

Summaries

UDC 519.2

Dyomin N.S., Rozhkova S.V., Rozhkova O.V.
INFORMATION ANALYSIS IN JOINT PROBLEM OF DISCRETE-CONTINUOUS FILTERING AND GENERALIZED EXTRAPOLATION. P. I GENERAL CASE

Information aspect of the joint problem of filtering and extrapolation when the observed process represents the set of multivariate processes with continuous and discrete time, which depend not only on current numbers but on arbitrary number of previous values of multivariate observed process, has been considered. The ratios determining information amount in the joint problem of filtering and extrapolation through the local information amount in the problems of filtering and extrapolation were obtained.

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Dyomin N.S., Rozhkova S.V., Rozhkova O.V.
INFORMATION ANALYSIS IN JOINT PROBLEM OF DISCRETE-CONTINUOUS FILTERING AND GENERALIZED EXTRAPOLATION. P. II. THE EFFICIENCY OF OBSERVATIONS WITH MEMORY AND OPTIMAL TRANSMISSION OF STOCHASTIC PROCESSES

The problem of information efficiency and optimal transformation of stochastic signals through the discrete-continuous channels with memory in the joint problem of filtering and extrapolation has been studied. The main results consist in obtaining formulas determining the efficient memory depth, coding and decoding functionals.

UDC 004.94

Pogrebnoy V.K.
ALGORITHM OF SOLVING THE PROBLEM OF DETERMINING ISOMORPHISM OF HYPERGRAPHS

The differentiation method of hypergraph vertices and edges implementing the idea of structural differences integration in hypergraph and obtaining integral characteristics for vertices and edges has been proposed. The efficient algorithm of solving the problem of determining isomorphism of hypergraphs was developed and justified. The method of parallel differentiation of vertices and edges in several hypergraphs is taken as a principle of this algorithm. Algorithm functioning is shown by the example of determining isomorphism of two hypergraphs.

UDC 004.94

Pogrebnoy A.I.V., Pogrebnoy A.N.V.
ALGORITHM OF SOLVING THE PROBLEM OF OBJECT SET COMPACT PARTITION OF GEOGRAPHICALLY DISTRIBUTED SYSTEM

The concept of topological graph describing the position of geographically distributed system objects on topological field has been introduced. The definition of compact partition is given; compactness assessment is introduced and statement of the problem of object set partition (topological graph vertices) into subsets by compactness criterion is proposed. The efficient approximate algorithm suitable for practical application is proposed for solving the problem. The example of solving the partition problem is given and some properties of algo-

rithm determined during the experimental investigations are discussed.

UDC 65.012.122

Samochnova L.I., Petrov E.S.
OPTIMIZATION OF QUEUING SYSTEM WITH A UNIFORM SPARE DEVICE

The queuing system with a uniform spare device controlled by current waiting time of a claim being in the first in the queue has been studied. The system was optimized in consideration of waiting and depreciation losses.

UDC 519.872

Ivanovskaya I.A., Moiseeva S.P.
STUDYING MATHEMATICAL MODEL OF MIXED TYPE CLAIM PARALLEL SERVICE

The model of claim parallel service in the system of queuing system, consisting of two service units with unlimited number of servomechanisms, has been constructed. Mixed flow, consisting of three simple flows with the parameters of dual claims, claims of the 1st and 2nd types, comes to the system input. Analytic expression for generating function of bivariate distribution of states of Markov chain characterizing the number of claims in each unit (subsystem) in unsteady state was found.

UDC 004.414:004.89

Andryushkevich S.K., Kovalev S.P.
INTELLIGENT MONITORING OF DISTRIBUTED PROCESS OBJECTS USING INFORMATION STATE MODELS

The article is devoted to the issues of constructing the intelligent monitoring systems of large-scale distributed process objects. The specialty of such systems from the systems of industrial control type is the necessity of determining actual global system state supposing to be constant to the planning horizon period. Knowledge of actual global system state may be used for solving different complex optimization problems. Its representation in the system is called the information model of state. The information model of the system is constructed dynamically from the information object model and time series of parameters and events values. The problem of optimizing flow charts of operating transport at oil-and-gas production enterprise is examined as an example. The approach to implementing forming functions of information state models on the basis of aspect-oriented paradigm is proposed.

