban, Vitalii Tkachov

An information distribution task technology for GRID-systems based on the use of simulation modeling GRASS environment was proposed. GRASS reproduces the process of functioning over time of elementary events that occur in the GRID-system with maintaining their interaction logic. This solution enables conducting of computational experiments that implement different methods of distribution, with a following selecting of the most effective solution on the basis of the collection, analysis and interpretation of simulation results.

The proposed task of distribution technology using simulation modeling GRASS environment, enables implementing multiple distribution methods and selecting the best distribution environment that increases the efficiency of GRID-systems by reducing the time of the task performance and reducing the downtime of resources in highly related tasks.

GRASS modeling environment has a modular structure, which consists of a core and dynamically loaded modules (plug-ins). Each module performs a highly specialized task, referring if necessary to the other modules of the system. The core provides means of inter-module interaction and provides boot and system configuration.

Keywords: distributed systems, GRID-system scheduler (broker), information technology, GRASS environment, computing resources, allocation policy.

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