

CONTENTS AND ABSTRACTS**RADIOENGINEERING, RADIOLOCATION AND COMMUNICATION SYSTEMS****V. G. Andreyev, H. L. Tran. PARAMETRIC SPECTRAL ANALYSIS OF UNIMODAL SPECTRUM FOR NOISY SIGNALS**

Key words: spectrum, spectral estimation, restoration of autocorrelation coefficients, autoregressive model, autoregression, power spectral density, MUSIC.

We proposed and investigated a method of restoring autocorrelation coefficients of discrete autocorrelation function of random signals with unimodal spectrum and an unknown form of power spectral density. The aim is to develop methods for improvement of accuracy of spectral estimation of signals with a priori uncertainty of their shapes of unimodal spectrum. The method is based on finding the optimum value of α weighting factor, which characterizes Gaussian shape and $(1-\alpha)$ for resonance shape of unimodal spectrum envelope. Experiments show that the proposed approach makes it possible to reduce 4...10 times the discrepancy between control and model spectrums as compared to the known methods of spectral analysis, in particular, AR method. Increasing the adequacy of spectral estimation makes it possible to reduce 4 ... 5 times the length of the time sample while maintaining achievable accuracy of spectral estimation by other known parametric methods. Increasing of adequacy is achieved through the use of a priori information about spectral properties of signals.

DOI: 10.21667/1995-4565-2016-57-3-3-83

S. I. Kholopov. THE RESEARCH OF PULL-IN RANGE INCREASE METHOD OF RELAY PHASE LOCKED LOOP SYSTEM

Key words: phase locked loop system, pull-in range, relay astatic phase locked loop system, discriminatory description, logical phase discriminator.

The method of pull-in range expansion of relay astatic phase locked loop system (PLLS) using as a device supporting the analysis of phase error and reset logic oscillation phase discriminator is examined. Essence of the method consists in variation discriminatory description of phase discriminator form due to the slow periodic change of the oscillation produced by PLLS tuned generator. The purpose of the work is to consider a method for constructing relay astatic PLLS with logical phase discriminator, providing pull-in range, equal to hold-in range, and analysis of system parameters to realize the method. Formulas, allowing to define conditions where pull-in range, equal to hold-in range, is provided in the system, are shown. Estimations over parameters of PLLS nodes, executing variation of tuned oscillation form in accordance with the requirements determined by the method, are obtained.

DOI: 10.21667/1995-4565-2016-57-3-9-159

V. K. Klochko, O. N. Makarova. INFLUENCE OF RADIOMETER ANTENNA SYSTEM ON THE ACCURACY OF IMAGES RECOVERY

Key words: radiometer, antenna system, dual-channel signal processing, recovery of images, antenna characteristics.

Influence of antenna system characteristics on the accuracy of objects images recovery in the radiometer is researched in the work. Antenna system represents a set of receiving elements

organized by a certain rule for data obtaining. The number of accepted signals processing channels and its antenna characteristics depend on the organization of receiving elements. Antenna system scans the area of review and accepts signals in the given range of frequencies. By results of scanning in one or two spatial channels the matrixes of radiometric observations differing in antenna characteristics are created. These matrixes are jointly processed by the algorithm of images recovery, based on the optimum matrix approach. **The work purpose** is to compare different antenna systems defining antenna characteristics on restoration accuracy. In the work analytically and experimentally a comparative analysis of restoration accuracy depending on the organization of receiving elements in case of one and two processing channels is carried out. Analytical research is based on the creation of a covariance matrix of recovery errors, experimental – on the basis of modeling.

DOI: 10.21667/1995-4565-2016-57-3-16-20 16

A. K. Grishko. OPTIMAL CONTROL OF FREQUENCY RESOURCE IN RADIO ELECTRONIC SYSTEMS ON THE BASIS OF PROBABILITY ANALYSIS OF INFORMATION CONFLICT DYNAMICS

Key words: radio system, radio-electronic devices, interference, electromagnetic compatibility.

The research is focused on the study of processes in radio-electronic system that consists of multiple various radio devices, actively used in the conditions of intentional and unintentional interference. The object of the research is models for ensuring electromagnetic compatibility of the total of radio-electronic devices. The research is aimed at finding the optimal plan for the operation of multiple radio-electronic devices so as to increase the efficiency of joint performance by means of readjusting the emittance parameters.

