# Contents

# Summary

**JUBILEES**

**PHYSICAL AND MATHEMATICAL SCIENCES**

**A. M. Zavyalov, E. A. Bedrin, M. A. Zavyalov**
**Mathematical modeling analysis of soil freezing and thawing processes**

The equations of mathematical physics are considered: the equation of Fure and equations of heat conductivity as the mathematical modeling analysis of soil freezing and thawing processes. The quadrature solutions for these processes are resulted.

Keywords: soil freezing and thawing processes; law of Fure; heat conductivity equation; heat exchange.

**L. V. Belgart**
**About one class of indefinite functionals of Lyapunov**

Dichotomy solutions of the Cauchy problem is investigated by the direct method of Lyapunov for the hyperbolic system on a plane. The approach for formation of class indefinite functionals of Lyapunov with feature of dichotomy is formulated. An illustrating example is given.

Keywords: hyperbolic system, dichotomy, direct method of Lyapunov, indefinite hermitian form, method of characteristics.

**N. G. Churasheva**
**Boundary control of heat transmission in anisotropic two-dimensional material. Hyperbolic model**

A hyperbolic model of heat transfer in a homogeneous anisotropic plate is considered. A temperature regime on the border is calculated. It provides the required temperature distribution at a given time.

Keywords: hyperbolic heat conductivity, an anisotropic body, Riemann's matrixes.

**D. N. Zaporozhets**
**Processing of source data when implementing extragradient methods for solving linear optimization problems**

The article offers the initial data processing of linear programming problems, allowing to increase the speed of convergence extragradient methods.

Keywords: extragradient method, optimization, convergence.

**A. S. Okishev**
**Formation and analysis of numerical optimization methods taking into consideration higher derivatives**

There are proposed and examined the algorithms for finding numerical solution of nonlinear equations by minimization of multivariable functions, which allows considering higher derivatives in implicit form by means of linear combination of first derivatives. We derive the two-stage algorithm for method with any order and show the formulas for the accuracy and the convergence speed. The results of theoretical analysis are proved by simulation data.

Keywords: functions optimization, numerical methods, order of convergence.

**N. V. Melenchuk, A. V. Zykina**
**Variation inequalities with related limitations in resource deficit model**

In the work convergence of doublestep extragradient method for solving variational inequalities with related limitations is proved. The suggested concept is the effective tool for the resolving of complex applied tasks arising in social and economical systems. As an example, the model of manufacture planning is developed, in which external market cost of resources coincides with the internal objectively stipulate estimations of resources.

Keywords: variational inequalities, extragradient method, optimization, convergence

**MECHANICAL AND THEORETICAL ENGINEERING**

**E. A. Rogachev, M. A. Zverev, V. I. Surikov**
**Forecasting of elastic properties of polymeric composite materials**

In this work the results of experiment defining concentration dependences of elastic modules of two systems of polymeric composites on the volume fraction of filling compound. As the results of modeling for the same systems the comparative analysis is presented.

Keywords: polymeric composite materials, the shift module, forecasting, modeling.

**O. A. Mamaev, O. V. Kropotin, A. A. Baybaratskiy**
**Elaboration and analysis of stress-strain state of sealing elements by finite element method**

Analysis of stress-strain state of sealing and force elements of radial sealing arrangement are considered using the finite element method. Usage of the finite — element models and the analysis of stress and strain dependencies on mechanical properties and operation serves as the base for developing more reliable sealing arrangements taking into account physical and mechanical properties of materials.

Keywords: sealing arrangement, stress-strain state, finite element method, mechanical properties.

**G. N. Minnekhanov, E. D. Skutin, E. N. Eremin, R. G. Minnekhanov**
**Research of gas desorption of ultradisperse powders of refractory compounds at solid activation phase of modifying complexes**

Processes of gas desorption from the particles of ultradisperse powders of modifying complexes are investigated at the thermovacuum processing. Dependences of the rate and volume of gas evolutions from modifying complexes are presented at their thermovacuum processing from a parity of initial components and conditions of their synthesis. Modes of solid phase activation of ultradisperse powders providing their full decontamination are established.

Keywords: ultradisperse powders, modifying complex, decontamination, solid phase activation.

**O. T. Danilova**
**The model of plasma process for ultrafine powders based on metal oxides of minerals**

This work develops fundamentals of plasma technology and equipment for production of powders of metal oxides made of raw material of complex composition in the plasma high-frequency induction discharge. Plasma applications in metallurgy can greatly simplify a number of complex multistage processes occurring under abnormal conditions; obtain materials with special properties; maintain high technical and economic indicators of the processes in case of involvement in the production of poor raw materials, as well as organize a vicious cycle of production, which allows making the process environmentally friendly. Particular interest to plasma processes of direct processing of ores and concentrates of nonferrous and rare metals is paid.