UDC 517.977.56:519.876.2

Popkov V.K., Toktoshov G.Y.
METHODOLOGICAL ISSUES OF ENGINEERING NETWORK OPTIMIZATION AT HETEROGENEOUS AREA

Hyper network technology of optimizing the design decisions for developing engineering networks at heterogeneous area has been proposed. Reducibility of intricate problem connected with engineering network design to a simpler hyper network problem was shown on the basis of the proposed technology.

UDC 004.9+622.2

**Noskov M.D., Istomin A.D., Kesler A.G.,
Nskova S.N., Cheglov A.A.
COMPLEX DATAWARE OF MINING
BY THE METHOD OF BOREHOLE IN-SITU LEACHING**

The structure and principles of functioning of geo-technological information-modeling expert complex intended for complex mining dataware by the method of borehole in-situ leaching have been introduced. The complex may be used for gathering, storing, processing and visualization of information on deposit and geo-technological process, in-situ leaching modeling, technological indices analysis, enterprise functioning optimization, estimation of ecological implications of mining and preparation of nature-conservative measures plans.

UDC 519.688:552.578.2.061.4

**Sergeev V.L., Anikanov V.S.
ADAPTIVE IDENTIFICATION METHOD
OF HYDRODYNAMIC ANALYSIS OF OIL WELLS SUBJECT
TO A PRIORI INFORMATION**

Adaptive identification method of oil pool parameters at hydrodynamic analysis of oil wells subject to a priori information has been considered. The example of determining reservoir pressure and filtration parameters of uniformly-porous oil pools by the data of oil field wells analysis at nonsteady filtration conditions by pressure recovery curve are made.

UDC 66.01:004.422.8

**Dolganov I.M., Frantsina E.V., Afanasieva Yu.I.,
Ivanchina E.D., Kravtsov A.V.
MODELING INDUSTRIAL PETROCHEMICAL PROCESSES
USING OBJECT-ORIENTED LANGUAGE DELPHI**

Computer modeling system of producing linear alkyl benzenes has been developed and program-implemented in Delphi 7.0 medium. The variant of operating production optimization due to additional paraffin recycle introduction was proposed. Optimal ratio of unreacted raw material recycle, equal 0,3, was calculated. Software product may be used for control and technical support of the device operation.

UDC 61.01.29

**Shnidorova N.O., Dolganova I.O.,
Dolganov I.M., Kochegurova E.A.
DEVELOPING COMPUTER MODELING SYSTEM
OF ALKYLATION PROCESS WITH REACTION NETWORK
OF DIFFERENT SPECIFICATION LEVEL**

The program allowing computing the main indices of benzene alkylation process as been developed and program-implemented on C# object-oriented programming. This model assumes the possibility of mathematical description of the process with any specification level of hydrocarbon reaction network. The proposed modified scan technique is applicable for determining kinetic parameters in simplified mathematical model and requires considerably small amount of iterations in comparison with the well known coordinate-wise search method. This model is the base for developing complex program for computing technologies of solid-phase alkylation process with different instrument formatting.

UDC 669.162.28

**Tkachenko N.I., Spirin N.A.
APPLICATION OF SERVICE ORIENTED ARCHITECTURE
AT INTEGRATION OF PROCESSING CONTROL SYSTEMS**

The experience of applying service oriented architecture at developing processing automated control systems and their integration at «Uralvagonzavod» has been reflected.

UDC 669.162.28

**Lavrov V.V., Spirin N.A., Burykin A.A., Krasnobaev A.V.
DEVELOPMENT OF REPORT DECISION
SUPPORT SYSTEM OF BLAST
FURNACE PRODUCTION
ON THE BASIS OF REPORTING SERVICES**

Technological features of applying Reporting Services instrument used by the authors at developing Web-oriented report decision support system of blast furnace production of «Magnitogorsk metallurgical enterprise» have been reflected.