The probability approach is offered to be used for the analysis of state dynamics of the model of radio-electronic devices, built on the basis of the theory of semi-Markov processes.

As a result of the application of this approach the models were obtained allowing calculating and analyzing system performance efficiency. These models consider the complex of factors influencing joint operation and are characterized by reliable formalized process description.

The suggested models may help to perform optimal planning of frequency resource so as to reduce the interference level for radio-electronic devices, and in this way to build an efficient radio-electronic system equipped with various types of radio-electronic devices. The suggested models do not only allow to analyse the efficiency of system operation but to solve inverse problems aimed at improving their protection until it reaches the level desired.

DOI: 10.21667/1995-4565-2016-57-3-21-27 21

A. N. Byzov, Yu. V. Petrov, S. A. Yukhno. METHOD OF TIME EVALUATION OF REQUIRED PRECISION REALIZATION OF RADAR LOCATION BY TWO MOBILE DIRECTION FINDERS

Key words: direction finding, passive location, radar location, triangulation, accuracy, positioning, range, bearing, movable direction spaced-finders.

The problem of time estimation to reach the given accuracy in determining the distance to the radar by two movable direction spaced-finders is studied. Today there are no valid methods of estimation of this time. Two models of time estimation are proposed: through "geometric" factor only and through "geometric" and "accuracy" factors. For each of the models the expressions to estimate required time to achieve given accuracy of determining the distance to the radar and the dispersion of the errors of its estimation are obtained. Common use of "geometric" and "precision" factors in the solution of this problem allows to reduce required time more than for an order. Accuracy of estimated time may be less than one second. Numerical examples are presented, showing the possibility of using this method in the aircraft for prediction time of task solution attribute.

DOI: 10.21667/1995-4565-2016-57-3-29-34 29

S. N. Tarasov, V. F. Osinin, S. I. Pastukhova. CONVERSION OF AMPLITUDE PROBABILITY DISTRIBUTION OF ENVELOPE OF ATMOSPHERIC RADIO NOISE FROM ONE BANDWIDTH TO ANOTHER USING GENERALIZED EMPIRICAL MODEL

Key words: atmospheric radio noise, distribution function, bandwidth, generalizing.

The task of transformation of amplitude probability distribution of atmospheric radio noise from one bandwidth to another is given. The aim is to develop a fully automated algorithm for the transformation of distribution function for atmospheric radio noise from one lane to another. Transformation characteristics of atmospheric noise in the band are defined by temporal and amplitude scales of response functions of intermediate frequency receiver on a single pulse. Increase of receiver bandwidth leads to the fact that impulse response becomes shorter in time and higher in amplitude, i.e. if you change the bandwidth then the pulse shape of the response is changed so that the area under the curve always remains constant. In the case where the strip increases ω times, the scale of voltage impulse response is multiplied by the conversion factor of ω strip, and scale of the pulse duration divided by it. From this it follows that the amplitude probability distribution of atmospheric radio noise depends on transformation ratio. Also practical recommendations on the use of the algorithm are presented.

DOI: 10.21667/1995-4565-2016-57-3-35-4135

V. T. Dmitriev, D. S. Konstantinova. ALGORITHM OF SPEECH QUALITY INTEGRATED ASSESSMENT IN THE COMMUNICATION CHANNEL

Key words: speech, acoustic noise, subjective evaluation of quality of terminal equipment, data transmission systems, voice quality assessment algorithm.

The task of developing an algorithm of integrated assessment of speech quality at the output of communication channel by the action of acoustic noise is considered. The aim is to develop an algorithm of complex estimation of speech quality at the output of communication channel, the results of which as much as possible are close to the results of subjective evaluation, prepared according to GOST 50840-95. In the process of evaluating the quality of speech such parameters as clarity, awareness, preservation of emotional color to vote are the most important criteria. In modern world it is very important to transmit the highest quality for comfortable communication and feelings of speaker's emotional state. As a result from all known algorithms of objective evaluation three algorithms were chosen, the results of which turned out to be mostly correlating with subjective evaluation prepared in accordance with GOST 50840-95. On their basis the algorithm of complex evaluation speech signals quality which will allow to automate the process of evaluating the characteristics of output speech transmission systems and to provide more accurate evaluation compared to known algorithms.