Keywords: plasma reactor, plasma flow, the process of heat and mass transfer, plasma reactor, high-frequency generator.

**I. M. Kovenskiy, A. N. Venediktov**
**Ageing and stabilization of electrodeposited coatings**

The processes of ageing in electrodeposited metals are studies. The stage of ageing and structural changes corresponding to various stage are determined. The parameters of heat treatment for stabilization of properties of electrodeposited coatings are proved.

Keywords: electrodeposited coating, ageing, stabilization of properties.

**K. N. Pantyukhova, Z. N. Sokolovskiy**
**Study of process of simultaneous upsetting of two parts**

This work reflects the results of investigation of the process simultaneous upsetting of two parts with different cross-section. The methods of upsetting and calculation of longitudinal stability are proposed. Experimental data are given.

Keywords: landing, methods landing, longitudinal stability.

**E. G. Kholkin, Z. N. Sokolovskiy**
**Design of trapezoid thin-walled profiles taking into account local loss of stability**

The criteria of a consequence of local loss of stability of lamellar elements of trapezoid thin-walled profiles are analyzed at longitudinal-cross-section bending. The design procedure of profiles with methods of supposed pressure and limiting conditions taking into account possibility of local loss of stability is offered. The technique is under construction on the basis of analytical, numerical and experimental research of authors.

Keywords: the thin-walled trapezoid profile, bearing ability, local loss of stability, admissible pressure, maximum loads.

**Yu. I. Nekrasov**
**Deformation of cutting chips under transition from flow chips to separated chips at processing heat-resistant steels and alloys**

It is shown that in the process of processing of nickel-chromium heat-resistant steels and alloys at reaching plasticity threshold of treated material there is transition from flow type to separated chips. Using theory of finite plastic deformations the threshold is determined. A kinematic model of separated chips and the geometry model of generated elements in the inter-connection with the parameters of deformation at cutting.

Keywords: chip structure, separated chip, metal strain, chip shrinkage.

**Yu. I. Nekrasov**
**Damage of metal cutting tools under processing of heat-resistant steels and alloys on CNC machine tools**

It is shown that accumulation of damages in carbide tools for processing heat-resistant steels and alloys with formation of separated chips is characterized by multiple fatigue and mixed destruction of cutting edges. By using the method of laser scanning the state and area of 4
In presented article the choice of photo-electric converters at a preliminary design stage with use of a method of analytical hierarchy is described.

Keywords: photo-electric converters, a method of analytical hierarchy.

**L. O. Shtripling, M. G. Popov**
**Application of high-speed milling for precise holes drilling for perfection of manufacture techniques of case workpieces from aluminum**

Application of high-speed handling (HSC) of precise holes is considered by manufacture of case workpieces from aluminum improving quality and speed of its manufacture. The efficiency of application of the given method is proved at manufacture of a small lot of products. The experimental analysis of geometry and roughness of the precise holes obtained by the method of milling and also wear and tear of cutting edges is carried out depending on the time of their processing.

Keywords: high speed cutting, milling, precise holes

**I. V. Lazarenko, A. V. Fedotov**
**Evaluation of compensating processing errors at milling of workpiece facet on CNC machine tools**

The article is devoted to providing of stable quality of milling of workpieces facets on CNC machine tools. Mathematical model is developed for

determining the components of processing error on the basis of the results of coordinate measurements with a measuring probe . In this work it is considered the possibility of compensation of errors improving machining and conditions for its implementation.

Keywords: accuracy, machining, processing error, machine tool cell, machine check.

**V. G. Khomchenko, O. I. Osipova**
**Synthesis of six-link four-bar structural group with output link dwelling**

The mechanism with six-link four-bar structural group with output link stopping method of synthesis is designed. The limiting positions method and approach part of connecting-rod curve to arc of the circumferences method are used. The method can be used when designing cycle machines-with dwelling of working organ.

Keywords: plan lever mechanism, six-link four-bar structural group, synthesis, link dwelling, cyclogramm, connecting-rod curve.

**G. U. Ualiev, B. Zhursenbaev, A. Sarbasov, E. S. Gebel**
**Dynamics analysis of lifting machinery**

For theoretical study of lifting machinery dynamics and determination of its design parameters the calculated mechanical models are needed. The selection of a lifting machine model is specified by the kinematic diagram and mechanical properties of its pats and units. Lagrange equations of second order are used for analysis of lifting machinery dynamics.

Keywords: lifting machinery, dynamics, Lagrange equations.

**V. E. Scherba, A. V. Grigoriev, V. S. Vinichenko, D. A. Uliyanov**
**Mathematical modeling of working processes of volumetric action pump**

Problems of mathematical modeling of the processes of the cycle of the pump of the three-dimensional action are considered in this work. The base of mathematical models is described by laws of mass conservations, the energy and dynamics of motion. For example it is considered modeling of the cycle of the piston single acting pump.

