

CONTENTS AND ABSTRACTS

RADIOENGINEERING, RADIOLOCATION AND COMMUNICATION SYSTEMS

Yu.N. Parshin, P.V. Zharikov, P.A. Kaznacheev. HARDWARE-SOFTWARE SOLUTION FOR CHANNEL MATRIX ESTIMATION OF MOVING OBJECT MIMO DATA COMMUNICATION SYSTEM

Key words: channel coefficient, estimation error, frequency synthesizer, phase noise.

Block diagram of hardware-software solution for channel coefficients estimation of MIMO data communication system was developed. The application of time diversity method in case of signal transmission from different antennas was proved. Estimation error variances as functions of input signal sample number were calculated. Existence of optimal sample number in presence of heterodyne frequency offset was shown. Comparison between results of simulation and experimental research demonstrates close matching.....3

E.V. Vasilyev. RADIO TRANSMITTERS TO INVESTIGATE MIMO RADIO CHANNEL WITH UNMANNED AERIAL VEHICLE

Key words: unmanned vehicles, MIMO systems, digital radio transmitters, direct digital synthesizer, PLL frequency synthesizer, transmitter efficiency, microcontroller algorithm.

The development and test results of 2,4 GHz band radio transmitters are represented. These three types of transmitters are intended for investigation of MIMO radio channel from unmanned aerial vehicle to terrestrial control station9

V.V. Ezersky, V.A. Pronin, O.V. Spirkina. ANALYSIS OF ALGORITHMS TO SEARCH EXTREMUM SPECTRAL DENSITY OF SIGNAL AMPLITUDE IN FREQUENCY SHORT-RANGE FINDER

Key words: signal frequency estimation, square-law approximation, golden section method, deviation average square minimum.

Three possible algorithms to search the extremum of spectral density amplitudes (SPA) by criteria of accuracy of methodical error and calculations speed estimation are considered.....15

A.V. Bakke, I.V. Lukashin. IMPROVED TIME SYNCHRONIZATION ALGORITHM USING FRACTIONAL FOURIER TRANSFORM

Key words: fractional fourier transform, CAZAC signals, Zadoff-Chu sequence, time synchronization, multipath.

The article is devoted to research the possibility of applying fractional Fourier transformation to the solution of the problem of time synchronization. Expediency of application of this transformation to identify time mismatch at receiving Zadoff-Chu sequences is shown. A new algorithm to estimate time position of preamble based on Zadoff-Chu sequence using fractional Fourier transformation is proposed. The results of simulation of the developed synchronization algorithm for multipath model of wireless communication channel confirming the advantage of the proposed time synchronization algorithm are given.20

A.Yu. Linovich. OPTIMAL DESIGN OF MULTIRATE ADAPTIVE FILTERS ON DIGITAL SIGNAL PROCESSORS

Key words: multirate signal processing, adaptive filter, digital signal processor.

The problem of optimal design of complex-valued multirate adaptive filters with independent adaptive cores on digital signal processors is considered. Accounting for quantities of full computational burden of multirate adaptive filter implementation is the feature of this method, i.e. the program complexity is measured not just in multiplications but in machine cycles spent for execution of all computing operations as well as data transmissions, branching and looping. The paper is supplied by experimental results which help to estimate the efficiency of multirate processing in adaptive filtering.....25

D.O. Markin. INDOOR MOBILE DEVICES POSITIONING ALGORITHMS EFFICIENCY RESEARCH

Key words: localization, positioning algorithms, trilateration, hidden Markov models, simulation modeling, nearest-neighbor method.

The work contains the results of indoor mobile devices positioning algorithms efficiency research based on simulation modeling. Positioning algorithms based on trilateration (triangulation) methods, nearest-neighbor method and hidden Markov models are analyzed. The algorithms optimal parameters are detected using given conditions. Experimental results of simulation modeling are accomplished and presented.....32

S.N. Kirillov, E.S. Popova. NEURAL NETWORK IMPLEMENTATION OF ENCODER SPEECH SIGNALS ADAPTIVE LEVEL OF ACOUSTIC NOISE

Key words: artificial neural network, speech signal encoder, μ -companding, acoustic noise.