DOI: 10.21667/1995-4565-2016-57-3-42-4742

COMPUTER ENGINEERING, INFORMATION SYSTEMS AND TECHNOLOGIES

A. V. Antonenko, S. V. Chelebaev, Y. A. Chelebaeva. MULTI-LEVEL NEURAL NETWORK APPROACH TO STRUCTURES SYNTHESIS OF FUNCTION INFORMATION CONVERTERS

Key words: synthesis, system, functional converter, neural network, neuron, activation function, time slot, digital code.

Structures synthesis of function converters of information form as a component of information measuring control system is considered. **The purpose** of operation is reviewing the process and synthesis stages of structures of function converters using multi-level neural network description from a problem definition to finite implementation in hardware description language VHDL. A functional converter is presented in the form of integral neural network device. At the stage of problem definition basic data in the form of characteristic of conversion, criteria of end device

structure optimization are set. During the synthesis the device is considered at three levels of neural network description: the level of a mathematical model of neuronet, the level of neurons converters, the level of standard neural network operations. The example of synthesis of non-linear converter of time slot in a digital code is given where the sequence of actions according to the level of a mathematical model of neuronet and the level of neurons converters is shown. Dependences of relative error of conversion on the number of weight coefficients of a network are constructed.

DOI: 10.21667/1995-4565-2016-57-3-48-5548

D. A. Perepelkin, I. Yu. Tsyganov. PAIRED TRANSITIONS ALGORITHM IN COMPUTER NETWORKS BASED ON SUBNET ROUTING METHOD

Key words: computer networks, adaptive routing, fast rerouting, paired transitions algorithm, quality of services, network services, topology, segments, subnets, optimal routes tree.

An improved paired transitions algorithm in computer networks based on subnet routing method is offered in the article. **The aim** is development of mathematical model and fast rerouting algorithm allowing to increase the performance of computer networks by reducing the complexity of building a routing table in case of dynamic changes in the structure of network and the load on communication links. Software of simulation of adaptive routing processes in computer networks is developed to confirm correctness of our approach and comparative analysis of effectiveness of the proposed algorithm with known Dijkstra and Jarry algorithms on various topologies of computer networks.

DOI: 10.21667/1995-4565-2016-57-3-56-6256

A. N. Ivutin, D. O. Yesikov. COMPUTER CLUSTER FOR SOLVING TASKS TO ENSURE THE SUSTAINABILITY OF DISTRIBUTED INFORMATION SYSTEMS

Key words: island genetic algorithm, cluster, distributed information system, cluster structure, cluster parameters, multi-agent algorithm, computational modules, a cluster computing system.

An island genetic algorithm is proposed to be used in solving sustainability problems of functioning of distributed information systems. A description of the proposed island genetic algorithm to solve the problems of ensuring the sustainability of distributed information systems is given. For rational (quasi) solutions under tight time constraints a cluster computing system is proposed to be used. Cluster structure, composition and parameters of the software and hardware are determined. The tables with the characteristics of computing modules, switches, and communication tools are given. The instructions for configuring each computer module in a clustered computer system, and for running the programs on each module are offered.

DOI: 10.21667/1995-4565-2016-57-3-63-67.63

D. E. Yablokov. APPLYING THE GENERIC CONCEPTS AS BASE ABSTRACTIONS FOR ACCESS TO THE UNIVERSAL MODEL OF DATA STORAGE

Key words: universal data model, programming paradigms, refinement of concepts, data abstraction, generic iterator concepts and container classes adapters.

The article deals with issues related to the creation of components of access to the universal data storage. As basic abstractions the application of generic concepts based on the use of multiple programming paradigms is proposed. The research is conducted within the project of creation an expert system using the information base of ToposPro software package. The aim of the article is to check the possibility of building the strategy of creation of independent component for access and processing the data placed in universal storage. Applying this strategy allows to connect storage structures and data accessors with the considered in the article generic concepts of adaptors of container classes and iterators. In this case the main tools during design and implementation are generic concepts, and concrete classes based on them can be customized using overloading, aggregation, inheritance and requirements specifications to abstract data types.