Keywords: pump of the three-dimensional action, worker processes, mathematical modeling.

**A. V. Grigoriev, V. E. Scherba, A. P. Bolshtyanskiy**
**Design of straight tooth rotary pump**

New design of a pump of volumetric action consisting of a rotor with straight teeth, cylinder and the end disk rotating synchronously with the rotor is considered. The technique for aperture shape in the end disk of the given pump is developed. Dependence of the area of the aperture to the angle of rotor turn is obtained.

Keywords: hydraulic machine, volumetric action, liquid pump

**T. A. Ivakhnenko**
**Experimental evaluation of gas flow in pseudo-porous feeders of gas bearing of a piston**

In the article flow of gas in flat porous feeders of gas bearing of the piston formed due to contact of rough surfaces is considered. It is shown, that the best characteristics on uniformity of the flow are provided when surfaces treated with laser. The simple formulas are resulted allowing to estimate an average clearance between the compressed rough surfaces.

Keywords: gas bearing, the piston compressor, gas greasing.

**A. P. Bolshtyanskiy, T. A. Ivakhnenko**
**The parametrical analysis of characteristics of the compressor with gas bearing with centered piston and pseudo-porous feeders**

In the article the basic characteristics of the compressor with gas bearing with centered piston and pseudo-porous feeders of gas bearing are considered. Comparison of parameters of such compressor and a compressor with gas bearings which centering the piston by feeders of the type of «simple diaphragm» is made. It is shown, that at small diameters of pistons the best results are reached by manufacturing feeders with gas bearings in the form of contacting rough surfaces.

Keywords: piston compressor, gas bearing

**A. A. Degtyarev, S. N. Karbainova, G. V. Redreev**
**Calculation of constructive parameters of angular volumetric hydro machine**

Original construction of angular volumetric hydro machine is considered in this article. Relation between basic constructive elements of hydro machine parameters is obtained the value of flow through the clearance is determined.

Keywords: angular hydro machine, parameters, calculation, productivity.

**R. N. Ivanov, V. V. Shalay, E. V. Khodoreva, M. V. Kucherenko, V. A. Grinevich**
**Application of a method of analytical hierarchy for choosing photo-electric converters at designing of microsatellite**

In presented article the choice of photo-electric converters at a preliminary design stage with use of a method of analytical hierarchy is described.

Keywords: photo-electric converters, a method of analytical hierarchy.

**V. N. Klimov**
**Sources of energy for turbine engine compressor at different operational modes**

In this article the author analyzes off-design modes of the compressor operation and has concluded that generally there are modes where the energy is supplied to it fron both turbine and incoming air flow in stable compressor operation.

Keywords: gas-turbine engines, mathematical model of the working process, off-design modes of the compressor operation

**V. G. Thyss, M.Yu. Sergaeva**
**Validation aimed at possible extension of service life of vibration-absorbing nippers in pipeline systems**

Predicted experimental validation aimed at possible extension of preset service life of vibration-absorbing nippers in pipeline systems. The validation methodology aimed at possible extension of preset service life for vibration-absorbing nippers in pipeline systems has been reviewed. It has been considered that the basic performance parameters of vibration-absorbing nippers are found to be in the limits of technical specification requirements applicable at the end of the service life hereto.

Keywords: vibration-absorbing nippers, designed service life, pipeline systems, performance parameters, accelerated tests, operational model.

**L. N. Kiselyova**
**The evaluation of cutting tool to soil resistance for digging machine**

In the article the problem of rational placement of cutters on working rotors of the digging machine is analyzed.

Keywords: working members, cutters, digging machine, angles of rotation cutter.

## Brief messages

**G. S. Garibyan, Yu. K. Korzunin, V. P. Raschupkin, A. I. Gromovik**
**The increase of construction strength of machines using optimal structure alloy**

The article analyses improvement of operational characteristics of manganese ferroalloys 110G13L by complex inoculation

Keywords: steel 110G13L, durability, viscosity, fragility.

**I. V. Mozgovoy, N. G. Makarenko, E. V. Dorovskikh**
**Analysis of wear and tear process in pump pairs of fuel equipment and implementation of the method without disassembling**

The article covers the topical problem - extension of the life time of units (diesel- fuel injection pump) of diesel- engines and armor technics. For revitalilizahion of the working capacity of the pump elements various methods are used. Authors use the method of electrical, chemical and mechanical treatment of the pump elements. The analysis shows that this method could be widely used.

