

IMPROVING THE QUALITY OF CONTROLLING COMPLEX OBJECTS ON THE BASIS OF POLYNOMIAL REGULATORS WITH DYNAMICLY CHANGING SETTINGS

V.I. Zakhvatov, S.L. Podvalny, A.V. Mikhaylusov

Abstract: the task of improving the quality of managing complex objects based on a polynomial controller with dynamic changes in settings is considered using the example of a backward pendulum on a carriage. A mathematical model of the control object was constructed, a polynomial controller was synthesized using the method of symbolic calculations of systems of differential equations with an additional input for specifying the geometric root from the outside and the PID controller settings for controlling the position of the carriage using the standard MATLAB Simulink tools were selected. To analyze the quality and parameters of the created control system, a reverse pendulum model on the carriage and regulator models were created using the MATLAB Simulink visual modeling environment. As a result of the simulation, a direct dependence of the installation time of the position of the pendulum on the value of the geometric mean root was obtained, which confirms the possibility of external control of the speeds of the presented control system. Also studied and confirmed the possibility of controlling the level of control actions to prevent the saturation of actuators. As a result of the analysis of the control system, several areas were identified for further research: improving the quality of preventing actuator saturation, controlling bandwidth based on the spectral characteristics of measurement noise, managing the speed of systems without adjusting the controller, dynamically controlling the area of attraction of systems, developing multi-alternative systems. In fact, an external parametric control system for the dynamics of processes was created, and the described controller does not require adaptation and training

Key words: control system, polynomial controller, parametric control, inverse pendulum, complex object

OPTIMIZATION SOLUTION TO THE PROBLEM OF REMOVING A LIMITED MANEUVERABLE AIRCRAFT FROM COLLISION WITH EARTH SURFACE

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Abstract: the paper discusses the formalization of the task of withdrawing a limited maneuverable aircraft from a collision with the earth's surface as optimal control tasks in the formulation of spatial maneuvering. The problems of choosing a mathematical model of the movement of a limited maneuverable aircraft, which significantly determines the subsequent computational complexity of the problem and the feasibility of the resulting analytical solution in real time, are considered. As a predictive model of the movement of a limitedly maneuverable aircraft, we consider the solution of the equations of motion of the trajectory or aerobatic level, depending on the meaning of the control problem being solved, with the "frozen" position of the controls, that is, the parameters of the motion model that have the meaning of equations that are set by constant values during forecasting. The presence of an analytical solution under the assumption of constancy of the overload vectors and angular velocity for the equations of the basic model of trajectory motion of a limited maneuverable aircraft opens up wide possibilities for developing a computationally cost-efficient algorithmic support for a system for removing a limited maneuverable aircraft from a collision with the earth's surface, synthesized based on the solution to the collision avoidance problem as optimal control problems

Key words: systems of prevention of collision with a terrestrial surface, aircraft, system of an automatic flight control, algorithmic providing

DESIGNING A MODEL TO IMPROVE TASK SCHEDULING IN CLOUD COMPUTING BASED ON PARTICLE SWARM OPTIMIZATION

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Abstract: cloud computing is a new kind of shared infrastructure which can attach huge pools of systems, provides users with a variety of storage and computing resources via the internet. The most important requirement in cloud computing environment is the task scheduling which plays the key role of efficiency of the whole cloud computing facilities. Task scheduling in cloud computing means that to allocate best suitable resources for the task to be execute with the consideration of different parameters like time, cost, scalability, make span, reliability, availability, throughput, resource utilization and so on. Most of the existing optimization algorithms only focus on one aspect. In this paper, we develop a comprehensive multi-objective model for optimizing task scheduling to minimize task execution time, task transferring time, and task execution cost. However, the objective functions in this model are in conflict with one another. Considering this fact and the supremacy of Particle Swarm Optimization (PSO) algorithm in speed and accuracy, we design a multi-objective algorithm based on PSO method to provide an optimal solution for the proposed model. The experimental result manifest that the proposed method is more effective and efficient in time and cost