The issues related to the design of adaptive to the level of acoustic noise encoder source speech signals companded on the basis of μ -based artificial neural network are considered. It was possible to achieve tenfold reduction in the dispersion of acoustic noise at the output of neural network implementation of source message encoder compared with the conventional codec, with increasing signal-to-noise ratio of 7 to 23 dB in the case of varying dispersion of the acoustic noise without reducing subjective assessment of speech signal quality in MOS scale.....40

V.G. Andreyev, Ngoc Luc Tran. SYNTHESIS OF MODIFIED OVERDETERMINED AUTOREGRESSION MODEL OF RANDOM PROCESS IN SHORT SAMPLE

Key words: overdetermined system of Yule – Walker equations, spectrum, weight vector, spectral estimation, parametric model, autoregressive model, autoregression, power spectral density.

We proposed and investigated a method for optimizing overdetermined autoregression model of random signals provided by short samples. The method is based on the account weight vector's w accuracy of the estimates of the autocorrelation coefficients in the calculation of autoregressive model parameters. The proposed approach allowed to reduce in 1,2 ... 2,5 times the discrepancy between the control and the model spectrum by introducing in the model more information about the accuracy of the estimates of autocorrelation function.45

V.A. Belokurov. AMPLITUDE ESTIMATION OF MOVING OBJECT AND COORDINATES OF GAUSSIAN FILTER WITH PARTIAL STATE VECTOR DIVISION

Key words: evaluation of moving object coordinates, Gaussian partial filter.

The modified Gaussian filter with partial separation of state vector into two components, linear and nonlinear is considered. At the same time the linear elements of state vector the evaluation based on the linear Kalman filter is generated. Non-linear elements of state vector are estimated using Gaussian partial filter. It is shown that the use of the proposed filter allows to estimate the signal amplitude and to increase the accuracy of position estimates of moving object in two times in comparison with the given one having the equal number of partial filters.....50

A.A. Boyev, S.N. Kuznetsov, B.I. Ognev, S.Y. Polyakov. ALGORITHM TO DETERMINE BEAM CENTER FOR FREE SPACE OPTICS TRACKING SYSTEM

Key words: Free Space Optics systems, axis of directional diagram sensor.

The problem of laser beam center detection for Free Space Optics equipment targeting and automatic control of directional diagram axis is solved. A new algorithm for determining the center of the beam is offered and evaluating criteria for its good performance are determined. A comparative analysis of developed algorithm and a number of known algorithms is made. It was shown that the proposed algorithm provides greater accuracy of axis directional diagram sensor in conditions of strong optical disturbances typical for optical communication systems55

M.B. Kagalenko. EVALUATION PARAMETERS SINUSOIDAL SIGNAL WITH LINEAR AMPLITUDE MODULATION

Key words: estimation of frequency, method of nonlinear least squares, method of variables projection.

We adapt nonlinear least squares algorithm to estimate the frequency, phase, amplitude and modulation parameters for sinusoidal signal in the presence of linear amplitude modulation. Application of variable projection method reduces the problem to one-dimensional search for maximum of object function. We investigate the sensitivity of estimate to additive noise by means of Monte-Carlo numerical experiments. The noise sensitivity estimates are found to be in quantitative agreement with theoretical Cramer-Rao bound60

V.E. Drach, I.V. Chukhraev, N.V. Samburov. ANTENNA AJUSTMENT METHOD DURING COMPACT RANGE MEASUREMENT

Key words: electrical axis, antenna, adjustment, reference levels, compact range measurement, compact range reflector.