Keywords: fuel pump, plunger, electrical-chemical- mechanical treatment

**D. S. Rechenko, A. Yu. Popov**
**Configuration of high-speed equipment**

Processing of hard to cut materials with speeds of cutting over 120 m/s demands designing and making of the high-speed equipment intended for productive processing of surfaces of details of mechanical engineering. Existing configurations of the metal-cutting equipment are not capable to provide possible safe high-speed processing. Therefore, creation of the basic scheme of configuration is necessary.

Keywords: configuration, the high-speed equipment, high-speed processing.

**V. A. Penner, A. P. Morgunov**
**Technological complex on control, repair and reconstruction of pump-compressor pipes and pump rods used for production of raw hydrocarbon material**

The project of technological complex on repair and reconstruction of pump and compressor pipes and rods to the pumps is presented. The list of basic and additional equipment is determined. The block diagram of the preparation of pump and compressor pipes and rods for reuse is developed.

Keywords: pump and compressor pipe, repair, control.

**E. A. Lysenko**
**Synthesis of a perspective mechanism of piston compressor motion**

In the article the algorithm searching for a number of constructive features is developed for synthesis of final version of compressor design with gas support of the piston. The scheme of completely dynamically counterbalanced drive without lateral load on the compressor piston is resulted. It gives the chance to refuse liquid grease for piston pair, or lower gas supply for gas-static centering of the piston.

**ELECTRICAL ENGINEERING. POWER ENGINEERING**

**A. V. Bubnov, A. N. Chudinov, V. A. Emashov**
**The algorithm of work of computer model of pulse frequency-phase discriminator and its development in Simulink application from Matlab software**

In the article the algorithm of work of computer model of the pulse frequency-phase discriminator is developed and developed in Simulink application of Matlab software. Time dependences and phase portraits of computer model operation of the pulse frequency-phase discriminator are obtained .

Keywords: pulse frequency-phase discriminator, electric drive with phase synchronization, nonlinear element.

**A. V. Bubnov, A. M. Daynovich, D. Yu. Storozhev**
**Peculiarities of signal demodulation in phase locking motor drive regulators**

This article describes signal demodulation in phase locking motor drives. The problems taking place during designing and analysis of precise motor drive systems are highlighted in this article. The computer modeling is done by authors to solve these problems. Completing the research authors make a conclusion about usage of methods of digital systems theory in electrical drive with pulse-width modulation.

Keywords: precise motor drive, digital systems, pulse-width modulation.

**I. N. Krasnokutskiy, V. L. Yusha**
**Protection, diagnostics and fuzzy regulation of group electrical networks in electrical power system of exterior lighting**

In the article problems of protection and diagnostics of group electrical networks in an electrical power system of exterior lighting are considered.

Keywords: group electrical networks, electrical power system, exterior lighting, protection, diagnostics, fuzzy regulation.

**E. Yu. Nosov, G. A. Nesterenko**
**The experimental stand for checking characteristics of low vibration piston compressor with combined mechanism of actuator**

In the article the experimental stand for checking characteristics of a low vibration piston compressor with combined actuator is considered. There is description of the following: general view of the stand, the layout scheme of the compressor actuator, problems of maintenance providing accuracy of assemble and manufacturing of separate units of the actuator, and also a fragment of technological process of manufacturing of the most important details proving its labor intensiveness.

Keywords: piston compressor, piston drive, accuracy, low vibrations.

**V. R. Vedruchenko, V. V. Krainov, N. V. Zhdanov, M. V. Kulkov**
**About schema selection and technical design for diesel fuel supply systems using alternative and heavy oil fuels. Part 2**

In the article the analysis of prospects of oil extraction and its usage for combustion engine fuel production is carried out. Inevitability of alternatives for oil fuel is shown. The detailed analysis of fuel supply systems for diesel engines that work on alternative fuels is done.New technical and technological solutions for using of light and heavy fuels in diesel engines are supplied.

Keywords: unconventional fuels, diesel, fuel supply, injector, injection and control system

**E. M. Rezanov**
**The increase of overall performance of thermal furnaces**

The technique of optimum heating temperature evaluation in air flow used for burning of fuel in thermal furnaces with radiating pipes is offered. The algorithm is developed for its evaluation taking into account minimization of the total expenses for a recuperator and fuel.The expediency of appli-cation of the developed algorithm for economical reason is optimal tempe-rature of air in the recuperator in thermal furnaces with radiating pipes. The use of the given methodology raises thermal efficiency and profitability.

Keywords: thermal furnace, radiating pipe, expenses, temperature, algorithm, efficiency.

**A. L. Kashtanov, A. A. Komyakov, M. M. Nikiforov**
**Checklist for power inspections of electrical supply networks in Russian railways**

In the given article features of carrying out of power inspections of electrical supply networks are considered. The list of obligatory and additional procedures is resulted in the maintenance log book at inspection of the system of electrical supply.

