

## ABSTRACT AND REFERENCES

## INFORMATION AND CONTROLLING SYSTEM

### ANALYSIS OF IMMITTANCE COMPONENT MEASUREMENT METHODS OF NON-ELECTRICAL NATURE OBJECTS (p. 4-9)

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The relevance of measuring active and reactive imittance components for the quality assessment of non-electrical nature objects is substantiated in the paper. The authors have examined evaluation methods of the relative quality indicators of these objects. The analysis of imittance parameter measuring devices was performed in the paper, and it was found that there is a need for the implementation methods of serial devices for separate admittance parameter measurement in the frequency range. The methods that are implemented by serial measuring tools of the wide and special application were proposed. Analysis of these methods has shown that the active and reactive imittance components in comparison objects can be directly measured or determined by the measurement results of the module and the phase using appropriate available serial measuring tools. Measurement of these parameters of controlled and basic samples should be carried out by such tools using the replacement method. To build specialized imittance component measuring tools in a wide frequency range, combined methods, namely measuring one of the components (active or reactive) and module or phase angle with further calculation of another component are proposed.

The component measurement results obtained by different methods can be considered identical within instrumental errors of measuring tools used, provided that the primary converter should be the same, the level of test sinusoidal signal must be the same, the connection of the primary converter is carried out by the same scheme, measurement conditions are the same.

According to the proposed methods, specialized identification tools of non-electrical nature objects, using building block components can be developed.

**Keywords:** measuring tool, imittance, non-electrical nature objects, imittance component measurement methods.

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### FUNCTIONAL IMPROVEMENT OF MONITORING THE DYNAMIC CHARACTERISTICS OF INFORMATION AND COMMUNICATION NETWORKS (p. 9-15)

Yuriy Babich, Lesia Nikityuk

The study reveals conceptual principles of predictive monitoring of the dynamic characteristics of modern information and communication networks. The suggested procedures of predictive monitoring are aimed at a functional improvement of the existing types of monitoring information and communication networks. The procedures that include consecutive stages of short-term, situational and long-term prognostication are implemented by means of statistic analysis and aimed at an early detection of possible emergencies.

The paper suggests a system of predictive monitoring. The existing types of monitoring that are functionally improved by means of the procedures of predictive monitoring are illustrated in terms of TMN and TINA.

Predictive monitoring allows making timely decisions on reconfiguring the resources of the monitored object in order to either prevent emergencies or decide on the network reconstruction if the means of reconfiguration are no more effective.

**Keywords:** predictive monitoring, dynamic characteristics of the information and communication network, prognosis/prognostication, polynomial extrapolation.

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## DEVELOPMENT OF THE CALCULATION METHOD OF COMPLEX ACOUSTIC RESONATOR PARAMETERS (p. 15-21)

Mykola Bohdanov, Fedor Kirchu

Despite the large number of works devoted to passive management methods of separated flows in the stages of axial fans, still little attention has been paid to the integrated approaches of impact on the end separated flows. In the paper, the calculation method of complex resonator parameters based on the method of hydro-gas-dynamic analogies was presented. The basic idea of using the complex resonator is pulse-periodic action on the end separated eddy flows, which consist of high-frequency and low-frequency components of oscillations. The paper presents the formation of generalized dependencies for calculating geometrical parameters of the complex resonator, which consists of two series-connected acoustic cavities, one of which is tuned to the high frequency component, and the other - to the low-frequency component of the oscillation field. The presented method allows to obtain the relationship between the geometric parameters of the complex acoustic resonator and the frequency of its natural oscillations. The research results can be used in the design of control systems of separated flows in the turbomachinery blade rows.

**Keywords:** complex acoustic resonator, oscillation circuit, gas-dynamic analogies.

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#### A MATHEMATICAL MODEL OF THE PROCESS OF FREEZE-DRYING (p. 27-33)

Yana Lysa

#### DEVELOPMENT OF SOFTWARE AND HARDWARE SYSTEM CIRCUIT FOR THE COMPUTERIZATION OF PHYSICAL EXPERIMENTS (p. 21-26)

Roman Lopatkin, Sergey Ignatenko

The problem of computerization of laboratory experiments and technical implementation of the previously proposed software and hardware system circuit to solve it were considered. The existing range of systems can not completely solve the problem because of the complexity and expensiveness of equipment. Therefore, the problem of software and hardware system development for the laboratory experiment automation with minimum time and financial costs is relevant in our time. The central module of the system is the data reception, processing and transmission module. To create the system prototype, the task to calculate the input digital-to-analog paths of the data reception and transmission module was set. The calculation technique of electrotechnical circuits, allowing to obtain accurate values of electronic components, providing the necessary technical characteristics of the system as a whole was presented. The measurement accuracy is 1 %, the input signal sampling frequency is 2000 samples per second per channel, the gain range is 1...1000, protection of input circuits from the high input voltage is up to 150 V.