DOI: 10.21667/1995-4565-2016-57-3-68-7468

I. V. Drozhzhin. THE ALGORITHM TO IMPROVE THE PROCESSABILITY OF MAKING MULTILAYER PRINTED CIRCUIT BOARDS

Key words: printed circuit board, density interconnect, chip, via, pad, build-up, Silting holes.

The article proposes the algorithm to improve the processability of making multi-layer printed circuit boards with a method of reducing the density interconnections. **The aim is** to make full automation of creating multi-layer PCB with a high degree of integration of the topological pattern on the stage of automated design and technological design by moving the vias under IC chip directly below the findings and technology for manufacturing multilayer printed circuit board according to the method above. The results of this work will help to place the electrical circuit on the printed circuit board with smaller dimensions, use a BGA chip with a smaller step, to reduce the plies of PCB, to improve the reliability of interconnections, avoid short circuits during installation of planar circuits and BGA chip.

DOI: 10.21667/1995-4565-2016-57-3-75-81 75

O. N. Romashkova, T. N. Ermakova. INCREASE OF INFORMATION FLOW CONTROL EFFICIENCY IN EDUCATIONAL COMPLEX

Key words: educational complex, structural division, information model of administrative processes, information flow, volume of documents, incoming documents, creation, processing and transfer of documents, speed of document processing.

The task of increasing effective document flow management between structural divisions of an educational complex and external organizations is considered. The purpose of the article is to find the main indicators for the assessment of the movement of document management workflow in educational systems. Management information processes are distinguished in an educational complex in which schools and preschool educational organizations are united. The formulas of the definition of incoming documents flow, proceeding (processed) documents flow, raw documents volume, speed processing of documents are considered. The model of distributed data processing between structural divisions of an educational complex has been constructed as a result. By means of this model it becomes possible to estimate efficiency level of working with documentation in various educational systems.

DOI: 10.21667/1995-4565-2016-57-3-82-87 82

SYSTEM ANALYSIS, CONTROL AND INFORMATION PROCESSING**S. N. Kirillov, I. V. Kostkin, A. V. Elyutin.** THE ALGORITHM OF VIDEO SEQUENCE SHAKE SUPPRESSION USING MODIFIED TOOL FOR SEARCH AND EXTRACTION OF FEATURE POINTS CONSTELLATIONS

Key words: video shake suppression, video processing, feature points, constellation of feature points.

The problem of video frame shake suppression using software resources is considered in this paper. The purpose of this paper is to develop software algorithm of video sequence shake suppression to achieve the most comfortable conditions of visual perception, and to improve the efficiency of video compression codec-converted video sequence.

Software algorithm for video frame sequence from static cameras is presented. The algorithm is based on the tool of selection, comparison and analysis feature points of video frames. It's proved that construction of feature points constellations decreases computing costs to 5 times in comparison with common feature points detection method.

Experimental researches of developed algorithm are presented. They show results of frame shaking decrease by 10% to 0.3% horizontally (relative to the horizontal size of the image) and by 9% to 0.5% vertically (relative to the vertical size of the image). Moreover it is presented that time used for enhanced video compression by H.264 video codecs 1.5 times decreases.

DOI: 10.21667/1995-4565-2016-57-3-88-93 88

V. M. Kashin, V. V. Belov, N. N. Vlasov, D. A. Vodichenkov. PRINCIPLES OF TRAINING FACILITIES CONSTRUCTION AND THE EXPERIENCE OF CREATING SIMULATOR OPERATIONAL-TACTICAL MISSILE COMPLEX

Key words: training facilities (TCB), types, structure, static and dynamic simulators, simulator 9Ф694-Alicesme simulators, simulator 9Ф694-E.

Simulators and training aids are designed to prepare professionals to perform complex technical systems management operations. The developed training aids to help implement theoretical and practical training of specialists in various fields, to teach them to use both standard equipment management procedures and actions in case of emergency situations. The article describes the principles of construction and variety of training tools used in different spheres, sets out the types of training aids, the features of simulators of various types, formulates basic principles of modern exercise machines for special purposes, used in the creation of the first simulator (product index 9F694-E) for training of self-propelled launcher crew (index 9P78-1 products) of operational-tactical missile complex (PTRC) "Iskander" (9K720 complex index). Design solutions implemented in 9F694-E, are productively used when creating a new simulator complex 9K720 as a whole, including and combining simulators for crews of five of the six types of machines, included in the complex (crew life support machine has not).