Keywords: power inspection, power passport, electrical supply distance, traction of trains.

**A. Yu. Finichenko**
**Technique of evaluation of specific consumption thermal energy for technological needs in stationary power system of railway transportation**

The problem of rationing of thermal energy in stationary power system of the railway transportation brings norms of the consumption of various kinds of energy and fuel on separate technological operations and productions is considered. The technique for evaluation of specific norms of consumption of thermal energy at technological processes, on the basis of the analysis of the statistics submitted by structural divisions of the JSC Russian Railway is developed.

Keywords: stationary power system of railway transport, specific norms of thermal energy consumption, thermal energy rationing, technological process.

**A. S. Nenishev, A. G. Mikhailov, S. V. Terebilov**
**Turbulence model with two equations for the flows of reacting gases**

There is formulated and solved the problem of turbulent heat transfer in a small boiler furnace burning gaseous fuel.

Keywords: turbulence, combustion, furnace, temperature, convection.

**V. P. Anufriev, V. E. Silin, G. I. Usova**
**Resource saving technologies of using of industrial wood waste**

The article presents the results of research and technical and economic studies carried out in «UCEE» and heat power engineering faculty of USTU on two innovative projects. The article deals with modern technology use of waste wood as an environmentally safe alternative energy source. The technological processes of production of bio oil from wood waste and energy from waste wooden sleepers are discussed.

Keywords: bio oil, gasification, resource saving, wood waste, wooden sleepers.

**A. P. Baskakov, D. A. Zinchenko, M. V. Varankin**
**Fundamental equation for assessment of hot water supplying systems using the solar energy**

An analytical dependence of water temperature on time of the day in a two-circuit solar heater for hot water supply is obtained. The heater has closed circulation circuit of antifreeze liquid, which includes solar collector and heat exchanger for water heating and accumulation. Intensity of the solar radiation, temperature of ambient air and quantity of the water, which is heated in the heater, are depending on time.

Keywords: hot water supply, solar heater , unsteady conditions.

**V. R. Vedruchenko, V. V. Krainov, M. V. Koksharov, N. V. Zhdanov, M. V. Kulkov**
**Fuel saving in boiler-rooms by improvement of heat engineering control**

The analysis of explored resources is implemented: oil and gas through 2300 for different countries, and coal, oil and gas through 2020 for Russia. An estimation is given for efficiency of technical actions for boiler-rooms of small and medium capacity: some results of testing "Oktan" gas boilers were presented.

Keywords: resources, prediction, extraction, heat-and-power engineering, economy, control.

**M. Yu. Derevyanov, M. Yu. Livshits, D. M. Fedorchenko**
**Optimal control of vacuum cementation by energy efficiency criteria**

The mathematical model of vacuum cementation use of variable heat-transfer coefficients is developed. Tasks of optimal control for vacuum cementation process by criteria of absolute precision of carbon distribution

and by criteria of maximum performance with given precision are solved by Green's functions method. The analysis of power inputs for optimal and present modes of vacuum cementation is done for furnace VUT – (LCP).

Keywords: vacuum cementation, alternative method of optimization, Green's functions method, maximum performance task, maximum performance task, analysis of power inputs.

**A. V. Krupnikov, A. D. Vanyashov, I. A. Yanvaryov**
**Analysis of efficiency of air coolers on the basis of units with various number of fans**

Currently the efficiency improvement of air cooling installations (ACI) achieved by means of advancing air cooling units (ACU) with purpose to improve their thermal and efficiency particularly through using multifan units, as well adjusting ACU operation modes during season operation is reached. For purposes of last one it is considered the comparison of discrete and frequency control modes of cooling medium discharge for ACI which consists of two fan gas air cooling units 2АВГ-75С – 12 pieces as well as for gas air cooling unit which consists of multi-fan gas air cooling units АВГ-85МГ – 14 pieces.

Keywords: air cooling installation, air cooling unit, control mode, k-drive

**A. F. Ryzhkov, A. V. Popov, T. F. Bogatova, V. E. Silin, P. V. Osipov**
**Effectiveness of modern ways of low-grade fuels conversion in power industry**

Due to necessity of selection and industry application of novel for Russian power branch high effective coal and biomass steam-gas power plants numerical and experimental researches are done to improve autothermal conversion of low-grade fuels (peat, wood, brown coal and so on) into a fuel gas. Estimation of energy effectiveness of using the mentioned fuel gas into IGCC power plants is done.

Keywords: autothermal, allothermal regime, gasification, low-grade fuels, steam-gas plant, chemical efficiency.

**N. V. Sakova**
**Analysis of environmental friendliness of gas-turbine steam power plant**

The environmental impact of a modern gas-turbine steam power plant is analyzed. The acceptable environment influence of a steam power plant is given.