Key words: cloud computing; particle swarm optimization; scheduling strategy; load balancing; virtual machine

RESEARCH OF THE POSSIBILITY OF MODELING THE POWER AMPLIFIER USING MEANS OF NEURAL NETWORKS

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Abstract: a power amplifier is located at the output of the telecommunications channel, the structure of which is completely unknown. Simulation of such a device was carried out according to the black box principle, operating only with data on the input and output of the power amplifier under study. The reference values supplied to the model are presented as complex numbers. The criterion for qualifying the model was the signal-to-noise ratio adopted in radio engineering. The brief results of the past research are given. The problems connected with the modeling of the operation of the power amplifier based on neural networks are raised. An example of the appearance of nonlinear distortion in the device under consideration is given. A joint work of a group of neural networks based on the clustering of an analog signal, which works on the principle of the adaptive resonance theory of Grossberg, is presented. The results of the application of this type of systems are briefly summarized. Problems are formulated when using such an approach to modeling the process under study. Also various algorithms for adjusting the weighting coefficients of neural networks are considered and examples of their work are presented, which are trained on the signal spectrum. The most popular current learning algorithms were compared to minimize the relative error function. The conclusions on the work of neural network models in the framework of the task are described

Key words: neural network, model, training, power amplifier, clustering, error, noise

UNMANNED AIRCRAFT TRACKING SYSTEM USING MONOCULAR TECHNICAL VISION SYSTEM IN A GYRO-STABILIZED SUSPENSION

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Abstract: the structure of the monocular vision system in gyrostabilization and object tracking modes is presented. In the tracking mode of the object of interest, the image is processed to determine its coordinates on the photomatrix, and then the tracking process is reduced to such a movement of the cardan suspension frames, which ends with the specified position of the image on the photomatrix. At the same time, the development of such a position of the suspension frames is shown so that the image of a singular point, which is a simple model of objects of interest, always tends to the center of the photomatrix, which improves the image quality of the camera and reduces the level of vibration during the movement of aircraft. This allows one not only to monitor the object of interest, but also to escort and capture various objects, as well as to solve the problems of aircraft navigation using a monocular vision system in a gyro-stabilized suspension. A further development of the mode of tracking the object of interest is tracking an extended object, on which two or more special points can be distinguished, then all three frames of the gimbal are controlled and not only the linear, but also the angular position of the image of the object on the photomatrix is stabilized

Key words: monocular system, technical vision, tracking system, gyrostabilization mode, vibration level, lighthouse constellation

RESEARCH OF SERVO SYSTEM WITH ASTATIC MODAL REGULATOR AND A KALMAN FILTER AS OBSERVER

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Abstract: remote control of the servo system (SS) with an automatic controller or control system (CS) based on a modal controller, observer and Kalman filter should provide specified indicators of SS control quality with minimal hardware and software. In the software and hardware implementation of the modal controller, observer and Kalman filter, it is necessary to take into account the required amount of information that provides the specified control quality parameters. Variants of the implementation of the automatic SS controller with a modal controller and two Kalman filters installed in the feedback circuit, in the drive signal circuit and in the mismatch circuit are investigated. When modeling a structural diagram of a SS with a vector-matrix description in the Matlab environment, the Kalman filter is used in the prediction, filtering, and smoothing mode. One of the Kalman filter installed in the structural diagram of the SS performs the functions of an observer to restore the components of the controlled state vector X . The quality indicators of setting the transfer function coefficients of the Kalman filter for three variants of the structural diagrams of the SS with a modal controller and Kalman filter are compared for a variable and constant rate of change of a given input signal. For one of the SS structural diagrams with a modal controller and two Kalman filters, the influence of the speed of the driving input signal on the input signal formation coefficient is studied taking into account the output signal of the modal controller and on the delay time of setting the transfer coefficients of the Kalman filter. Depending on the structural SS with a modal controller and Kalman

filter, the interference is set in the feedback circuit, in the input signal setting circuit and in the mismatch circuit, i.e., noise immunity or restoration of the useful signal during reception and transmission is studied