The purpose of this work is to consider the principles of training facilities construction and to present the experience of major subsystem simulator creation (self-propelled launcher) PTRC "Iskander".

DOI: 10.21667/1995-4565-2016-57-3-94-10494

L. A. Demidova, I. A. Klyueva. THE DEVELOPMENT AND STUDY OF HYBRID VERSIONS OF PARTICLE SWARM ALGORITHM BASED ON GRID SEARCH ALGORITHMS

Key words: particle swarm optimization algorithm; grid search algorithm; hybrid algorithm; test function; classification, SVM-classifier, optimization parameters, radial basis kernel function.

The present paper considers the approach to the problem solution of unconstrained optimization based on the hybridization of particle swarm optimization algorithm (PSO-algorithm) and grid search algorithm. The aim of this work is the development of hybrid versions of PSO-algorithm and study of its search characteristics. The paper presents two hybrid versions of basic PSO algorithm, involving the use correspondingly of classical Grid Search (GS) algorithm and Design of Experiment (DOE) algorithm. It is proposed to use canonical PSO-algorithm as base algorithm. The results of experimental studies confirming the application efficiency of the proposed hybrid versions of basic PSO-algorithm in solving optimization problems are represented. Herewith the comparative analysis of main quality indicators of basic PSO-algorithm and its hybrid versions in the problem solution of finding the global optimum of several test functions has been carried out. In addition, the application's expediency of hybrid versions of basic PSO-algorithm in order to reduce the time expenditures for searching of optimum parameters' of SVM-classifier is shown.

DOI: 10.21667/1995-4565-2016-57-3-105-116105

A. V. Bragin, R. R. Navletov, D. V. Pyanzin. NEURAL NETWORK FOR IMAGE RECOGNITION OF MAGNETOOPTIC MATERIALS DOMAIN STRUCTURES

Key words: neural network, training, labyrinthine domain structure, informative signs, magneto-optical materials.

Computer vision systems are often used to study the structure of materials allowing to improve the quality of the results and reduce the time spent. The basis of these systems is neural network architecture. The article describes a neural network for image recognition labyrinthine domain structure. Such a structure is formed in magneto-optical materials being necessary in optoelectronic devices, spin electronics, magnetophotonics.

The aim is to develop a neural network of direct distribution for image recognition labyrinthine

domain structure and classification of shape (round, elliptical, dumbbell, bandpass and branched) objects. Registration of domain structures of images is a magneto-optical unit, developed at the Department of Radio Engineering of National Research Mordovia State University [6.9].

As a result two-layer neural network of direct distribution is built and trained, the software for magneto-optical system is developed.

DOI: 10.21667/1995-4565-2016-57-3-117-121 117

V. N. Ruchkin, A. N. Kolesenkov, V. A. Fulin, V. V. Drozdova. ANALYSIS OF TECHNOGENIC ENVIRONMENT BY MEANS OF CYBER-PHYSICAL SYSTEMS

Key words: cyber-physical system, CPS, forest-fire monitoring, RSE, sensors, fire, decision-making, clusters, microcomputer module MB 7707, intellectual telecommunications structure.

The work analyzes technical and experimental research in the field of fire monitoring. It proposes a technique of using cyber-physical systems for monitoring natural and technogenic emergencies, providing information and algorithmic support for a cyber-physical system of forest-fire monitoring. We also provide hierarchical structures of components for a cyber-physical system of forest-fire monitoring. The methodology is implemented as development of intelligent telecommunications structures on the base of the neuroprocessor systems that can undergo training in conditions of uncertainty. **The aim** is the creation of complex information, operational and algorithmic support of cyber-physical systems to reduce the risk of making decisions on pre-Prevention of emergency situations of natural and man-made by specialized processing of land, air and remote sensing of the Earth in under uncertainty using fuzzy sets by means of neural networks.

