MECHANICAL AND THEORETICAL ENGINEERING

D. I. Chernyavsky, D. D. Chernyavsky
Calculation strength of torsion bar suspension of micromirrors (MEOMS)

The paper considers the strength calculation of the torsion bar suspension of a micromirror with a reflective layer of high optical quality of the surface for deflecting the reflected laser beam. By changing the angle of inclination of the micromirror, the laser beam enters the various input channels of the optical sensor. In this case, a control signal is generated for the further operation of the microcircuit. Thus, the micromirror performs the function of a switch for input optical channels connecting certain input or output elements of the microcircuit in various combinations for further processing.In this work, the calculation of the strength parameters ofthe mechanical structure of a micromirror made of various materials has been carried out. Practical recommendations related to the development of micromirror torsion bar suspension are given.

Keywords: microtechnology, microelectromechanical systems (MEMS), microoptoelectromechanical devices (MOEMS), similarity theory, torsion strength calculation, electrostatic micromirror drive, kinematics, mechanical strength.

A. G. Kondrashov, D. T. Safarov
Measurement of total normal length of helical cylindrical gears by three-axis indicator on five-axis CNC machine

The article discusses a method for automated measurement of the length of the general normal of a helical cylindrical wheel, which allows to obtain its exact value without removing the part after gear processing with disk or end mills. The measurements are carried out by means of an automated supply of a three-coordinate linear measurement indicator to the calculated measurement points. The formulas for calculating the length of the general normal are given, which allow calculating the value of the length of the general normal and the correction value of the CNC gear ring processing program for two and one-point measurement schemes with the indicator. The use of the two-point method of measuring the length of the general normal with a three-coordinate indicator made it possible to measure the length of the general normal without removing the processed gear wheel from the mandrel, the single-point method completely eliminates the possibility of adjustment defects and reduces the complexity of carrying out machine changeovers in the mode of single and small-scale processing of gears. Comparison of gear measurement data with the three-coordinate indicator Mahr and a specialized CNC gear measuring machine give similar values and confirm the possibility of using the developed scheme to measure the length of the common normal.

Keywords: common normal length, measurement, three-coordinate probe, three-coordinate indicator, CNC machine, adjustment.

K. V. Kostin, K. S. Kryukov, I. Yu. Lepeshinsky
Diagnostic complex «Bort»

The article deals with the issue of checking the operability of electrical equipment of armored vehicles. This issue is relevant, due to the need to maintain constant combat readiness of armored vehicles. The system is saturated with automated and automatic systems for various purposes, while there is a problem of rapid troubleshooting in the operation of devices and electrical equipment systems. Existing diagnostic systems allow testing through diagnostic connectors or with a break in the supply circuit through adapters. The diagnostic complex discussed in the article will allow you to check the operation of consumers, blocks without disconnecting connectors.

Keywords: diagnostic complex, electrical equipment, armored vehicles, diagnostics, on-board network, sensor.

D. A. Blokhin, A. G. Koltsov, Yu. A. Blokhina, M. M. Lakman
The method for identifying of inaccuracy causes in turning machining center by processing a sample part

The article discusses the issues of the processing method of a turning machining center for processing the accuracy of processing a sample part. The model of sample part with the smallest possible control surfaces processed by various shaping methods has been developed to detect the amount of machine errors, such as the accumulated error of the screw pitch, or the axial non-perpendicularity, or the misalignment of the X and Y drives. This allows you to get more complete information of the equipment accuracy. A test procedure is presented according to the results of measuring each surface of the sample part.

Keywords: turning centers, accuracy, sample part, shaping motion, ballscrew, servo mismatch.

S. V. Pashukevich
Investigation effect of depressant additives on physicochemical properties of engine oil

In this work, laboratory tests of M8G2k engine oil are carried out with the introduction of SAP 110 depressants by Shell Additives and Lz 6662 by Lubrizol and their impact on the properties of the lubricant in question are assessed separately. During the tests, the values of the following indicators of engine oils are obtained: kinematic viscosity at 100 °C, base number, flash point in an open crucible, pour point and content of active elements (calcium, zinc). With the help of the SI-010 bench installation, the values of anti-pitting properties are indicated, as well as experiments are carried out on the NAMI-1m and Petter W-1 installations, with their help the tendency to the formation of low- and high-temperature deposits in the internal combustion engine (ICE) and the assessment of anti-corrosion properties respectively. To analyze the detergent properties of the engine oil under consideration, a test procedure are carried out on a D-240 tractor engine. Positive laboratory test results give grounds to recommend using M8G2k engine oil containing SAP 110 or Lz 6662 additives for the D-240 engine manufactured by MMZ.