UDC 621.928.93:004.67:004.421

**Kulakova I.M., Kulakov A.Yu., Aslamova V.S.
AUTOMATED SYSTEM OF DUST-PRECIPITATION
CHAMBER TECHNOLOGICAL CALCULATION**

Module of automated system of deduster technological calculation for determining process variables and refinement efficiency has been introduced. Algorithms of computing overall parameters and fractional overshoot magnitude were considered; the example of module operation allowing decreasing data processing laboriousness, choosing optimal modes of deduster efficiency functioning, reducing investigation period was given.

UDC 620.178.4

**Androsov V.Ya., Plotnikov A.V.
COMPUTER-BASED TECHNIQUE OF STRENGTH TEST
OF SPACE AND MARINE ENGINEERING STRUCTURES**

Product structure reaction spectra under the action of various types mechanical load have been considered. Experimental-calculated technique of obtaining real dynamic characteristics of the product structure was introduced. The possibility of one type mechanical load exchange by the others as well as decreasing actuating load applying the developed program-analytical module has been substantiated.

UDC 001.57/519.876.5/004.942

**Blednov V.A., Iordan V.I., Solonenko O.P.
MODELING LAMELLAR STRUCTURE
AND POROSITY FORMATION OF PLASMA
POWDER COATINGS SUBJECT
TO THE VARIABLE SURFACE TOPOLOGY
AT SPRAYING**

Algorithms as part of program complex for modeling splat laying process (flown or hardened on the surface of melt drop base) at covering spraying subject to dynamically changed topology of its surface as well as forming its lamellar structure have been developed and implemented in Delphi 7.0 environment. The experimentally approved theoretical solutions are used for predicting splat formation scenarios and operational estimation of their sizes. Bundled software was tested subject to spraying practice.

UDC 621.382.2/.3:004.42

**Abramov A.O., Babak L.I., Dobush I.M.,
Dorofeev S.Yu., Peskov M.A., Samuilov A.A.
THE SOFTWARE OF CONSTRUCTING
MICROWAVES ELEMENT MODELS
OF MONOLITHIC INTEGRATED CIRCUITS ON
THE BASIS OF MULTIDIMENSIONAL POLYNOMIALS**

The software Indesys-MB for constructing microwaves element models of monolithic integrated circuits on the basis of multidimensional polynomials has been described by the results of spreading parameters measurement. Algorithms of multidimensional approximation on the basis of genetic algorithms are taken as a principle of the software. It was implemented on the basis of universal platform Indesys Framework.

UDC 004.415.2:528:681.518

**Dorofeev S.Yu., Zaitseva M.A.
VISUAL INTERACTIVE TECHNOLOGY
OF CAD AND GIS INTEGRATION**

The efficiency of visual interactive technique of spatial data exchange in vector format CADGIS Integrator between different types of CAD and GIS has been shown. The universal interchange format of vector spatial data as well as commercial software product В состав данной технологии входят «CADGIS Integrator», including independent service of geo-data translation and plug-in options for existing GIS and CAD platforms, are included into this technology. This technology allows automating and efficiently exchanging the materials between different types of GIS and CAD platforms.

UDC 004.42:771.347.5

**Zaitseva M.A., Lysak A.P., Dorofeev S.Yu.
THE TECHNIQUE OF DEVELOPING VIRTUAL
INTERACTIVE TOURS RUBIUS 3D TOURKIT**

The main types of projections for 3D-panoramas have been briefly described. The problems occurring at developing interactive virtual tours were stated. The integration and main capacities of Rubius 3DTourKit were technology described. The structure and main capacities of software system Rubius 3DTourKit Studio for developing virtual tours on the basis of 3D-panoramas as well as used techniques and technologies were described.

UDC 681.5

**Efimov S.V., Zamyatin S.V., Gaivoronskiy S.A.
SYNTHESIS OF PID CONTROL SUBJECT TO ZEROES AND
POLES ARRANGEMENT OF AUTOMATIC CONTROL SYSTEM**

The ratios connecting overshoot and settling time of automatic control system with its zeroes and poles arrangement have been obtained. The technique of synthesis of PID control parameters was developed on the basis of these ratios. The numerical illustration is given.