Key words: mobile transport systems, block diagram, automatic regulator, astatic modal regulator, Kalman filter, time characteristics

Radio engineering and communication

TECHNICAL IMPLEMENTATION OF HIGH-SPEED DATA RADIO CHANNEL FROM AN UNMANNED AERIAL VEHICLE TO GROUND CONTROL STATION

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Abstract: currently the Russian Federation is actively developing unmanned aircraft in the interests of various Customers. At the same time, as of 2019, the domestic industry has developed a series of complexes with unmanned aerial vehicles (UAV) of various classes and purposes – light ("Tipchak", "Zala 421-04M", "Aleron-3"), medium ("Aleron-10", "Forpost", "Corsair"), heavy ("Orion"), superheavy ("Altair", "Hunter"), which solve both the problems of increasing the defense and security of the Russian Federation, and meet the interests of civilian consumers. One of the key elements complexes with unmanned aerial vehicles is a radio link the transmission of command and telemetry information and target direct radio line of sight between the UAV and the ground control and information processing station (GCIPS). Unmanned aerial vehicles of a heavy class can have several target loads in their composition at the same time – an optical-electronic system, a radar system, a radio monitoring system, etc. Due to the fact that the flow of information coming from the target loads to the input of the radio line at peak moments can be quite large, serious requirements are imposed both to the equipment of primary processing of the target information on board the UAV and its compression in the equipment of information registration, and to the capacity of the radio line in terms of transmission of target information to the GCIPS for its subsequent analysis and processing by the operator of the complex. This article describes a promising method of modulation OFDM (multiplexing orthogonal frequency division) and OFDM modulation (OFDM with channel coding) applied to high-speed data channel UAV-GCIPS, the results of calculations of parameters of high-speed radio, as well as the evaluation of the noise immunity of the OFDM signal with the cascade code (low-density LDPC code in conjunction with code Reed-Solomon)

Key words: complexes with unmanned aerial vehicles, high-speed line-of-sight information radio link, OFDM signals, COFDM, noise-resistant coding, LDPC code, Reed-Solomon code, error probability, signal/noise, on-Board antennas, ground antennas

METAL OXIDE PYROLYTIC FILMS FOR THE PRODUCTION OF PHOTO-ELECTRICAL ENERGY CONVERTERS

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Abstract: the paper describes the technology for manufacturing metal oxide films ZnO, SnO₂, Zn₂SnO₄, CuO from aqueous solutions of the corresponding salts by spray pyrolysis. In the spray pyrolysis method, an aerosol of aqueous solutions of salts is deposited on a hot (420 °C) glass substrate. The regimes and conditions for the deposition of metal oxide films on hot glass substrates are given. The composition of the obtained structures was controlled using X-ray phase analysis. The electrical parameters of the films were measured by the Van Der Pauw method and using the Hall effect. The surface resistance of the films, the type of conductivity, the concentration and mobility of charge carriers are measured. The concentration of charge carriers in metal oxide films varied from $n=2 \cdot 10^{17} \text{ cm}^{-3}$ (ZnO) to $6.53 \cdot 10^{19} \text{ cm}^{-3}$ (SnO₂) and was $3.2 \cdot 10^{16} \text{ cm}^{-3}$ for CuO. The metal oxide films ZnO, SnO₂, Zn₂SnO₄ had n-type conductivity, and the CuO film had p-type conductivity. The properties of the ZnO, SnO₂, Zn₂SnO₄, and CuO films were studied to estimate the possibility of using them as structural elements of a thin-film solar cell. The band gap was determined from the light absorption spectra and was in the range of 3.2...3.5 eV for oxides based on Zn and Sn; for copper oxide (II), the band gap was 1.6 eV. Synthesized n-type films can be used to make a solar cell with a p-CuO light-absorbing layer. Preliminary results on film structures of n-SnO₂/p-CuO in daylight showed values of $I_{kz} = 3 \text{ } \mu\text{A}$ $U_{xx} = 48 \text{ mV}$. More research is needed to increase the efficiency of the solar cell

