

MECHANICAL AND THEORETICAL ENGINEERING

F. N. Pritykin, V. I. Nebritov

Construction of work area of hand mechanism of android robot considering position of exclusion zones

The shape and position of projection of working area of the hand mechanism of android robot are investigated at a different position of preeminent obstacle environment. A method is proposed for analytical set of working area of the projections circuits through the use of methods of analytic geometry and the theory of sets. The studies can be used for development of android robots management systems that functioning autonomously in difficult organized surrounding space.

Keywords: work area of manipulator, robot external environment, manipulator mechanism, intelligent robot control system.

V. A. Konovalov, S. I. Belov

Investigation of stability of round billets with relatively thick wall, shingled matrices with cone angle of 50°

Experimental studies to establish the effect of the tool performance and workpiece sizes on the stability of the cylindrical section is not crimped, crimped in conic matrixes of thick-walled workpieces. These quantitative estimates are presented graphs to predict defect-free implementation of the deformation in designing manufacturing processes of hollow extruded products with variable profile pro-longitudinal contour.

Keywords: crimp, conical matrix, thick-walled tube resistance.

Yu. P. Makushev, L. Yu. Volkova

The diagnosis of spray nozzles of locomotive diesel engines by the amount of fuel drained from the drain line

There is method that by the largest leak of the fuel from injectors with hydromechanical control determines the gap between needle and nozzle body. For fuel with electrohydraulic control apparatus needle injectors have been calculated by the discharged fuel valve, fuel leakage is determined depending on the pressure in the accumulator, the gap in the nebulizer and the pair of "control piston - guided". Inspection of technical condition of largest amount of drained fuel control valve of the injector nozzle is done.

Keywords: spray nozzle, diagnostics, leak, clearance, control valve.

Yu. P. Makushev, L. Yu. Volkova

The calculation research of diesel spray nozzles with piezoelectric control

There is considered device and operation control of the piezoelectric injector nozzle needle stroke. An example of the calculation of piezo injectors changing the length of which depends on the electric field, the geometric dimensions, the coefficient of elasticity of the material and the force developed piezo is proposed. The graph of dependence on the size of the piezoelectric element thickness applied

voltage is constructed. Recommendations for control of the basic parameters of the piezodrive during the diagnosis are given.

Keywords: nozzle, management, piezo drive, diagnostics, valve, fuel injection.

A. V. Shashok, T. B. Brylova, A. V. Kutyshkin

Evaluation of cutting temperature in high-speed processing of structural steels

The paper presents the results of theoretical evaluation of the temperature distribution during high-speed turning of structural steels. Based on the description of methods of thermal processes at cutting developed Vorontsov A. L., Sultan-Zade N. M., Albagachiev A. Yu., Savkin A. I. are obtained explicit expressions for determining the cutting temperature, heat distribution estimation flows between the cutting chips generated during the cutting tool and the front surface and its rear surface and contacting it with workpiece material. To assess changes in mechanical properties of the workpiece material used the Johnson-Cook model. The calculated values are compared with the cutting temperature of the open published experimental data, which are obtained by high-speed turning of medium-carbon steels.

Keywords: high-speed machining of steels, orthogonal turning, Johnson-Cook model, cutting temperature, distribution of heat fluxes at cutting.

A. G. Kisel, E. D. Purtov, A. V. Deylova, N. N. Kochura

Evaluation of cooling properties of cutting fluids

The article assesses the cooling effect of a number of coolants. Today, improving the quality of products and the duration of operation of the cutting tool, improved metal cutting machining technology are the primary tasks of production. In the application of coolants (GM) during certain types of processing considerably increases tool life, reduces the number of surface irregularities, the residual stresses are reduced, thereby improving productivity.

The following brands are selected for the experiment: Sinertek DS, Addinol WM440, Sinertek MX, Akvol-6, Isogrind-130EP. A cooling effect may be estimated from the coolant temperature sensor cooling rate, heated to temperatures occurring in the cutting zone, and immersed in the test coolant. According to the results - the greatest cooling effect have coolant Akvol-6, Sinertek DS because they are able to cool down with the greatest speed.

Keywords: coolant, the cooling effect, the cooling rate, a temperature sensor, a digital thermometer.