Keywords: emissions in the atmosphere, discharges into water bodies, waste products, noise influence

**A. V. Sokolov, V. S. Belousov, A. Yu. Bolshikhin**
**Efficiency studies of gas heat recovery after regenerative rotating air heaters**

The work deals with analytical solution of the problem of non-uniform gas temperature distribution after regenerative rotating air heater. Sufficient gas temperature gradient is shown here. The results presented in the work allow the part of outgoing gas to be used for industrial usage and utilities.

Keywords: steam boiler, gas temperature, rotating regenerative air heater, metallic packing.

## Brief messages

**A. V. Arkhipov, A. A. Zyabkin, P. N. Remizov**
**The decentralized supply power in Khanty-Mansiysk Autonomous region–Ugra**

The advantages of cogenerative technologies for decentralized supply power in Khanty-Mansiysk Autonomous region – Ugra are considered taking into account the features of the region.

Keywords: cogeneration, decentralized power supply.

**M. F. Bogdanova**
**Significance of control and measuring instrumentation in fuel and energy industrial sector**

In this article main problems of fuel and energy sector and necessity of control and measuring instrumentation development are considered providing country energy security.

Keywords: control and measuring instrumentation, fuel and energy industrial sector, energetic strategy, wear out, energetic.

## INSTRUMENT ENGINEERING, METROLOGY, MEASURING SYSTEMS

**V. I. Glukhov**
**Invention of coordinate axes different informational load in geometrical sizes of reference systems for parts of machines and devices**

It is proved that three coordinate axes of the rectangular Decart system, applied in mechanical engineering, differ in function, information, which is expressed in different number of linear and angular coordinates, counted from each axes, at the task of an arrangement of parts elements. Introduction of coordinate axes information in designing practice, including automated, will allow to raise geometrical accuracy of machine and device parts.

Keywords: machine and devices parts, coordinate systems, geometrical sizes, coordinate axes information , linear and angular coordinates of parts elements.

**A. A. Khryakov**
**The current measurement in electric power meters of DC for rolling stock and traction substations**

The article describes the basic problems of direct current measurement in electric power meters. Leading causes of accurate measurements degradation are analyzed. Methods for their removal are presented. The method for improving the accuracy of measurements with zero offset correction system in real time is considered.

Keywords: zero drift, sigma-delta ADC, instrumentation amplifier.

## INFORMATION TECHNOLOGY

**V. I. Potapov**
**Functional reliability of two neuro systems with time redundancy**

Two models of neuro systems adaptive to failures of neurons in artificial neural networks with time redundancy and periodic control of the problem are considered. The formulas for calculating reliability function of both neuro systems, allowing to find the required reserve of time to optimize the probability of failure-free operation, are given.

Keywords: neural systems, reliability, redundancy, recovery of operability, neurons.

**V. I. Potapov**
**On the effectiveness of providing reliability of redundant neural systems with a random period of monitoring and recovery of operability after the neurons failure**

The analytical solution for evaluating the effectiveness of the reliability of redundant and restorable after a failure neural system with a random period of monitoring and recovery of operability is given.

Keywords: reliability, neural systems, recovery of operability, failure, neurons.

**L. A. Denisova, E. M. Raskin.**
**The event-driven simulation of automatic control system of steam generator feed system of nuclear power generating unit**

The mathematical model of the steam generator feed system of the nuclear power generating unit is suggested. The model has variable parameters. The event-driven simulation is implemented with MATLAB/Simulink/Stateflow. The dynamical behavior of the steam generator automatic control system is investigated.

Keywords: steam generator feed system modeling, event-driven simulation, transfer functions containing variable parameters, an automatic system of the water level control

**E. M. Raskin, L. A. Denisova, G. V. Shipilova**
**The pressure control system of the main steam manifold of the nuclear power generating unit**

The steam pressure control system of the main steam manifold of the nuclear power generating unit is developed. The system is based on basis on the digital local controllers. The dynamic testing and system optimization results are given.

Keywords: the fast-acting reducing plant, pulse automatic control system, computer-aided design.

**S. S. Shevtsov, A. G. Yanishevskaya**
**Automation of manufacture scheme design at an enterprise of petrochemical industry**

A flowchart design is a first step in the process design of a refinery unit, factory economy and showing preliminary solution for future design process as well as flowchart design is the main step for further design process.

Keywords: design, design documentation, technological scheme

**V. A. Gerasimov, O. N. Kaneva**
**The chasing problem: prior map estimation**

This article is about chasing problem in games and its solutions. Authors suggest a new solution which is based on the prior map estimation. The

solution makes possible to accumulate knowledge and use it for resolving the chasing problem.

Keywords: chasing algorithms, map estimation, path-finding, $A^*$ algorithm.

