COMPARISON OF SYNDROMIC METHODS FOR CORRECTING BLOCK POSITIONAL AND TIMING CODES (p. 4-8)

Mikola Zaharchenko, Matin Gadzhyiev, Bronislaw Radzimovskyy, Yuri Gorokhov, Dmitry Shpak

Based on statistical data of quality characteristics of correcting block codes in real channels of urban telephone network (UTN) at position coding and using timing signal designs, conditions of their compliance to the Gilbert model channels are checked.

Formation principles and structure of the timing signal designs are stated. Statistical parameters of the transmission fragment using TSD are experimentally determined and given. Analysis of statistical characteristics of transmission in “good” and “bad” condition of the channel is performed. It is found that introducing double repetition of each transmitted codeword is expedient in simplex systems, and in adaptive transmission systems, at “bad” condition of the channel, the received codewords are not analyzed and retransmission is requested. Advantages and disadvantages of syndromic methods for error correction in the channel are formulated.

The algorithms, providing the increase in the transmission rate are synthesized. It is experimentally proved that TSD provides the decrease in the number of coordinates in the allowed signal designs by hundreds of times as compared with the positional coding and, respectively, the increase in the transmission rate by 2.5-3 times while maintaining high transmission quality

Keywords: timing signal designs, codewords, syndromic method for error correction, positional coding

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GENETIC ALGORITHM FOR CONSTRUCTING FUNCTIONAL TESTS OF ARITHMETIC LOGIC UNITS (p. 9-13)

Yurij Skobtsov, Dmitry Ivanov, Vadim Skobtsov

A genetic algorithm for constructing functional-level test sequences for built-in self-test schemes of arithmetic logic units of modern systems-on-chip is proposed in the paper. The idea of the method lies in the automated construction of functional tests, which are arithmetic operands, allowing maximum coverage of the selected type of damages of the structural level, at which test is considered as a binary set. In fact, providing input sets and checking reactions are performed directly by the arithmetic logic unit. Since the task concerns two-level representation of the digital device with an appropriate representation of input tests, two types of genetic operations, namely binary and arithmetic are used in the method.

Inversion of input/output lines of arithmetic logic unit is selected as a functional level coverage metrics.

Approbation of the proposed algorithm is performed for arithmetical division. It is experimentally shown that the functional test with the length of seven sets allows covering about 90 % of constant structural-level damages. The test compression level with respect to the structural level is more than 100 times

Keywords: digital device, system-on-chip, built-in self-test, functional test, genetic algorithm

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SELECTING PHOTOPLETHYSMOGRAM INDICATORS TO MONITOR ADAPTATION STATUS OF A PERSON AT MAGNETIC-LASER THERAPY (p. 14-18)

Grigory Tymchik, Alexander Osadchy, Marina Filipova, Alyona Ponomarenko, Anna Stetska

Magnetic-laser therapy is widely used by doctors for treating many diseases, but there is no single method of evaluating the effectiveness of selected parameters of therapy.

A literature review on the presence of similar studies was conducted in the paper, and it was found that photoplethysmographic signal was widely considered, but it had no connection to magnetic-laser therapy. The purpose of this research was to argue the use of photoplethysmography to monitor the adaptation state of the human body.

The photoplethysmographic signal parameters were analyzed, and the selection of appropriate parameters to determine the adaptation status of the person was argued. The appropriateness of using qualitative and wave analysis of photoplethysmogram was proved.

These developments will enable doctors to conduct magnetic-laser procedures without harmful effects by monitoring the human state in real time

Keywords: photoplethysmogram, magnetic-laser therapy, pulse wave, wave analysis, adaptation status

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COMPUTER-INTEGRATED ELECTRIC-ARC MELTING PROCESS CONTROL SYSTEM (p. 18-23)

Dmitry Demin

Developing common principles of completing melting process automation systems with hardware and creating on their basis rational choices of computer- integrated electric-arc melting control systems is an actual task since it allows a comprehensive approach to the issue of modernizing melting sites of workshops. This approach allows to form the computer-integrated electric-arc furnace control system as part of a queuing system "electric-arc furnace - foundry conveyor" and consider, when taking automation decisions, not only the melting process itself, but also the associated processes such as casting, molding, equipment transportation.