P. V. Nazarov, I. K. Chernykh, E. N. Matuzko, I. A. Bugay, E. V. Vasilev

The analysis schemes of fastening cutting inserts for sharpening rear surface

In modern engineering for the use in process of cutting metal plates commonly observed situation where the plates are no longer used by the occurrence of wear limit specified by the manufacturer. The plates are not restored by hand for precision geometry and rarely recovered on specialized equipment due to, firstly, the lack of such equipment and, secondly, because of the incomplete study and research of this issue. In the article, the problem of sharpening the cutting inserts on the rear surface, the analysis of attachment schemes is done. Analyzing the advantages and disadvantages of each of the schemes, we choose the most appropriate and supporting calculations.

Keywords: carbide blades, sharpening, tool life recovery.

P. V. Nazarov, I. K. Chernykh, I. A. Bugay, E. V. Vasilev, M. V. Vasileva, E. N. Matuzko
Design device for rolling periodic angular profile

In the modern machinery occurs the problem of manufacturing of broken angular profile on a sheet workpieces because of design features of the workpiece. The analysis of existing methods manufacturing profile on the sheet workpieces is done. There are analyzed the advantages and disadvantages of application methods under current conditions and selects the most appropriate. Calculation of stresses stamping process by software is done. The result of the research is development of device for rolling a broken angular profile on universal horizontal milling machine.

Keywords: forming, plastic deformation, blank workpieces.

Yu. V. Titov, D. S. Rechenko, N. S. Artemenko, A. Yu. Andreychuk
Intermetallic compounds

For development and improvement of technology it requires new materials that have special mechanical, physical and chemical properties, provide long and dependable performance material in harsh environments and have a fairly low specific gravity. There is big potential in improving properties of structural materials lies in the formation of surface layers on the basis of intermetallic compounds and phases of implementation. This article presents the structural and physico-chemical characteristics of intermetallic compounds and phases of implementation.

Keywords: intermetallic compounds, intermetallics, structural type, alloy, crystal lattice.

A. A. Shargaev, N. G. Makarenko
Electrochemical and mechanical hardening of bearing races

The article considers the survey of existing directions for increase of the resource of roller bearing life. To increase the bearing life the author offers electrochemical and mechanical hardening of bearing races with copper graphite material. He defines the methods of the studies. The article conducts hardening and running-in of roller bearings and implements bench and operational tests for the vehicle. Comparative tests for samples of bearings based on vibration characteristics, microhardness and roughness are carried out. The author receives the results of limited operation life for details of serial and work-hardened samples of roller bearings.

Keywords: electrochemical and mechanical hardening (EMH), a roller bearing (RB), a resource, microhardness, roughness, vibration monitoring.

A. S. Yanushevskiy, V. V. Korshunov
Production of magnesium castings in metal molds

In this paper, we analyzed the results of research in the field of magnesium casting and production experience in obtaining quality castings. It is established that the quality of the cast product surface, dimensional accuracy of castings and their mechanical properties are affected by the temperature of pouring, the composition and properties of core materials, the methods of hardening of the rods, the compositions of the protective chill colors.

Keywords: melting, casting, flux, refining, modifying, magnesium alloy.

ELECTRICAL ENGINEERING. POWER ENGINEERING

A. V. Bubnov, A. N. Chetverik

Improving dynamic processes in synchronously-inphase electric drive based on the use of control methods with positive change in algorithm of logical comparison device

The synchronously-inphase electric drive, built on the basis of electric drive with phase synchronization, widely used in thermal imaging and laser scanning systems due to the high accuracy and dynamic characteristics in a wide range of adjustment of the angular velocity. The aim of the article is to analyze the possibilities of improving the dynamic characteristics of the electric phase-locked and synchronously-inphase electric drive based on the use of control methods with a positive change in the mode of operation of the logical comparison device in transient modes of the drive. The classification of methods of forced mode change of the logic comparison device, and is a functional diagram, the implementation of which use the logic comparison device with the possibility of forced release.

Keywords: the electric drive with phase synchronization, synchronously-inphase electric drive, logical comparison device, discriminator, phase-locked loop.