**M. A. Boganets**
**Methods and algorithms for artificial neural networks with non-linear activation functions diagnostic**

Article describes design of artificial neural networks with non-linear activation functions diagnostic methods and algorithms for full group failures diagnostic. Artificial neuron and neural network layer model with diagnostic possibility are developed.

Keywords: artificial neural network, non-linear activation function, failure, diagnostic methods, diagnostic algorithms

**D. G. Dubynin**
**Methods for analyzing of productivity of information and computing systems in the segment of multiservice network of Omsk Region**

The article provides an overview of methods for analyzing of productivity of computing systems, the comparison of these methods, in addition, paid attention to the shortcomings of the analyzed methods. Imitating modeling of computing systems is considered in details. The given tasks are achievable using imitating modeling of computing systems.

Keywords: methods for analyzing, computing systems, multiservice network.

**E. S. Ershov**
**The peculiarities of implementation of Simulab simulation system core**

Aspects of the effective implementation of the Simulab simulation engine for virtual time mode are considered. The methods of increasing the performance of the event queue and ways of effective use of memory are offered.

Keywords: discrete-event simulation, agent-based simulation, performance.

**V. A. Kulbida**
**Mathematical modeling in the system of discrete information transfer**

The paper describes a mathematical model proposed by the author of a new universal continuous vector code, for which a universal high-speed encoding and decoding algorithms for the system of discrete information transfer.

Keywords: model, unjammable code, coding, adaptation, simulation, mathematical modeling.

**V. V. Sosedko**
**Organization of uniform libraries of radioelements on the basis of a software the directory of radioelements**

Correctly organized design of radio-electronic devices in Computer-Aided Design systems needs application of uniform libraries of radioelements. For this purpose it is necessary not only to fill up and update libraries, but also to integrate them with other available systems of designing, production management, databases and corporate directories. In the given article uniform libraries, a software for working with it, and also their place in a uniform information field of the enterprise are presented.

Keywords: Computer-Aided Design system, radio-electronic devices, radioelements, Enterprise Resource Planning System, database, Product Data Management system.

**O. V. Lukina, N. A. Guliyev**
**Modern equipment and technology automation of tourism enterprises**

The need to improve automation technology of tourist enterprises are dictated by current market conditions and development of hardware and software. There are various ways to automate tourist enterprises, the application of which is due to specific tasks.

Keywords: engineering, technology, tourism enterprises, software product.

**RADIO ENGINEERING AND COMMUNICATION**

**I. R. Faizullin, R. T. Faizullin**
**Hardware-effective algorithm based on the problem of selector choice**

New cryptographic and steganographic algorithm based on the one problem of selector choice is presented.

Keywords: marker, problem of choice, effectiveness

**T. O. Pozharskiy**
**Analysis of the digital correlation function evaluation of m-sequences**

Digital evaluation of correlation function was analyzed. Expectation value of distribution was determined and estimation of variance value is calculated. The dependence of correlation function estimation on correlator characteristics was revealed. Analysis is provided for the case when m-sequences are used as code sequences.

Keywords: correlator, digital signal processing, code sequences, correlation function.

**V. A. Berezovskiy, I. D. Zolotarev, E. Yu. Mikhailov**
**Studying of amplitude methods of direction finding in systems with digital array**

The impact of distortions implied by analog to digital converter and digital array on accuracy of amplitude methods of bearing is investigated. The results of mathematical modeling of beam pattern of digital array are presented. Error of direction finder is evaluated.

Keywords: digital array, amplitude methods of bearing, multibeam pattern.

**V. S. Budyak, V. P. Kismereshkin, A. A. Vorfolomeev, O. V. Karaseva**
**Assessment of HF radio line power loss**

The paper presents the results of estimating HF mobile radio link energy loss due to the mismatch between HF transmit/receive antennas and radio path dynamic parameters.

Keywords: HF low power communication systems, matching HF antenna directional characteristics and radio path parameters.

**S. A. Doberstein, V. A. Arzhanov**
**Balanced low-loss SAW filters with impedance conversion**

This paper presents the balanced low-loss selfmatching SAW filters with impedance conversion. These filters allow to eliminate the cumbersome balance and matching elements from an electronic scheme.

Keywords: SAW filter, low insertion loss, passband, selfmatching, functionalities.

**I. E. Komarov**
**Analysis methods for determination of optimality wavelet–basis by the example of vibration signals**

This article considers methods of selection of best wavelet – basis for vibration signals based on criterion of minimum entropy.

Keywords: wavelet, basis, entropy, optimality, estimation, vibration.