Keywords: lubricants, engine oil, depressants, kinematic viscosity, base number, flash point, pour point.

D. T. Safarov, A. G. Kondrashov
The method for evaluation errors of automated measurements of base tangent length by three-axis indicator on five-axis CNC machine

The article provides an overview of studies of various errors in the process of measuring parts with three-coordinate probes on CNC machines. The paper considers a method for estimating systematic and random errors in the process of measuring the length of the base tangent using control maps and probabilistic and statistical methods for processing multiple repeated inputs of a three-coordinate indicator to the measured side surfaces of the wheel teeth. The method is designed to assess the acceptability of the measurement process by technologists and adjusters. The data of experimental estimation of random and systematic errors of measurement of the length of the base tangent on a five-coordinate CNC machine with a three-coordinate indicator of Mahr are presented. The obtained error values for the five-axis machine under study allow us to measure the length of the base tangent for the purposes of periodic monitoring and adjustment of the machine when processing oblique cylindrical wheels with universal disk or end mills.

Keywords: base tangent length, three-dimensional measuring indicator, suitability of the measuring process, CNC machine.

I. A. Battalov, Ya. V. Denisova, V. F. Sopin
Improving the quality of gas supplies to consumers when performing repair work on gas pipelines-branches

Providing consumers with high-quality gas supply services envisages ensuring uninterrupted fuel supply during repair work on gas pipelines - branches. In this regard, the purpose of this study is to

consider the organization of the backup fuel supply system for the specified period and develop proposals for its improvement. Achievement of this goal determines the solution of the following tasks: study of regulatory documents in the field of gas supply, consideration of existing options for organizing a backup fuel supply system, development of proposals for their improvement, assessment of the effectiveness of the proposed measures. Based on the results of the study, in order to ensure the provision of high-quality services to consumers for the uninterrupted supply of gas, as an alternative, it is proposed to consider gas supply using mobile automobile gas refuellers and a reducing device. The advantages of using this method and the possible effect of its implementation are noted.

Keywords: gas supply, quality of services, gas distribution stations, redundancy, compressed natural gas, mobile gas tanker.

I. E. Vasileva, A. G. Saybel
Determination of the relationship between the characteristics of LED lamps by calculation methods

The article presents results of the task statement and results of the research of the functional relationship of parameters of LED lamps in relation to the modern concept of quality management in an industrial enterprise. The regression dependencies obtained for the complete and truncated sets of the studied objects are described. Graphic illustrations of the identified dependencies are presented, which make it possible to predict the parameters of lamps at the early stages of designing lighting systems for special-purpose objects contributing to the optimization of decision-making on the organization and management of production.

Keywords: LED lighting, regression analysis, early design, decision-making, correlation dependencies, function smoothing.

V. V. Merkulov, Yu. V. Kalinin. L. O. Shtripling
Change in technology and equipment to simplify implementation of neutralization of oil-contaminated soil by the method of reagent capsulation in winter conditions

The article discusses some features of the implementation of the reagent encapsulation method in winter conditions. When preparing the next batch of oil-contaminated soil in a mixture with snow, a sufficient amount of water is formed, which can be used in the technological process, in this regard, it is proposed to make a change in the design of the installation. Since the presence of water in the contaminated soil prevents the mixing process with lime, it is proposed to change the traditional technology of reagent encapsulation. During the experiment, the possibility of implementing the encapsulation process using the modified technology is determined.

Keywords: equipment for decontamination, oil- contaminated soil, reagent encapsulation.

ELECTRICAL ENGINEERING

T. D. Gladkikh
Power supply reliability models of oil production facilities

This paper presents power supply systems reliability models of oil production facilities. There are two types of electrical complexes: an electrical network with a consumer sensitive to voltage dips and an electrical network with a consumer with technological redundancy. A comprehensive analysis of the power supply system and the power consumer allowed us to clarify the reliability indicators and determine the direction of improving the power supply reliability to oil and associated petroleum gas production facilities.

Keywords: electrical complex reliability, Markov models, voltage dips, temporary redundancy.