**Keywords:** computerization, automation, measurement, analog-to-digital converter, sensor, remote interaction, experiment.

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The study explores the process of freeze-drying of biological materials and the basic parameters that affect the quality of the original sample. We have considered the existing methods of controlling freeze-drying stages and their main limitations. The research findings will be used for modeling and optimizing the lyophilisation process. The paper focuses on the problem of monitoring the temperature of biological materials in vials during the freeze-drying. It is necessary to control the temperature of the product to keep it below the triple point (transition point) in order to avoid spoilage. It is also important to determine the position of the moving boundary of sublimation, which informs about completing the stage of primary drying. There are many models of developing temperature sensors, but none fully satisfies the needs of the process. Therefore, we have calculated a mathematical model that will be used further to develop a temperature sensor to control the process of sublimation. Our experimental study was processed in COMSOL Multiphysics 5.0 Final and tested at the State Scientific-Control Institute of Biotechnology and Strains of Microorganisms. The study has revealed a significant impact of the zone of acontact between the heater and the object of drying on the duration of dehydration (about 20 %). The devised mathematical model will further allow conducting multivariate calculations aimed at minimizing energy consumption and choosing optimal treatment regimes in obtaining and maintaining a certain level of product quality.

The suggested calculation method can help estimate the real duration of the vacuum freeze-drying, taking into account the conditions of the contact.

**Keywords:** lyophilisation (freeze-drying), biological materials, heating surface, temperature, sublimation, heat-and-mass transfer, freeze-drying.

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## RESEARCH OF SCATTERING MATRIX METHOD CONVERGENCE IN THE COMPUTATION PROBLEM OF QUASI-H MODE MICROWAVE FILTERS (p. 34-38)

Dovlet Mamedov, Alexander Yushchenko

Based on the methods of partial areas and a generalized scattering matrix, an electrodynamic model of the microwave filter design with waveguide-dielectric resonators, partially filling rectangular waveguide by width was constructed. The model allows to consider a countable number of modes in all the problem geometry areas. A numerical algorithm based on the model obtained was implemented and the influence of accounting higher modes on the convergence of the computation algorithm of the amplitude-frequency characteristics of one-, three- and five-tier microwave filters was investigated. The research revealed that at insufficient consideration of harmonics in the area of below-cutoff waveguide, the calculated dependences significantly differ from those to which the experimentally verified algorithm converges, namely, frequency shift and irregularity change of the amplitude-frequency characteristic are observed. The resulting multimode model allows to reduce the error of the intelligent CAD system of the multi-tier filter designs.

**Keywords:** microwave filter, waveguide-dielectric resonators, generalized scattering matrix method, intelligent CAD system, multimode model.

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## THEORY AND PRACTICE OF CRC CODES: NEW RESULTS BASED ON AUTOMATON MODELS (p. 38-48)

Vasyl Semerenko

The theoretical foundations of CRC codes based on the mathematical apparatus of linear finite-state machine (LFSM) were considered.

A mathematical analysis of two interpretations of CRC was performed. Interpretation of CRC as Cyclic Redundancy Check means computing the stream hash function or checksum of the given information message I. It is shown that CRC will be an effective hash function (checksum) under the following conditions: CRC generator polynomial must be primitive, of degree  $r \geq 16$  and the message length must be equal to  $n_w \leq 2^r - 1$ . Cyclic Hamming codes meet such requirements.

Interpretation of CRC as Cyclic Redundancy Code means the search for errors by the rules of shortened cyclic code. Using the automaton-graph model, it is shown that generator polynomials of the Abramson code in the form of  $g(x)=(1+x)p(x)$ , where  $p(x)$  is primitive polynomial have the best error detection properties.

Only specified Hamming and Abramson codes are proposed to consider as CRC codes and recommendations for the optimal selection of generator polynomials for them were given.

A method for parallel CRC computation with the reduction in the number of iterations by  $\rho$  ( $\rho \leq r$ ) times for a random polynomial of degree  $r$  was proposed.