**S. S. Abramov**
**Stability analysis of pulse-width systems by converting reference pulse**

This paper presents the results of the study of pulse-width system (SIS) with of negative feedback loop. On the basis of the asymptotic method of reducing the order of a linear system the technique of SIS information to an equivalent non-linear amplitude-pulse system (AIS) for which you apply the known methods are developed. The possibility of analyzing the SIS in cases with known or calculated response of the linear part of the SIS to impulse action is considered.

Keywords: pulse-width system, nonlinear distortion, stability.

**D. N. Klypin, A. K. Chernyshev**
**System for locating and monitoring of divers**

Conventional systems for technical support and tracking of divers, main parameters of these systems and methods of enhanced them are discussed in this issue. Novel system for locating, monitoring of physiological state of divers group and generating of automatic alarm is offered.

Keywords: diver, absolute coordinates, physiological state monitoring.

**E. I. Algazin**
**Assessment of noise immunity invariant system transfer with rough determination of transmission link coefficient**

Noise immunity invariant system is determined by the way of information signals transmission and be thresholds accuracy. In this paper investigation of the noise immunity of an invariant system with inaccurate setting of thresholds is carried out. The determined curves of noise immunity.

Keywords: noise immunity, invariant, probability of pairwise transition, signal/noise relation.

**V. A. Arzhanov**
**Application of orthogonal polynomial for approximation of transmission functions of band delay**

Performance analysis of group delay characteristics for approximation of transmission function of band delay with orthogonal polynomials is done.

Keywords: polynomial, approximation, group delay, prototype.

**L. G. Rogulina**
**Estimation of the internal hindrances of power supply systems for radio relay-type communication link**

In this work there are presented mathematical and simulation models of the estimation of the internal hindrances of the systems of the power supply. The models calculate characteristics in transient operational modes. Calculation of the factors of power supplies quality is organized on the results of modeling for radio relay – type communication link.

Keywords: internal hindrances, power supply system, simulation modeling.

**V. L. Hazan, D. V. Fedosov, D. A. Korneev, V. N. Horvat**
**Mobile trunk communication system**

This article examines implementation of example of mobile trunk communication system. The main feature of the system along with rapid installation and mobility in operating mode is long communication range because using MF(HF)communication channels.

Keywords: over-the-horizon communication, ground wave, medium frequency, near-vertical incident sky wave antenna, compact dipole antenna.

## Brief messages

**I. D. Zolotarev, T. O. Pozharskiy**
**The method of decreasing of mutual interference impact in communicational systems with code division**

The method of decreasing of mutual interference influence in communication systems with code division was developed. In the paper recurrence formula is given for elimination of interfering signals from received signal. The results of mathematical simulation are provided and figures are presented.

Keywords: correlator, code division multiple access, mutual interference.

**V. A. Maistrenko, I. E. Komarov**
**Methods of quantitative estimation of wavelet-basis**

This article considers methods of quantitative estimation of wavelet-basis based on criterion of minimum entropy. The peculiarity of this method is in taking into account all levels of decomposition of the signal and using this wavelet as a basis for decomposition of the signal.

Keywords: wavelet, basis, entropy, optimality, estimation, decomposition.

**CHEMICAL TECHNOLOGY AND INDUSTRY**

**I. V. Mozgovoy, V. A. Gryaznov, E. V. Mironova, E. I. Mozgovoy**
**Perspective of ultrasound application at pyrolysis**

The application of high-frequency influence to hydrocarbon materials (solid and liquid mediums) permits: first of all, to increase the yield of base product, secondly, to reduce costs and increase efficiency of complex and expensive technology of petrochemical production.

Keywords: ultrasound technologies, pyrolysis, cavitations, mechanical influence, hydro dynamical influence, hydro acoustical influence.

**D. N. Dorogobid, I. V. Bukin**
**Application of complex modifying additives and their influence on energy saving during manufacture of construction materials and products**

In the article problems of decrease in power inputs are considered by manufacture of construction materials by application of complex modifying additives. Results of practical tests of the developed complex modifiers are presented.

Keywords: chemical additives, energy saving, dispersion, acceleration of hardening.

**PUBLISHING. PRINTING**

**E. A. Voronov, I. S. Lebedev**
**The study of printing drive dynamics in technological machines**

The article considers the dynamic phenomena in drives of roll rotary printed machines in which technologically connected units are driven by one electric motor.

Keywords: dynamics, drive, printed device.

**S. P. Gnatyuk, A. B. Likhachev, L. G. Varepo, A. S. Borisova**
**Image quality assessment under adhesive-adsorption interaction in the system of «image carrier – colorless and colored components of ink»**

A method for assessment of the quality of paper and polymer-based image carrier has been developed. The procedure for identification of individual and group characteristics of the complex absorptive-adhesive interaction in the system «image carrier – colorless and colored components of ink» is obtained.

Keywords: printing, ink, absorptive-adhesive interaction