Key words: spray pyrolysis, thin films, zinc oxide, tin oxide, copper oxide, zinc stannate, electrophysical parameters

FORECASTING ELECTROMAGNETIC INTERFERENCE IN THE NEAR FIELD USING GREEN METHOD

V.V. Glotov, T.S. Glotova

Abstract: solving electromagnetic compatibility issues is now becoming an integral element of the activities of enterprises - developers and manufacturers of electronic devices, the basis of which, as a rule, are printed modules. In order to keep up with new trends, design engineers have to miniaturize electronic components, which increases the chances of failures in the work of electronic tools. So, for example, a conventional printed circuit board can have hundreds or even thousands of circuits, with each circuit being a potential source of energy that can ultimately unintentionally affect other circuits or elements. Since the problems that arise when solving the issues of electromagnetic

compatibility are in the late stages of the development of electronic equipment, the resulting new methods for assessing electromagnetic interference should be predicted in the early stages of design. In the case of complex printed circuit boards containing integrated microcontrollers, as well as a large number of tracks, to evaluate it is necessary to find a compromise between the accuracy and simulation time of the tested printed module. The basic algorithm used in the new tool for the predictive analysis of electromagnetic radiation is presented in the article. It is able to accurately take into account the actual cross section between the metal plane and the air for each track, an element of the printed circuit board. This is compared with theoretical formulas for verification. The effect of PCB coating on dipole radiation is described

Key words: printed circuit board, wire, case, Green model, electromagnetic compatibility, near field

ALGORITHM OF GENERATION CLOCK SIGNAL FOR SDRAM MEMORY

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Abstract: an algorithm for generating a clock signal of SDRAM chips is considered to increase the reliability of read and write operations under the influence of the external environment. The idea of the algorithm is a sequential write and read operations. First, the constant value is written to the memory, and then read from it. If the writing operation was successful, the delay value is stored in the internal register. Next we need to find a value that the algorithm cannot read. The algorithm will try to find this value until a working option is found, or the delay limit elements is over. When the first working delay value is found and stored, the algorithm will continue to perform a write-read cycle, simultaneously increasing the delay value until the read value coincides with the recorded value. Thus, the minimum and maximum delay values will be found, the average delay value is calculated and set as the main one. The description of the algorithm is performed by means of the VHDL language. The FPGA from Xilinx of the Virtex 5 family, model XC5VLX110, is used as a development platform

Key words: clock signal, SDRAM, delay, algorithm, FPGA, Virtex 5

LOCAL NAVIGATION SYSTEM USING LOW-FREQUENCY MAGNETIC FIELD

I.M. Golev, A.V. Sergeev

Abstract: the article describes a local navigation system using a low-frequency magnetic field, which has a number of advantages over systems using other physical fields. The features of the magnetic, electromagnetic, acoustic fields that determine the characteristics of navigation systems are considered. It is shown that the use of a magnetic field allows one to create navigation systems with high noise immunity, independence from climatic and weather conditions and the type of underlying surface. The block diagram of the navigation system consisting of ground and onboard equipment is described. The system uses a rotating magnetic low-frequency field, which is created by a magnetic beacon — two mutually perpendicularly arranged inductors. To determine the characteristics of the magnetic field generated by the magnetic beacon at the point of location of the moving object, a three-coordinate magnetometer is used, which measures three mutually orthogonal components of the induction vector of the alternating magnetic field, whose amplitudes and phases are uniquely associated with the three linear and three angular coordinates of the object. The parameters of the layout of the navigation system module with a magnetic field frequency of 419 Hz, a magnetic beacon moment of $250 \text{ A}\cdot\text{m}^2$ and a magnetometer sensitivity not worse than 1 nT are given. The range of the described navigation system is at least 30 meters. The errors of linear ΔR and angular measurements $\Delta\psi$ non-linearly depend on the distance R, with $R = 30 \text{ m}$ the value $\Delta R = 8.8 \text{ m}$ and $\Delta\psi = 25^\circ$, and for $R = 5 \text{ m}$ the value $\Delta R = 4\cdot 10^{-3} \text{ m}$ and $\Delta\psi = 0.13^\circ$. To increase the range, modules can be located on the surface (or underground) of the territory, creating a navigation field of the required configuration. Navigation systems, using a rotating alternating magnetic field, can solve the problems of local navigation and landing of unmanned aerial vehicles of both aircraft and helicopter types; indoor navigation; robotic navigation devices; work as part of management systems and control the movement of personnel, equipment and goods at the facilities