DOI: 10.21667/1995-4565-2016-57-3-122-128 122

INSTRUMENT ENGINEERING AND INFORMATION-MEASURING SYSTEMS

M. S. Grigorov, B. R. Ivanov, O. O. Basov, O. A. Ignatenkova INCREASE OF EFFICIENCY OF NONDESTRUCTIVE X-RAY CONTROL OF ELECTRONIC MODULES

Key words: nondestructive x-ray control, electronic module, x-ray multiimage, multipower X-ray analysis, automation, software and hardware complex.

The problem of disambiguation between the need of obtaining the image of all functional elements of electronic module with the required quality and decrease in expenses of time for carrying out its nondestructive x-ray control, due to improvement of mathematical and program and technical support of formation, processing and the analysis of x-ray images of electronic module is considered. The purpose of the work is to increase the efficiency of nondestructive x-ray control while ensuring a given accuracy of the determination of electronic module defects, due to development of structural and functional model of system of nondestructive x-ray control of electronic module, a method of formation of x-ray multiimage of electronic module, a technique of multipower X-ray analysis and software and hardware complex realizing the developed model, method and technique.

DOI: 10.21667/1995-4565-2016-57-3-129-138 129

A.I. Bobikov, A.O. Bozvanov. NEURAL NETWORK POSITION CONTROL OF DC MOTOR

Key words: DC motor, non-linearities, angular position, PID-controller, adaptive controller, back propagation algorithm, neural network controller, regression.

The increasing demand for use of DC motors for various industrial applications in the last few decades has made them one of the most important system drives. Thus, it is important to develop intellectual angular position of engine control system, neural DC engine control in particular, based on a well defined mathematical model, which is a very important tool for this type of drive

systems. Nonlinear parameters such as dead zone, saturation and clearance, cause the greatest concern in the management of angular position of DC motor. To reduce the impact of these non-linearities, and to improve the efficiency of the system in the paper a new algorithm for management of angular position of a DC motor using neural network controller is proposed. The aim is to design a neural network controller which will be able to eliminate or reduce the influence of non-linearities in the angular position of DC motor. The article describes the system of angular position of DC motor control built using Simulink tool in MATLAB application package.

DOI: 10.21667/1995-4565-2016-57-3-139-144 139

ELECTRONICS AND NANOELECTRONICS

E. V. Mamontov, V. V. Zhuravlev, V. N. Dvoynin, A. A. Salikov. ENTER OF CHARGED PARTICLES IN FOURIER TRANSFORM MASS ANALYZER BASED ON RADIO FREQUENCY MONOTRAP

Key words: RF ion trap, mass analyzer with Fourier transform, discrete planar electrodes, ion input system.

The problems of matching the initial parameters of analyzed ions with the parameters of periodic orbits of charged particles in RF ion traps with discrete planar electrodes used as detectors of induced currents in mass spectrometers with Fourier transform are considered. The aim is the development of mode and input device of charged particles in RF ion trap Monotrap. It is shown that to implement uniform field ion mode the input voltage is required to be changed exponentially. The parameters of exponential voltage during inout are defined. Computer simulation of the process of ion trap entering the radio frequency Monotrap is given. The estimates of mass range in mass - spectra with Fourier transform, using ion trap ions as a detector of radio frequency are obtained.

DOI: 10.21667/1995-4565-2016-57-3-145-150 145

T. A. Glebova, A. A. Shishkov, V. I. Yurkin. DOUBLE GAP CAVITY OSCILLATOR WITH MONOTRON EFFECT IN THE FIRST INTERACTION SPACE

Key words: generator, double-gap resonator, in-phase oscillation mode, monotrone effect, extended interaction space, large voltage amplitude, efficiency coefficient.

SHF generator having one double-gap resonator which works in the mode of in-phase oscillation with monotrone effect in the first interaction space has been considered. This interaction space is extended and has the transit angle more than $2,4\pi$. It serves as an efficient electron buncher, which enables to receive the relative amplitude of convection current of first harmonic more than 1,5. Supplementary factor of device efficiency increase is the energy removed from the electron flow due to the monotrone effect in this interaction space. Conditions of efficient operating support have been discussed. A method to receive appropriate gap voltage amplitude ratio under high resonator characteristic impedance has been proposed. Numerical computations and analysis of electronic processes have been carried out, and availability of power efficiency coefficient about 55 % has been shown.

DOI 10.21667/1995-4565-2016-57-3-151-156..... 151