M. M. Nikiforov, A. P. Shatokhin

The calculation of introduction limit cost of electric energy storage unit for DC electric traction system

The article discusses a question about economic expediency of introduction of electric energy storage unit at objects of the railway transport of OAO "RZhD". The basic indicators of the economic effect by setting the electric energy storage unit are given. The calculation of electric energy storage unit's limit cost is given for two variants of its setting and precisely on the section, where the limiting areas between substations are missed and by their existence.

Keywords: the economic efficiency, the energy efficiency, the electric traction system, the capacitive energy storage unit, the limiting areas.

P. V. Rysev, V. K. Fedorov, V. O. Kropotin, V. I. Novoselov

Increasing power in oil transformer reliability by improving heat transfer

This paper presents different methods of quality evaluation of the reliability of transformers based on statistic analysis and a logical method of fault tree techniques considered for the identification of frequent failures and dependence of characteristics of the transformer windings on the oil temperature, and time spent in it. The paper demonstrates the heat transferring calculation of the oil-immersed three-phase two-winding power transformers TM type with power 25000 kVA (TRDN-25000) and the dependence of heat transfer coefficient on the number of cooling tubes. The calculations are based on the method by Golunov A. M. presented in the book "The cooling device of oil-immersed transformers". The final results of the study based on the theoretical calculations allow to control reliability and the operational lifetime of transformers.

Keywords: reliability, heat transfer coefficient, oil-immersed power transformers, fault tree, oil cooler.

V. Yu. Miroschnik, D. V. Batulko, A. A. Iyashkov

The methods and algorithms determining place of one-phase ground in networks 6–35 kV using emergency mode parameters

The review and analysis of existing methods in defining the distance of single-phase short circuit to earth in 6–35 kV network with emergency mode settings is done. The advantages and disadvantages of reviewed methods and algorithms are formulated. The ways to improve the accuracy of defining the distance of single-phase short circuit to earth are examined. The description of the most perspective methods used in modern digital protective devices are included.

Keywords: distribution network, single-phase ground fault, determination of the distance to the place of the single-phase circuit, digital protective device.

T. A. Novozhilov, A. N. Novozhilov, A. O. Potapenko

Determining electrical signal period in power industry for spectral analysis

One of most common methods of study of electrical signals in the power received from the transmitter is spectral analysis by decomposition into the Fourier series. The reliability of the results obtained in the diagnosis largely depends on the accuracy of determining the period of the fundamental harmonic of this electrical signal. In this paper, the analysis of the known methods of determining the period of the needs of the diagnostic systems damage of short cut winding rotor of asynchronous motor, identified their weaknesses and proposed a new method based on the definition of the period at the extrema of the sum of discrete values of the controlled signal.

Keywords: measuring transducers, electrical signal spectral analysis, the definition of the period.

E. C. Flek

Peculiarities of calculation of heat transfer in furnace of boiler when burning coal-water fuel

There is developed method of thermal calculation of the furnace when burning coal-water fuel. There are presented the results of thermal calculation of the furnace of the steam boiler TP-35. There is evaluated the performance of the steam boiler at different loads. The thermal modes of operation of the steam boiler TP-35 in the estimated range of performance are indicated.

Keywords: water-coal fuel, steam boiler, thermal conditions, thermal characteristics of the furnace, the products of combustion.

**INSTRUMENT ENGINEERING, METROLOGY
AND INFORMATION MEASURING EQUIPMENT AND SYSTEMS**

I. V. Dulkeit, V. L. Khazan, I. S. Zemlyanov, A. N. Yurev

Time-frequency synchronization for highly reliable modem with OFDM

The article presents the results of the analysis of time-frequency synchronization method for low-energy radio links using orthogonal frequency division method (OFDM – Orthogonal Frequency Division Multiplexing). It is shown that the proposed method has low sensitivity to the accuracy of time synchronization. This method allows you to use system with exact time signals for entering and maintaining communication.

Keywords: time-and-frequency synchronization, OFDM modem, systems of exact time.