Key words: local navigation system, rotating alternating magnetic field, magnetic moment, three-coordinate sensor

APPLICATION OF SEMI-DEFINED PROGRAMMING METHODS FOR THE SOLUTION OF THE PROBLEM OF IMPROVING INTERFERENCE STABILITY OF OFDM COMMUNICATION SYSTEMS

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Abstract: in this paper, the problem of noise-tolerant detection of signals with spectral efficient frequency division multiplexing is considered. The optimal detection of signals with spectral effective frequency division multiplexing is based on the least-squares technique and maximum likelihood algorithms. The task of detecting multi-user code division multiple access systems can be classified as integer linear programming optimization. The standard methods for optimal signal detection in the article are transformed into convex optimization of semi-defined programming. A combined technique of the most probable detection of SEFDM signals based on semi-defined programming methods is proposed. A simplified block diagram of the receiver with POP estimation and MP detector is given. Algorithms are derived that make it

possible to increase noise immunity when detecting signals with spectral effective frequency division multiplexing. The modeling of the considered methods for the optimal detection of signals with frequency division multiplexing with multiplexing in the Matlab environment is carried out. The main characteristic of the study was selected bit error of reception from the signal-to-noise ratio. The simulation results show the effectiveness of the proposed techniques for semi-definite programming in BER characteristics over existing receivers, based on the reduction of the minimum mean square error of reception

Key words: relaxation, semi-determined programming, maximum likelihood, noise immunity, signal detection

MODELING OF PRINTED CIRCUIT BOARDS IN THE CLOSED DESIGN OF ELECTRONIC PRODUCTS BY THE METHOD OF LONG LINE

V.V. Glotov, T.S. Glotova

Abstract: at the present stage, the problem of electromagnetic compatibility plays a significant role in the development of electronic equipment. Most developers try to miniaturize electronic components, which increases the chances of malfunctioning electronic equipment. To save the fund of working time and money, it is quite logical and advisable to identify problem areas of the printed circuit board in the early stages of development. The article describes the methodology for assessing the electromagnetic characteristics of printed circuit boards in enclosed structures. The efficiency of using the Transmission Line Matrix (TLM) method is described - a long line method for studying intra-equipment electromagnetic compatibility in enclosed structures of electronic devices. This method is used to record and analyze the interactions of the printed circuit board and the product body, based on the physical features of the printed circuit board. The results obtained using the H-probe, a scanner of the near electromagnetic field are described. The results obtained by the experimental method and the moment modeling method (MoM), which confirm the reliability of the numerical model, are compared. The analysis of ensuring electromagnetic compatibility in various electronic devices showed that in the development of any electronic instrument, the greatest attention should be paid to the design of printed circuit boards. Therefore, the developer needs to identify problem areas of the printed circuit board in the early stages of the design of electronic devices

Key words: printed circuit board, wire, enclosure, TLM method, electromagnetic compatibility, near field