UDC 681.5

**Efimov S.V., Zamyatin S.V., Gaivoronskiy S.A.
STRUCTURAL-PARAMETRIC IDENTIFICATION OF CONTROL
OBJECT ON THE BASIS OF TRANSIENT CHARACTERISTICS**

Classical approaches of identification have been considered; their advantages and disadvantages have been studied. The ratios connecting direct quality indices of the identified object transfer characteristic with its zeroes and poles arrangement were obtained. The identification technique of linear dynamic object was developed on the basis of these ratios. The numerical illustration is given.

UDC 004.021:658.58

**Gromakov E.I., Aleksandrova T.V.,
Rudachenko A.V., Malysenko A.M.
MAINTENANCE WORKS AND REPAIR BY THE EQUIPMENT
STATE USING SHUKHART MAPS**

The possibility of using methodology of process statistical control for determining degradation of process equipment state at the early stage of alert condition has been shown. Shukhart maps are proposed to be used for controlling its state. The conclusion was drawn that the dynamic of process equipment state of rotor (with rotating power blocks) and non-rotor types in real time scale may be tracked with their help.

UDC 004.89

**Stoyanov A.K.
OSCILLATORY NEURAL NETWORK – CLASSIFIER**

The features of operation of a neuron with local reverse coupling have been considered. It was shown that neuron transfer to oscillation operation conditions is possible. This property is taken as a principle of developing a network solving the problem of object classification. The technique of network neuron parameter design is given. The results of experimental check of such network operation are introduced.

UDC 004.931

**Nguyen Toan Tkhang
ALGORITHMS AND SOFTWARE FOR SHAPE RECOGNITION
BY FOURIER DESCRIPTORS AND NEURAL NETWORK**

The survey of shape simple signatures on the basis of contour has been introduced. Algorithms were proposed and application for shape recognition using Fourier descriptors and multistage neural network was developed. The conclusion was drawn that Fourier descriptors may be used as input data for neural networks at complex shape recognition.

UDC 519.688:53.083.98

**Volkov Yu.V., Tartakovskiy V.A.
ALGORITHM OF JOINT FILTRATION
OF TREE-RINGS CELLULAR CONSTRUCTION SERIES**

Algorithm of joint filtration applied for increasing quality of recovering bioindication information has been considered by the example of series of annular tracheid increment of pine four climatypes.

UDC 004.021:004.932:621.391+519.673

**Dubin D.V., Laevskiy V.E., Kochegurov A.I.
THE TECHNIQUE OF EVALUATING
ALGORITHMS FUNCTIONING QUALITY
FOR OBTAINING EDGE IMAGE OF OBJECTS
N PATTERNS APPROXIMATED
BY HOMOGENEOUS MARKOV RANDOM FIELDS**

The essay outlines one particular possibility of evaluating the quality of edge detector algorithms. Three generally known and published algorithms (Canny, Marr, Shen) were analysed. The analysis is based on two-dimensional signals created by means of homogenous Markov random fields and subsequently provided with an additive Gaussian noise component. Five quality criteria allow comparing the algorithms.

UDC 681.3

**Tsapko I.V., Tsapko S.G.
ALGORITHMS AND METHODS OF INFORMATION
PROCESSING IN PROBLEMS OF OBJECT 3D-SCANNING**

Methods of processing images obtained by 3D-scanning method have been proposed. Algorithm of matching product single scanned surfaces was thoroughly examined. The technique of forming product model in stereolithography format on the basis of source information of 3D-scanner and mathematical methods of processing 3D-graphics was developed. The results of approving scanline algorithm using z-buffer in respect to the problems of clearing scanned 3D-image were introduced.