Several possible options for solving the problem of selecting means for software and hardware implementation of the melting control system at the melting-casting-molding workshop sites are presented. Such solutions include forming two- or three-level control systems, built according to the hierarchical principle. Implementing these recommendations, along with the optimal control algorithm for electric-arc melting in a furnace, considered as an element of the queuing system, allows to modernize the existing electric melting control systems

Keywords: computer-integrated control system, hardware, automation system

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REVIEW OF EXISTING CONTROL SYSTEMS THAT ARE USED ON UNMANNED AERIAL VEHICLES (p. 23-28)

Anastasiya Mishchuk

The aim of the work is to systematize the information on automatic control systems that are used on unmanned aerial vehicles for the selection and further use of combined control methods in the new automatic control system that can withstand unknown external disturbances with guaranteed accuracy.

Adaptive, optimal and robust control systems are considered. Advantages and disadvantages of adaptive control systems with intelligent control, in particular, using the neural networks are investigated. The issues of eliminating drawbacks, inherent in this type of adaptive automatic control systems are considered. Hybrid control architecture is reviewed. The synthesis of optimal control systems is examined.

Advantages and disadvantages of using optimal control systems in conditions of uncertain external disturbances are given in the paper. Robust automatic control systems with robust adaptation algorithms are considered. Using the game theory in automatic control systems is studied.

Conclusions about the feasibility of using a set of adaptive, intelligent and robust control methods to create a control system with the guaranteed accuracy of observing the specified parameters in conditions of uncertain external perturbations are drawn

Keywords: automatic control systems, machine learning, intelligent control systems

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INVARIANT TRANSDUCERS OF CAPACITIVE SENSOR PARAMETERS INTO VOLTAGE (p. 28-32)

Marta Herasym, Yevgen Pokhodylo

This paper presents the importance of capacitive primary transdusers, by which the electrical parameters of products of nonelectric nature are monitored. The main objective is to provide a result invariance to the near-electrode impedance, as uninformative parameter and to provide a proper measurement mode. Different variants of construction of invariant transducers with four-electrode contact sensors, that realize the method of direct transformation "impedance-voltage" are considered. The electrical and mathematical models of sensors of a given current mode and given preset voltage are shown.

By these transducers we can provide result invariance to the capacity of a double layer and to parameters of a test signal. Results can be used for designing the devices of monitoring the parameters of products quality by reactive and active components of admittance within the audio-frequency range simultaneously providing an appropriate measurement mode

Keywords: capacitive sensor, transducer, electric model, double layer capacity, uninformative impedance

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CARBON MONOXIDE CONTROL SYSTEM IN INDUSTRIAL PREMISES (p. 33-38)

Eugeny Shvets, Egor Kiselev, Andrii Sechin

Carbon monoxide concentration control system in boiler, gas-generating, blast-furnace, open-hearth and foundry shops, based on the infrared spectrometry method is developed. The design of the optical carbon monoxide sensor, which is characterized by compactness, high sensitivity and selectivity, long service life and reasonable cost is proposed.

According to the two-way circuit, the system structure, which provides the error of determining the CO concentration not less than 0.0168 % in the range from 0 to 5 % is developed.

The conducted studies of the developed system control device errors have allowed to optimize the sensor control modes and improve the accuracy of determining the carbon monoxide concentration.