AUTOMATED PROBE STATION FOR TESTING THE ELECTRIC PARAMETERS OF THE CRYSTALS AND DIODE OF TRANSISTORS

V.V. Kondusov, V.A. Kondusov

Abstract: the described device relates to the measurement technique and presents a setup for testing the electric parameters of the crystals and diode manufacture. As one of the types of control, probe measurements allow us to estimate the main parameters of the developed semiconductor devices prior to their encapsulation in the process of developing and sorting parameters. Through this, it is possible to avoid additional costs and to reduce production costs. To conduct these measurements, a probe station is required, which will connect the studied device with the measuring device and ensure the integrity and validity of the obtained results. The article describes problems that occur when measuring the electric parameters of the crystals and diode on the enterprises of electronic industry. It presents shortcomings of modern solutions for testing crystals electronic devices. It shows the solutions to these problems and shortcomings on the example of the developed installation. The described installation is an integral part of the hardware-software complex and provides verification of electrical parameters of the chips separated from a common semiconductor wafer (workpiece), and also allows one to determine which of the crystals are made serviceable and can be used in further work on mounting them in the housing. The work gives innovative solutions in the design of needle contact and air supply, describes the process of design, algorithm of operation and purpose of the main controls

Key words: probe testing, crystals and diodes of transistors, precision positioner, hydraulic damping, monocrystalline material, duty cycle

Mechanical engineering and science of machines

QUALITY ASSURANCE OF THE PART SURFACE LAYER WHEN DRILLING HOLES

IN THE ROCKET ENGINES FILTERS

A.Yu. Ryazantsev, E.V. Smolentsev, V.G. Gritsyuk, A.A. Shirokozhukhova

Abstract: the article consider the methods for producing holes in metal filters of various sizes. It discloses the specifics of the application of electro erosive and electron-beam processing methods for piercing holes. It presents the ways to ensure the quality of the surface layer of parts in the manufacturing process of filter elements of liquid rocket engines. The analysis of existing combined methods of processing metal filters allows us to conclude that maximum productivity is achieved when using electron beam processing for flashing holes. Based on the fact that the actual microstructural state of

the contact surfaces is the main condition for the formation of the characteristics of the filter elements, research methods are determined. In accordance with the processing methods considered in the work, studies were performed of the roughness parameters of the holes made on the sample simulator and the hydraulic characteristics of the filter element at a constant flow rate of the working medium. During testing, process water was used as a test medium. Based on the calculated parameters of the filter strait and the actual results obtained, it was concluded that, to ensure optimal hydraulic characteristics of the filter elements, the electro erosive method of processing holes is more preferable. The results of the work contribute to improving the manufacturability of products of new generations of technology, which is important for engineering

Key words: quality, filter element, surface layer, engine, roughness, part

STUDY OF THE MANUFACTURING PROCESS OF A COMBINED ELECTRODE-TOOL FOR ELECTROCHEMICAL TREATMENT IN CONDITIONS OF SINGLE AND EXPERIMENTAL PRODUCTION

A.P. Suvorov, A.V. Kuzovkin

Abstract: this article considers the problem of design, construction and operation of the combined electrode-tool (ET) in single and pilot production, which lies in high technological and economic costs of production of such ET, comparable and sometimes exceeding, the cost of manufacturing the part using traditional cutting processes. The objects considered in this study are combination electrodes-tools, designed and manufactured on the basis of modern digital technologies and 3D printing and used for processing of geometrically-complex surfaces in single and pilot production. It is shown that the combination of parametric design based on digital models and fabrication methods, additive technology framework of the combined tool and subsequently giving it conductive properties significantly expand the scope of electrochemical treatment due to the possibility of finish machining geometrically-complex surfaces with a high degree of curvature. Experimental studies have shown that tested in single and pilot production combination tool may further be made for the needs of mass production. The materials of the article are of practical value to engineering companies in connection with the simplification of the manufacturing process of the electrode-tool for electrical machining methods

Key words: electrode-tool, electrochemical processing, additive technologies

ASSESSMENT OF THE INFLUENCE OF TECHNOLOGICAL HEREDITY ON THE PROCESS OF FORMING THE PARAMETERS OF THE SURFACE QUALITY OF PARTS BY DIAMOND BURNISHING