The accuracy of the antenna electrical axis adjustment is being analyzed by the comparison of compact ranges measurements and measurements in "far field region". The method of the alignment of antennas in a compact range is being described and investigated.65

COMPUTER ENGINEERING, INFORMATION SYSTEMS AND TECHNOLOGIES*V.P. Koryachko, A.P. Shibanov, A.N. Saprykin, H.L. Fam.* FINDING THE CHARACTERISTICS OF BASE CHANNEL IN NETWORKS WITH TWO-PHASE ROUTING

Key words: data transmission network, two-phase routing network, queuing system M/G/1, probability density function.

The problem of finding the characteristics of the base channel in networks with two-phase routing is explored. The expected value and the dispersion of flow transmission time through the base channel with different parameters of the probability distribution of transmission time are found. The most important characteristics of the base channel using the queuing system M/G/1 are determined.....72

S.V. Chelebaev, Y.A. Chelebaeva. DEVELOPMENT OF STRUCTURES CONVERTERS OF TIME-AND-FREQUENCY SIGNALS PARAMETERS IN THE CODE OF TWO VARIABLES ON RADIAL BASED NETWORKS

Key words: neural network converter, frequency, time slot, code, radial based network, function of two variables, VHDL hardware description language.

The necessity of radial based neural networks application for creation of time-and-frequency signals parameters converters in a code of two variables is justified. The converter structure of

time-and-frequency signals parameters in the digital code of two variables on the radial based neuronet is offered. The converter decomposition on two components is offered, in which the second component is the radial based network. The analysis of implementation options of radial based activation functions on field programmable gate arrays is carried out. The structure of the frequency converter in a positional code of two variables is implemented on VHDL hardware description language.....78

V.E. Sukhov. NETWORK TRAFFIC ANOMALY DETECTION SYSTEM BASED ON ARTIFICIAL IMMUNE SYSTEMS AND NEURAL NETWORKS APPROACH

Key words: artificial immune systems, artificial neural networks, anomaly detection, intrusion detection, network technology, network traffic analysis.

The anomaly detection system based on artificial immune systems and neural networks was suggested. The structure, operation algorithms and software implementation of anomaly detection were created.....84

T.I. Kalinkina. MODIFIED MANDATORY ACCESS CONTROL MODEL

Key words: database, database management system (DBMS), trigger, mandatory access control, access control model, level of confidentiality, access level, access object, access subject.

The article describes the modification of mandatory access control model based on the Bell-LaPadula model. The model takes into account peculiar properties of storage of information in a database. Also the article presents the system of mandatory access control for DBMS Microsoft SQL Server which was developed and implemented in accordance with the described model91

V.P. Koryachko, A.P. Shibanov, O.V. Lukyanov. DATA TRANSMISSION NETWORK FOR FLIGHT TEST EQUIPMENT

Key words: measurement information, bandwidth, singular points.

The questions to determine the performance of data channels during flight testing at landfills are considered. The probability-time characteristics of information transmission paths when changing traffic matrices are determined.98

V.S. Gorin. INCREASING THE EFFICIENCY OF SERIAL PLACEMENT ALGORITHMS

Key words: algorithm, placement, formal task set, dynamic programming.

Possible ways for solving the problem of placing unconnected subcircuits into blocks with preset contact and module limitations are considered. Formal task sets are given. Precise and approximate numerical algorithms based on computing circuit of dynamic programming method are offered.....104

N.D. Syomkin, D.V. Kuntushev, I.A. Ksenofontova. STUDY OF SOLDER JOINTS DURABILITY BETWEEN PCBs AND BGA-COMPONENTS

Key words: Solder joint, Ball Grid Array (BGA) components, Intermetallic Compound, Weibull Distribution, Engelmaier Wild Model, reliability, cyclic loads, Fatigue life.