Sensor tuning device in the form of an adaptive measuring system, based on the model of the adaptive correction of the characteristics of the Lyapunov transducers is proposed. The studies of the designed device have shown that the peak error value of the adaptive tuning depends on the voltage value at the sensor gate. Thus, transient is completed in the time from 0.8 s to 2.9 s, and the values of the adjustable coefficient allow to select the optimum values of the transient duration and the amplitude deviation error, maximum by the module. Also, the adaptive tuning model does not contain unwanted oscillations. The advantages of the developed system also include the ability to retune the sensor for monitoring the content of other impurities, contained in the air, such as CO_2, NO, NO_2, NH_3, H_2O_2, C_2H_4, CH_2O, CH_4, CH_3OH and other.

The developed system can be used for carbon monoxide content control in industrial premises, air monitoring in settlements and upgrading modern medical spirographic equipment

Keywords: carbon monoxide, concentration sensor, two-way circuit, adaptive tuning, modeling, monitoring

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STATISTICAL PROPERTIES OF OUTPUT SIGNALS IN OPTICAL-TELEVISION SYSTEMS WITH LIMITED DYNAMIC RANGE (p. 38-44)

Tatyana Strelkova

Much attention is paid to studying the statistical properties and models of output signals in optical-television systems, post-detection processing methods. Despite the wide use of the Poisson and Gaussian models for describing the output signals due to their relative simplicity and possibility of obtaining analytical results, an adequate description of real processes requires taking into account the influence of abnormal emissions when registering optical radiation and fluctuations of transfer coefficients of receiving paths of optical-electronic systems.

Modern methods of signal detection under a priori uncertainty are quite effective for the Poisson and Gaussian statistics, while abnormal emissions in the received optical field can significantly distort the estimates of system detection characteristics as a whole.

Statistical properties of the output signals in the optical-television systems with limited dynamic range taking into account interaction between the input radiation and optical link are considered in the paper.

The model of α-stable processes was used to describe signals. Limiting distributions of the output signals are analyzed for belonging to the domain of attraction of the normal and stable laws with the characteristic indicator α. The asymptotic behavior of the distribution function of the output signals in the optical-television systems with limited dynamic range is experimentally verified and the applicability of generalized limit theorems is proved. Using the proposed model will allow to avoid conflicts between experimental data and existing mathematical models of output signals, and can be a theoretical basis for extending the dynamic range of optical-television systems

Keywords: optical-television systems, signal fluctuations, α - stable processes, limiting distributions

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ADAPTIVE AUTOMATIC CONTROL SYSTEM WITH PI-CONTROLLER FREQUENCY TUNING (p. 45-48)

Aleksandr Stepanets, Dariya Motoryna

Application of adaptive control systems, based on self-tuning controllers with a test periodic signal is considered in the paper.

The main purpose of the study is to develop a new adaptive control algorithm since the technological process maintenance quality directly affects the automatic control system profitability. To implement the control algorithm, digital controllers, based on microprocessors, allowing to realize complex mathematical processing of the input data can be used.

The methods for implementing the adaptive control systems with harmonic input signal, using the method of frequency-division of control channels and self-tuning are discussed. The method of quick adaptive tuning of one-loop local automatic control systems using test harmonic signal is given in the paper. The considered control object must have self-regulation properties and medium persistence. To identify the control object, modern error estimate prediction method used.

The method is based on analyzing the properties of the system output signal and calculating PI-controller settings, guaranteeing aperiodic transient of the set parameters. When optimizing the PI-controller settings, direct quality indicators of transient of closed-loop control system are estimated.

The results of developing the adaptive control algorithm can be applied in one-loop control systems with simple local technological objects, and can also serve as a basis for further research of control systems, which use harmonic signals to obtain more information about the control object

Keywords: adaptive tuning, local systems, PI-controller, static object, test harmonic signal

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APPLICATION OF WATTMETERS IN MEASURING MEAN INDICATED PRESSURE OF PISTON INTERNAL COMBUSTION ENGINES (p. 49-53)

Denis Zubenko

In connection with the expanded fleet of piston engines and enhanced operation requirements, requirements for their reliability and durability, as well as reducing their harmful effects on the environment significantly increased. While in operation, cylinders are loaded unevenly.