M.N. Nagorkin

Abstract: the article presents a technique for quantifying the influence of technological heredity on the formation of surface quality parameters of machine parts. Technological systems for finishing face milling with composite 10 were investigated, followed by diamond burnishing of the flat surfaces of cast iron parts. An example of a qualitative assessment of the results of experiments is presented, which makes it possible to identify the controlling factors of technological systems that make the greatest contribution to the formation of the microstructure of the surface layer. The effect of kinematic processing schemes for face milling and diamond burnishing on the formation of the surface microstructure of the workpiece is evaluated. Analysis of the correlation relationships between the quality parameters of the surfaces obtained during the preliminary processing of the parts and the corresponding parameters obtained after the final processing allowed us to establish the minimum necessary number of quality parameters for their technological support. For a quantitative assessment of the impact of technological heredity on the formation of quality parameters in the process of processing it is proposed to apply the method of simulation modelling. Using the example of the formation of the roughness parameter Ra of the surface of a part by face milling with composite 10 and subsequent diamond burnishing, the influence of technological heredity is estimated, which makes it possible to differentiate the choice of processing factors according to values k_{qv} in order to effectively control the regulated quality parameters. A graphical interpretation of the influence of technological heredity on the formation of microprofile parameters is presented

Key words: diamond burnishing; technological heredity; correlation, roughness parameters

INFORMATION SUPPORT OF ASSIGNING THE CUTTING TOOL EFFICIENT OPERATING STRATEGY

A.V. Antsev

Abstract: the article considers the task of assigning a strategy for efficient operation of a cutting tool directly in the process of machining a batch of parts on a specific cutting machine, taking into account the variability of the cutting

process. The operating strategy of the cutting tool is a set of principles and rules that ensure the specified control of the process of cutting tool operation by maintaining rational operation modes of the cutting tool and assigning work to restore it in accordance with the technical condition. The necessity of taking into account the variability of the cutting process in assessing the tool life and ensuring effective operation of the cutting tool is shown. To automate the process of assigning the cutting tool operating strategy in the self-learning mode, a program-methodical complex of the assignment of the strategy for efficient cutting tool operation is proposed. The proposed program-methodical complex allows to assign a cost-effective mode of prevention of the cutting tool, to assign rational cutting modes, to make a comparative assessment of the quality of the cutting tool of different manufacturers, to form a set of the cutting tool of the operation system and to calculate the rates of the cutting tool consumption taking into account the process variability cutting. The general method of application of the program-methodical complex of the purpose of the strategy of effective operation of the cutting tool is considered. Using the proposed program-methodical complex will improve the efficiency of industrial technologies for the production of engineering products, including at the enterprises of the military-industrial complex

Key words: operating strategy, optimization, cutting speed, replacement period, unit costs, information support, software and methodical complex

MORPHOLOGY ANALYSIS OF CHIPS OBTAINED AFTER CUTTING WITH HIGH PERFORMANCE MILLING METHOD

M.V. Vilkina

Abstract: the paper is aimed at studying the morphology of chips obtained by high-performance milling (HPM) on the CNC machine with average kinematic and force characteristics by milling of high-quality alloy steel for four levels of performance with higher cutting data and average chip thickness. The samples of chips were grouped by treatment level, after which the electron microscope obtained micro pictures of the samples from each group; and we carried out morphological analysis to establish the optimal conditions of HPM. Based on the results of current research in this area, we managed to establish optimal border enhancing handling dynamics, while remaining within which we can expect a decrease in the tool wear associated with thermal effects and adhesion. The depth of treatment exceeds 2 times the diameter of the cutter, thus it was found the optimum cutting condition, in which the phenomena of adiabatic shear does not appear and the chips on the General classification in their morphology are close to the continuous. Thanks to the calculated in CAM system trajectory, HPM chip has a constant thickness and segmented enough to satisfy the conditions of the automated production

Key words: metal cutting, high performance milling, chips morphology, improving performance