The analysis of microstructure of solder joints for BGA components was carried out. Results of accelerated tests of samples for definition the lifetime of solder joints are stated. Also the estimation of the lifetime of solder joints between printed circuit boards and BGA components was conducted.....109

G.V. Mylov, I.V. Drozhzhin. REDUCING THE INTERCONNECTION DENSITY OF MULTILAYER PRINTED CIRCUIT BOARDS

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

The article proposes a method of reducing the interconnection density of multi-layer PCB with a high degree of integration of topological pattern on the stage of automated design and technological design by moving the vias under IC chip directly below the findings as well as the technology for manufacturing multilayer printed circuit board according to the above method. The results of this work will help to place the electrical circuit on the printed circuit board with smaller dimensions, to use BGA chip with a smaller step, to reduce the plies of PCB, to improve the reliability of interconnections, to avoid short circuits during the installation of planar circuits and BGA chips..... 115

A.I. Martyshkin. DEVELOPMENT AND RESEARCH OF OPEN-LOOP MODELS OF THE SUBSYSTEM "PROCESSOR-MEMORY" MULTIPROCESSOR SYSTEMS ARCHITECTURES UMA AND NUMA

Key words: multiprocessor systems, architecture, model, performance, Queuing system.

The options to implement "processor-memory" subsystem of multiprocessor systems with UMA and NUMA architecture are examined on the basis of the models. The mathematical model was examined using the apparatus of Queuing theory. The analysis of various factors influence on the models considered is made. The research was a comparative analysis of UMA and NUMA systems architecture. Their strengths and weaknesses are identified. The end of the article shows the conclusions..... 121

V.N. Ruchkin, V.A. Romanchuk, V.A. Fulin. CLUSTER PRESENTATION OF EXPLICIT AND IMPLICIT PARALLELISM OF NEUROPROCESSOR SYSTEMS

Key words: neurocomputing system, equivalence classes, clustering, fuzzy clustering, explicit and implicit parallelism, linguistic variables, intellectual compiler, fuzzy logic.

The article is devoted to the development of the neurocomputing system (NCS) model based on the clustering and the analysis of the obtained fuzzy structures. The production model of explicit and implicit parallelism is suggested. The given model could be used for the intelligent compiler development and for the choice of the optimal technical parameters, such as NCS modules number, firmware memory volume, system productivity, etc..... 127

O.V. Milovzorov. REALIZATION OF SYNTHESIS PRINCIPLES OF TECHNOLOGICAL PROCESSES USING GENERALIZED STRUCTURE ON THE BASIS OF T-FLEX TECHNOLOGY

Key words: CAPP-systems, generalized structure, automation of route and operational technical processes design.

A new method of automated route and operational technological processes automated design is offered using new implementation of generalized structure, including generalized operations and operation steps, as well as information model. Optional functions of CAPP systems on the basis of expanded and modernized concept of the generalized structure are considered. The concepts of basic and auxiliary parameters of technological elements allowing to carry out the automated synthesis of technical process with use of a prototype in T-Flex System Technology on the basis of information model of a part are entered..... 133

S.V. Anikeev, M.G. Kostikov, A.V. Markin. MATHEMATICAL MODEL OF CERTAIN ACTIVE SERVICES ON THE BASIS OF MATRIX ALGEBRA

Key words: multidimensional matrix, multi-threading, calculation algorithm.

A parametric model definition of active subscriber services is offered. The algorithm implementation of the model on the basis of operations on multidimensional arrays is developed. When performing operations using parallelism in multiple threads the speed of calculation execution increases..... 139

V.S. Gurov, V.V. Eremeev, A.E. Kuznetsov, V.V. Soldatov, A.I. Taganov, S.I. Gusev, S.V. Kolesnikov, O.V. Antipova. ASPECTS OF RESEARCH AND EDUCATIONAL ACTIVITIES OF RYAZAN STATE RADIO ENGINEERING UNIVERSITY IN THE DIRECTION OF SPACE TECHNOLOGY

Key words: small spacecraft, space technology, training, space industry.

Aspects of research and educational activities of the Ryazan state radio engineering university in the profile of modern space technology in the form of scientific and methodological trends, actually presented at the International Scientific Conference «3rd IAA Conference On University Satellites Missions & CubeSat Workshop» (Italy, Rome, 30 November - 5 December 2015) are given..... 144

INFORMATION ABOUT THE AUTHORS (Russian)..... 147

INFORMATION ABOUT THE AUTHORS (English)..... 149