UDC 519.688

**Parubets V.V., Ogorodnikov A.S., Berestneva O.G.
OPTIMIZATION METHODS OF COMPUTING LIGHTING
FOR INTERACTIVE APPLICATIONS**

The technique of computing lighting based on series expansion of ambient and reflected light functions by associated spherical functions has been proposed; the possibilities of its optimization and elimination of limitations, conditioned by static geometry and light source type have been proposed as well.

UDC 004.021

**Betev Yu.Yu.
APPLICATION OF SIGNAL DECOMPOSITION ON THE
BASIS OF WAVELETS FOR LOCATING PROBLEMS
OF PRESSURE WAVES**

The method of analyzing pressure waves at small leakages against the background of large signal noisiness from pressure sensors has been proposed. It is shown that signal decomposition on the basis of wavelets with serial time scaling allows locating insignificant changes in signal with high-accuracy.

UDC 519.673

Khamukhin A.A.
APPLYING HOMOGENEOUS STRUCTURE CELLS
FOR COMPUTING CONTINUOUS WAVELET TRANSFORM

Application of homogeneous structure cells for parallel synchronous computation of continuous wavelet transform has been considered. The possibility of implementing functional cell filing independently of used wavelet type was shown. The results of modeling cell matrix with the size 16×64 for test input signal, consisting of two sinusoidal oscillations of different frequencies, were introduced.

UDC 004.04

Reznichenko V.A., Reznichenko E.V.
DEVELOPING FUNCTIONAL PROGRAMMING
LANGUAGE FOR CLUSTER

The possibility of developing functional programming language organizing operation with computational resources of cluster as a whole and resources of its single nodes developed on the basis of multinuclear processes has been shown. The tools abstracting a programmer from low-level facilities of computation organization in cluster and multinuclear systems were proposed.

UDC 004.94

Zamyatina O.M., Sokolova V.V.,
Malakhova E.S., Ushakova E.V.
SIMULATION MODEL OF COMPUTER CLUSTER FOR OPTI-
MIZATION PROCESS OF DISTRIBUTED-PARALLEL COMPU-
TATIONS

Supercomputer cluster parameters have been studied; its simulation model has been developed on their basis. The model allowed optimizing cluster load increasing incoming knowledge processing decreasing their queuing time for service at maximum cluster computer load.

UDC 004.89

Sokolova V.V., Zamyatina O.M., Novoseltsev V.B.
RELATION ALGEBRA EXTENSION
BY RECURSIVE STRUCTURES

Classical relation algebra extension required for providing the possibility of reflecting compound (hierarchical) data sets for wide range of subject fields has been stated. The main notions of Codd algebra, are predetermined for achieving this goal. The relation theory positions significant for further statement are singled out and extended algebra closure is proved.

UDC 004.94

Silich V.A., Silich M.P.
INDICATIVE ASSESSMENT OF SITUATION
WITHIN THE BOUNDS OF CRISIS SITUATION CENTER

The assessment method of current situation risk used within the bounds of crisis situation center for modern determination of the problem and choice of measures for removing undesirable consequences has been proposed. The assessment in the form of conformity degree to certain risk levels of typical situations is determined on the basis of indicator values by the phasification method, attribute dependence output on functional network or fuzzy neural network. Object-oriented model of situation assessment and the structure of situation center using the proposed approach were introduced.

UDC 004.89

Vakhitov A.R., Silich V.A.
USING FUZZY INFERENCE FOR INTELLIGENT DATA ANALYSIS

The method of intelligent data analysis based on using fuzzy inference has been shown. Principles of this method implementation, field of application, as well as advantages in comparison with other methods of data processing are discussed. Special attention is paid to practical application of this method in application domain connected

with students' research effort in university. The conclusion is drawn on appropriateness of using fuzzy logic in conditions of uncertainty and knowledge imperfection.

UDC 004.89

Vakhitov A.R., Silich V.A.
SELECTION OF THE SYSTEM MATHEMATICAL MODEL CLASS
ON THE BASIS OF SAATI'S METHOD AND INTEGRAL CRITERIAS

Justification of selecting the class of information system mathematical model containing information on students' research effort at university has been shown. The alternative model classes, main criteria of selection and application of Saati's method and integral criterias for choosing more suitable variant from the existing alternatives, were described. The conclusion was drawn on appropriateness of using fuzzy logic as mathematical model class for the examined application domain.