P. I. Puzyrev, K. V. Semenov

Research of influence of CORDIC algorithm parameters as part of digital mixer to spurious free dynamic range

In this paper we research the effect of CORDIC algorithm parameters as part of the digital mixer, to the spurious free dynamic range (SFDR), identified the best values of CORDIC parameters to implement the most effective digital mixer, with high spectral purity. The result is dependence of SFDR shift from CORDIC parameters, as well as obtained approximating expression allows to perform a lower bound, i.e., get the value of SFDR is guaranteed to be provided for selected CORDIC parameters over the entire frequency range. New in this work is the use of cross-cutting approach to design, which allows to go quickly from mathematical modeling to prototyping on FPGA.

Keywords: CORDIC, digital mixer, SFDR, digital down converter.

A. Yu. Tetter, V. Yu. Tetter

Methods of signal processing in vibrodiagnostic wheel-motor blocks of locomotives

It shows the importance of vibrodiagnostic equipment in the process of repair of rolling stock. The advantages and disadvantages of the main methods of signal processing in time and frequency domains when vibrodiagnostic knots of rolling stock of Railways are considered. There are identified promising directions of implementation of the considered methods. The conclusion about the feasibility of using multiple methods of analysis in the frequency domain is made.

Keywords: vibration, diagnoses, settings, time signal, frequency analysis, spectrum, conversion.

A. I. Cheredov, A. V. Shchelkanov

Voltage-to-frequency converter based on electrical domain

This paper describes the possibility of developing voltage-to-frequency converters (VFC) based on electrical domain. The sensitive elements of measuring converters are fabricated from GaAs. The conversion range of VFC is in the range from (7–8) to 10 volts. Sensitivity of VFC reached (7–10) MHz/V. The experimental results are presented in the paper.

Keywords: measuring converter, Gunn effect, frequency output signal, sensitivity, semiconductor.

V. E. Leonov

Technology for producing solid solutions of CdSe-ZnS system and research of acid-base properties

Process of obtaining of solid solutions of system CdSe-ZnS by the method of isothermal diffusion in the mode of programmed heating is presented. The results of X-ray analysis according to which obtained objects are identified as solid solutions of substitution are shown. Results of studies of acid-base properties of solid solutions $(\text{ZnS})_x(\text{CdSe})_{1-x}$ by methods of hydrolytic adsorption, mechanochemical dispersion and nonaqueous conductometric titration are presented. The possibility of predicting of the practical application of the studied objects as materials for sensors of environmental application is shown.

Keywords: semiconductor, diamond semiconductor, solid solution, hydrolytic adsorption, mechanochemistry, nonaqueous conductometric titration.

A. S. Chernov, V. A. Gridchin, A. D. Byalik

Optomechanical unit design of new type of photoelectric pressure sensor

In this paper questions of optomechanical unit design of new type of pressure sensor intended for use in explosive and fire hazardous conditions are discussed. The analysis is based on the finite element model of optomechanical unit for a two-point load application scheme. Within the framework of a simplified analytical model considers the influence of design parameters on the converting function of optomechanical unit.

Keywords: elastic element, optomechanical unit, optic fiber, photoelectric pressure sensor, numerical simulation.

V. V. Tomilov, O. S. Tomilova, P. B. Sergeev

Improved method of water ultraviolet irradiation dose control

The quality of water supplied to the consumer provides for the development and preservation of the centralized water supply systems. Water transportation over long distances it requires after treatment systems, for example, by ultraviolet irradiation. The article is presented accuracy evaluation of the existing methods of dose monitoring of ultraviolet irradiation water. The improved method based on optical control of tinted streams allows to experimentally determine the time of water irradiation, to assess the effectiveness of the existing disinfection devices in the laboratory by using a specialized stand and into existing installations.

Keywords: ultraviolet, sterilizer, irradiation dose, irradiation time, videocontrol, specialized stand.

V. I. Mamychev, V. I. Sedinin

Optimization algorithms of high-speed performance of GSI on technology of system on crystal with project and technological norms of 180 nanometers

In the article the technique and optimization algorithms for systems in which high-speed performance has critical value is considered. The purpose of article is qualitative and quantitative analysis of piping and multiplexing in integrated circuits. The system method of research considering different parameters of integrated circuits is used. The considered operation is oriented on microelectronic factory TSMC. Dependences of high-speed performance, energy consumption and the area of the integrated circuit on optimization parameters are obtained.

Keywords: integrator, interpolation, piping, multiplier, clock signal.