I. G. Odnokopylov, D. Yu. Lyapunov, N. A. Voronina, A. D. Umurzakova, K. V. Khatsevskiy
Induction motor speed control in closed loop system with thyristor voltage regulator

There exists a huge class of actuating mechanisms based on induction motors, where the use of a thyristor voltage regulator is relevant. This paper presents studies on the introduction of the ability not only to reduce the starting current of the motor, but also to regulate the speed of rotation. Studies have been conducted on the possibility of obtaining a regulation range of 1:5 using simulation model. The influence of the resolution of the speed sensor on the accuracy of regulation is investigated. Recommendations on the implementation of the developed method of speed control are given.

Keywords: induction motor thyristor voltage regulator, closed loop system, speed of rotation.

N. A. Tereshchenko, V. Yu. Miroshnik, M. A. Kholmov, K. I. Nikitin, B. N. Kovrizhin
Development diagnostic device of pin insulators

The article proposes an invention to diagnose a damaged insulator under the operating voltage of the power line (VLEP), using leakage current control. There is made a prototype, experiments are carried out. The leakage current removed from the shunt design is converted to a digital signal for processing, transmission and further processing on the substation control room. The controlled leakage current corresponds to the magnitude of the insulation resistance of the insulator.

Keywords: leakage current, pin insulator, LED, alternating voltage.

V. I. Skorokhodov, O. A. Lysenko, A. V. Simakov, S. A. Gorovoy
Forecasting consumption of electric energy by using wavelet transform

Forecasting electricity consumption is an urgent task for generating companies, since it is currently impossible to accumulate electricity on an industrial scale. Also, the forecast is necessary for consumers to carry out technical work and other activities. The purpose of this work is to make a forecast of electric energy consumption using the wavelet transform, and to select the optimal wavelet function for forecasting. Data for forecasting is a schedule of the load of the shop, which plays the role of a household room, warehouse, as well as a working office for personnel who service electrical installations at a production enterprise. Based on the results of the work, the optimal wavelet function is selected. The result of the work is a representation of the trend of electric energy consumption by the object under consideration, i.e. a forecast presented in the form of a graph, and a detailed component of the projected consumption is obtained, which in theory is justified as interference and sharply variable nature of electricity consumption.

Keywords: short-term forecasting, time series, mathematical model of forecasting, analysis of electricity consumption, wavelet transform, load graph, forecasting methods.

INSTRUMENT ENGINEERING, METROLOGY AND INFORMATION MEASURING EQUIPMENT AND SYSTEMS

A. A. Kabanov
Development of hand gesture classification system based on electromyography signals

The paper presents the results of research of electromyography signals and their application to control prostheses. There are compiled upper limb prostheses classification scheme. Signals are determined with the potential to identify them in various patterns responsible for the hand gestures. A program for processing signals has been developed to obtain the resulting patterns of hand movements in the LabView software environment. The main result of the program is the identification of possible gestures and the development of an appropriate response to control the prosthesis.

Keywords: electromyography, wavelet transform, digital signal processing, upper limb prosthesis, bioimpedance, hand gesture classification.

V. A. Smirnov, A. B. Snedkov
Adaptive calibration of the angle sensor for gyroscope

The article proposes methods of control and testing of information-measuring systems. The methods for calibrating the angle sensor included in the flight control system are considered. The principle of creating a test bench for evaluating the accuracy of angle sensor calibration is defined. The process of neural network training is described, which allows to compensate the disadvantages inherent to the traditional calibration method. A comparative analysis of the traditional method of joint calibration of angle sensors with the method based on the use of neural networks is performed.

Keywords: angle sensor, gyroscope, Hall sensor, calibration, control system.

I. A. Ershov
Using effective signal filtering methods to data processing from a fiber-optic temperature sensor

The article deals with signal processing of a fiber-optic temperature sensor using extremal filtering and filtering with Wavelet transforms. The aim of this work is to find a way to reduce the response time in a fiber-optic temperature sensor by using effective signal processing methods. Reducing the response time of systems for monitoring hazardous production facilities is rarely discussed in the literature. The results showed that the use of extreme filtering and filtering with Wavelet transforms can significantly reduce the number of implementations necessary to identify a signal with a low signal-to-noise ratio.

Keywords: fiber optical temperature sensor; DTS spatial resolution; measurement accuracy; EMD data processing; Wavelet analysis; Raman scattering; observation of unsafe production.