UDC 004:65

Kapilevich O.L., Markov N.G.
INFORMATION CONTROL SYSTEM OF BUSINESS
PERFORMANCE ON THE BASIS OF KPI

The problem of control process automation of company performance has been considered. The methodology of forming key performance indicators of staff, departments and company as a whole is described. The structure of information control system of business performance on the basis of KPI is given. The features of its subsystems of collection, process and reflection of KPI are considered in details.

UDC 519.866

Medvedev A.V., Pobedash P.N.
NUMERICAL PARAMETRIC ANALYSIS OF THE MODEL
OF THE EFFICIENT ECONOMIC DEVELOPMENT
OF THE SYSTEM «MANUFACTURER – TAX CENTER»

The aggregated model saving the main quality properties of the source one has been obtained on the basis of operational calculus and double-criterion dynamic model of the region; the conditions of solution existence for the given models have been found as well. The numerical parametric analysis of investment project efficiency described by these models was carried out by the example of statistic data of Krasnoyarsk Territory by the application package. It allows estimating the investment attractive of the project of developing regional business system «manufacturer – tax center» and developing trade-off investment decisions subject to the aims of all its participants.

UDC 004.94

Andreev S.Yu., Batalov R.E., Popov S.V.,
Kochegurov V.A., Vadutova F.A.
INTRAOPERATIVE MODELING OF ATRIAL
MYOCARDIUM EXCITATION

The issues of modeling atria excitation in clinical condition, the main requirements made for the model and the existing methods of modeling contractile myocardium excitation dynamic have been considered. The theory of cellular automaton is taken as a principle of the model. The calculation is carried out at rectangular mesh. The value of excitation transfer delay was calculated for each pair of cellular automaton element. Such approach allowed adapting the model to individual features of test subject.

UDC 004.67;004.891.3

Starikova A.V., Berestneva O.G., Shevelev G.E.,
Sharopin K.A., Kabanova L.I.
DEVELOPMENT OF DECISION-MAKING SUBSYSTEM IN
MEDICAL INFORMATION SYSTEMS

The issues connected with the development of medical information systems have been considered by the example of the system for monitoring and predicting pregnant women state. The issues connect-

ed with the development of decision support subsystem in particular the technology of constructing the decision rules on the basis of production models were considered in details.

UDC 004.75

Sonkin D.M., Shkuratov A.V., Savrasov F.V., Minkov A.S.
UNIFICATION OF DATA FORMATS AT INTERACTION WITH
MOBILE FACILITIES TERMINALS

The parametric technology of forming and sending data for the systems of monitoring and controlling transport allowing decreasing the volume of data subject to be sent saving all significant and urgent information has been considered. The original format for forming data packages supporting the transfer of navigation, manufacturing and housekeeping information was proposed. The principles of delta coding and binary transformation taken as a principle of the considered format allow decreasing the volume of transferred information. The example of adapting the proposed data format for the system of monitoring and supervision of taxi company is given.

UDC 681.5(092)

Konovalov V.I.
50th ANNIVERSARY OF THE DEPARTMENT
OF AUTOMATICS AND COMPUTER SYSTEMS OF TPU

The history of generation, formation and further development of the department of automatics and computer systems of Cybernetics Institute at TPU has been described. The information on educational, methodical and scientific activity of the department for 50 years of its existence is introduced. The review of the existing schools and scientific directions at the department is made.

UDC 378.2:001.89

Kudinov A.V., Markov N.G., Cheredov A.D.
TRAINING OF ELITE IT-STAFF AT THE DEPARTMENT
OF COMPUTER ENGINEERING
AT TOMSK POLYTECHNIC UNIVERSITY

The department of computer engineering of Tomsk polytechnic university celebrated its 50th anniversary in October 2010. Scientific-pedagogical activity of the department for this period was summed-up in the article. The department staff contribution to the development of IT-education, science and industry of Russia is described.