**Keywords:** CRC codes, shortened cyclic codes, checksum, generator polynomial, linear finite-state machine.

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## THE APPLICATION OF SENSOR NETWORKS WITHIN MOBILE CELL NETWORKS (p. 48-52)

Volodymyr Mosorov, Sebastian Biedron, Taras Panskyi

Mobile devices such as mobile phones are getting increasingly popular by the year. Currently, most users cannot imagine doing without these devices that support our daily lives. Using them, however, entails a certain drawback, namely having to conclude an agreement with the mobile network operator, where the user undertakes to operate the device in keeping with the set rules and pay fixed amounts for the communications service provided by the operator. The authors' overarching idea is both to reduce the costs of using mobile phones and achieves total independence from the mobile operator. To achieve this goal they propose a communications system that omits the mobile network operator's infrastructure using methods taken from sensor networks. With the technological advancements it is now possible to manufacture devices whose size is in the order of centimetres. This enables the use of sensor nodes on an unprecedented scale and opens new opportunities even for a private user. Initially, sensor networks were wired solutions. The development of wireless and data processing technologies has helped sensor devices to take over a larger area of research. The purpose of this paper is to present the concept proposal of a free and reliable mobile network.

**Keywords:** mobile devices, mobile network, sensor network, self-organization protocols, data transmission.

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## INFLUENCE OF SOFTWARE RELIABILITY MODELS ON RELIABILITY MEASURES OF SOFTWARE AND HARDWARE SYSTEMS (p. 53-57)

Alexander Mulyak, Vitaliy Yakovyna, Bogdan Volochiy

An increasing part of modern machinery, and virtually all electronic and telecommunications systems are software and hardware systems (SHS), the operation of which lies in the

interaction between software (SW) and hardware (HW). High responsibility and complexity of modern SHS imposes strict requirements for evaluation and maintenance of the set reliability measures. In the paper, the influence of the choice of software reliability models on the assessment of reliability measures of software and hardware systems was investigated. To build the SHS reliability model, modeling technology of complex information systems based on Markov processes, in which SHS is represented as a discrete-continuous stochastic system was applied. As software reliability models that give the input value of the HW failure rate, the model with the HW complexity measure on the one hand, and the Goel-Okumoto models and S-shaped model as the most popular models on the other hand were chosen for the SHS reliability model. It is shown that using traditional HW reliability models, such as S-shaped and Goel-Okumoto leads to inflated SHS reliability measures, which makes it impossible to accurately assess the system operation risks. In addition, the behavior of the SHS readiness function, calculated based on the input data, received from the SHS reliability model with the complexity measure shows the non-monotonic dependence with the extreme point, and in this case this point is a point of minimum and is located in the area of small time values. Such differences in the SHS reliability estimates, made based on various HW reliability models, should be considered at stages of operation and routine maintenance of such systems.

**Keywords:** fault tolerance, readiness function, hardware and software system, software reliability model.

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### THE STATISTICAL CHARACTERISTICS OF A SUPERHET RETRANSMITTING METER SIGNAL (p. 58-63)

Anatoly Velychko, Dmytro Velychko, Sergiy Velychko, Aleksey Vichkan, Anna Klyueva, Kostyantyn Netrobenko

Using computer simulation, distribution densities of the signal phases and amplitudes of superhet measuring retransmitting systems (MRS) and radar sensors were obtained. The features and relations of such signal characteristics of MRS and radar sensors to random effects on the stable controlled object were obtained, the results of their comparative analysis were given.

The effect of fluctuating reflectors on the statistical signal characteristics of the MRS currently has hardly been studied, but has been well studied for the case of radar sensors. Therefore, it is necessary to take into account the peculiarities of these effects in order to improve the MRS parameters and applications and improve signal processing methods.

The use of the reflector, fluctuating according to the Weibull law has revealed the causes of different forms of differential distribution law of fluctuations of signal phases and amplitudes of MRS and radar sensors. Comparison of the statistical characteristics has shown that the distribution densities of phases and amplitudes of input signals of the retransmitting system are approximately two times larger than the corresponding probability densities of input signals of radar sensors. This relation can be used to estimate the type of effect that caused the fluctuation process.

An explanation of the fluctuation density expansion due to double radio wave reflection by stable and fluctuating parts of the reflecting object at the forward and reverse radio wave propagation was given. It was proposed to use the extension of the differential distribution law of characteristics of signals, received by the MRS to enhance the detection of the processes that cause the reflectivity fluctuation of the monitored objects.

**Keywords:** measuring retransmitting system, signal, phase, amplitude, model, reflection, statistical characteristics.

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