This shortens the engine life. Thus, during the diagnostics, control of irregularity degree of load distribution on cylinders is ensured by the wattmeter. High operational reliability can be achieved by appropriate and timely technical condition monitoring during maintenance and repair. This places high requirements for diagnostic tools. This is especially important in determining the technical state of complex systems, in particular, internal combustion engines. Therefore, creating diagnostic tools for piston engines is a key issue.

The possibility of using a power meter, such as a multiplier - integrator in measuring the mean pressure in piston engines, during diagnostics and maintenance of transport vehicles is considered.

The way the uneven load in cylinders of internal combustion engines affects the basic structural elements of the machine life, reliability and fuel economy is investigated. Spectrum of frequencies in the signals P_t and U_t is experimentally obtained. A new device, allowing to determine the mean indicated pressure is proposed. Using this device defines the possibility to perform engine diagnostics

Keywords: internal combustion engines, engine life, efficiency, mean indicated pressure

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RESEARCH OF DEPENDENCE OF SECURITY ALARM SYSTEM ON LOCATION OF SEISMIC SENSORS (p. 54-60)

Bohdan Volochiy, Vladimir Onishchenko

Designing a promising security alarm system requires solving a number of scientific problems. In the known publications, the features of formation and propagation of seismic waves in soil, influence of seismic sensors characteristics on the signal formation, seismic signal processing techniques, mathematical models of spatial and organizational structure of the protected object for making design decisions when determining the system hardware environment, are considered. Using the findings and recommendations of these studies allows improving the security alarm system efficiency.

Another possibility to improve the security alarm system efficiency is to select a rational scheme of locating seismic sensors on the probable routes of objects moving to a stationary object. In practice of using the systems, there are schemes of probable routes for moving objects such as: four seismic sensors are located in far and near zones of control; two seismic sensors are located on the border in far or near zone of control; two seismic sensors are located sequentially in far and near zones of control; one seismic sensor is located either in far or near zone of control.

To study the dependence of the system efficiency on the location of seismic sensors, mathematical models of the reaction of security alarm system at the appearance of a moving object were developed by the authors. One of these models, namely, the mathematical model of the system reaction to the appearance of the moving object with the location of four seismic sensors in far and near zones of control, is given in the paper. Description of the model development makes it possible to assess the level of its adequacy to the object of the study.

Using the developed mathematical models, the dependence of the efficiency on the number of seismic sensors and schemes of their location on the probable routes is shown. In the studies, it was taken into account that the system efficiency is determined by sensitivity of seismic sensors and the system parameters: probability of correct classification of moving objects and probability of appropriate receiving the radio signal

Keywords: security alarm system, seismic sensors, mathematical model of security alarm system

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DIGITAL DEVICES SIGNAL PROCESSING SYSTEM BASED ON K-VALUED DIFFERENTIAL CALCULUS (p. 60-66)

Valeri Dmitrienko, Sergey Leonov, Tetiana Gladkikh

The proposed modeling system, based on the K-valued differential calculus provides more qualitative and accurate modeling compared with binary modeling. This is achieved by taking into account the steepness of fronts, amplitude K-valued signal level quantization and considering electromagnetic compatibility during modeling.

Modeling in the system is performed by a joint solution of ordinary K-valued differential equations and K-valued delay differential equations. When solving ordinary K-valued differential equations, crosstalk and noise, associated with the electromagnetic compatibility of individual blocks are modeled based on solving ordinary K-valued differential

equations. Modeling of the functional blocks of logic elements is carried out based on the K-valued delay differential equations. The joint solution of these two types of equations allows to analyze the performance of high-speed computing devices, designed taking into account the steepness of fronts, as well as races and noise, caused by electromagnetic interaction of individual components

Keywords: modeling system, K-valued differential calculus, electromagnetic compatibility, signal quantization

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