INFORMATION TECHNOLOGY

V. N. Zadorozhnyi

Growing network with node losses

Methods of analysis for growing networks with random node losses are developed. Equations of the transient and steady-state vertex degree distribution are displayed on the basis of preferential attachment random graphs theory. Numerical methods for solving the equations are offered. Calculation examples are given. Vertex degree distribution robustness against losses is estimated.

Keywords: network science, preferential attachment random graphs, transient and steady-state degree distribution.

V. N. Zadorozhnyi, E. B. Yudin

Calibration of random graphs of preferential attachment by degree of distributions of vertexes and edges endpoints

Methods for calibration of random graphs preferred binding when modeling large growing networks are offered. Calibration adjusts the characteristics of the graph by data on the distribution of degrees of connectedness of vertices and edges of real network. The mathematical basis of the method is the theory of random graphs with nonlinear preferential attachment rule. These results extend the capabilities of an adequate modeling and study of real growing networks (social, telecommunication, transportation, terrorism, financial, etc.).

Keywords: random graphs, degrees distribution, joint edges endpoints distribution, nonlinear preferential attachment.

A. A. Ibatullin, A. A. Ogudov, R. A. Khakimov

Application of continuous analysis of quality developing advanced process control system of sulfuric acid alkylation unit

In this article there is considered the problem of increasing data operativeness of products quality for advanced process control (APC) sulfuric acid alkylation unit. It is necessary for solving problem in rate of technology process by APC. The aim is developing virtual analyzer of main product quality of unit. Several models of virtual analyzer of quality are created on the basis of laboratories and technological data regression analyze. Then models were valuated and chosen final model.

Keyword: virtual analyzer, APC, sulfuric acid alkylation.

A. A. Ibatullin, A. A. Ogudov, R. A. Khakimov

Application of fuzzy-logical PID-regulator temperature control loop in isostripper column

In this article there is deployed problem of temperature loop regulation in isostripper column of sulfuric acid alkylation unit. Main problems and characteristic features of setting loop are analyzed. The aim is creating software for considering of nonlinear and high inertial of technological process. Necessity of implementation of fuzzy-logic regulator is reveled and justified. The model of fuzzy-logical PID-regulator has been developed on the basis of current research. Package of settings realizing principles of fuzzy-logic in DCS Centum VP is obtained.

Keyword: fuzzy-logical control, alkylation, Centum VP.

A. N. Florensov

Asynchronous processes of interaction as basis of concept of information

The formalized concept of information is insufficient to cover the contents actually used in technical sciences taking into account not discrete control processes. The subject of this research is development of definition generalizing discrete and analog approaching and based on asynchronous influences on controlled system linking local property of information and entropy evaluation of multiple interactions. Instead of a message as the final sequence of characters, it is proposed to consider the broader concept of the inverse image of impact dynamics piecewise mapping. Asynchronous interaction studied in the theory of successive cooperating processes is used as a model of non-stationary flow of messages.

Keywords: information, message, control, influence, interaction, asynchronous processes.

E. B. Yudin

Counting of network 3-node motifs by carcasses random sampling method for directed networks

The developing of efficient algorithms for calculating the frequency of occurrence of non-isomorphic connected subnets (motifs) is important task of Network Science. Combinatorial and logical nature of this problem leads to time-consuming and/or memory-consuming calculating when analyzing networks contain hundreds of thousands of nodes. In this paper for solving this problem is developed an algorithm to calculate frequency of occurrence of 3-motifs in networks with directional links. The algorithm based on a statistical approach and random sample of carcasses method. The implementation of the algorithm using parallel programming is considered. The developed algorithm revealed significant advantages in terms of accuracy, speed and memory costs comparing with other known algorithms.

Keywords: network motifs, motifs frequency, statistical approach.

V. S. Zykin

Instrumental environment of foreign keys formation on schema of relational database

The paper discusses the original software for automation of constructing non-redundant set of referential integrity constraints on the data (foreign keys). These constraints are intended to regulate of the business rules in the use of information in the enterprise, which is stored in a relational database and is maintained by the database management system. The developed software automatically searches for possible variants of referential constraints leaving the user the right to accept or reject these restrictions. Then in automatic mode there are identified and removed redundant referential integrity constraints.

Keywords: database, referential integrity constraints, foreign keys.