Informatics, computer engineering and control

INTELLIGENT SYSTEM OF FLEXIBLE AUTOMATED MANUFACTURING SCHEDULING

A.D. Danilov, V.A. Lomakin

Abstract: in modern production systems, the scheduling system plays a key role in optimizing the loading of technological equipment and reducing production time. This article presents a methodology for optimizing the load on production capacity, taking into account the group of criteria that represent characteristic of metalworking enterprises. The task of scheduling is presented in the form of a weighted graph, which must be oriented, the time of the plan and the load on the process equipment are the target functions. As an effective method of solving these production problems, an ant colony algorithm is used, which perfectly solves large-scale problems and problems that have graph interpretation. At the initial stage, in the process of creating process charts, for the purpose of preliminary optimization, clustering is performed according to the type and sequence of technological operations on the parts. To meet the needs of flexible, quick-change production, a matrix of priorities of parts is introduced. Thanks to this improvement of the algorithm, the products that are most important for the production and execution of the order on time will be manufactured first. The next step is the calculation of the optimal load plan and the visualization of the constructed solutions in the form of tables, oriented graph and Gantt chart

Key words: scheduling theory, scheduling, intelligent systems, ant colony algorithm, clustering

APPLICATION OF A GENETIC ALGORITHM FOR CLEANING A DIGITAL IMAGE FROM CORRELATED NOISE

O.S. Buchnev

Abstract: when using images to perform applied research, a researcher is often confronted with the presence of noise contained in the image. To eliminate the noise, frequency filtering methods have been developed and are widely used. However, in the image spectrum, it is not always possible to separate the frequencies corresponding to the noise and the frequencies corresponding to the image. In the case when the noise contained in the image has the property of spatial correlation, it is possible to use a genetic algorithm to obtain a random field that is mutually correlated with the noise contained in the image, and the subsequent cleaning the image from the noise. The article discusses the use of a genetic algorithm to obtain a mutually correlated random field; this will allow cleaning the image from noise, thus increasing its quality. Using the example of a specific image, it is shown that the considered algorithm has an advantage over the frequency filtering. As criteria for evaluating the measure of proximity, the mutual correlation functions of the model noise and the random field obtained as a result of the proposed genetic algorithm are given, as well as the mutual correlation functions of the non-noisy image and the image, obtained as a result of using the genetic algorithm

Key words: image processing, frequency filtering, Fourier transform, random field, correlation function, genetic algorithm

SOLUTION TO THE PROBLEM OF DIFFERENTIAL GAME FOR A GROUP OF AGENTS BASED ON THE PRINCIPLE OF SWARM INTELLIGENCE

S.V. Ivanov, D.G. Belonozhko, I.D. Korolev, N.Ya. Polovinchuk, M.Yu. Zhukova

Abstract: the solution of the problem of optimization of their actions by a group of agents in a single information space is considered. The urgency of this problem lies in the fact that a single agent of a multi-agent system is able to carry out a limited list of actions, especially in conditions when large streams of information are considered and the number of targets is large-scale. The implementation of complex tasks facing agents is possible only if they are combined into groups. The paper analyzes the principles of managing a group of agents. Analysis of the principles of managing a group of agents showed that for solving large-scale multi-purpose tasks of controlling the movement of a group of agents in a single information space, in the face of opposition, the structure of decentralized management, which includes the method of swarm intelligent control of a group of agents, is most suitable. The method of swarm intellectual control provides for the exchange of information both within the group and with the external environment. Therefore, the actual scientific task is the integration of the navigation system, communication and motion control of agents as part of a multi-agent system. In order to obtain the optimal function of controlling the actions of the multi-agent system, a two-point boundary-value problem was solved in the work, and an optimal trajectory of the agent's motion within the multi-agent system was obtained. An example is given illustrating the effectiveness of the proposed approach

Key words: decentralized control structure, multi-agent intelligent systems, aircraft, evaluation, regularization, swarm intelligence

ROBUST QUASI-LIKELI ESTIMATION OF THE PARAMETERS OF THE CONTINUOUS-DISCRETE SYSTEM MODELS

V.M. Chubich, S.O. Kulabukhova

Abstract: anomalous observations may arise, for example, as a result of a hardware failure during the reception and/or transmission of measurement data. In this regard, the development of robust data processing procedures that are resistant to the presence of anomalous measurements is relevant for practice. This article presents a solution to the problem of robust parametric identification of nonlinear continuous-discrete systems described by models with deterministic equations of state and measurement equations perturbed by white Gaussian noise. Three modifications of the maximum likelihood criterion are proposed, based on the adaptation of the corresponding results known for models with noise in the state equations. The unknown parameters to be estimated were contained in the equations of state and observation. The software developed within the MATLAB system was tested on the model of electrodialysis, which can be used, for example, in the production of fresh water from salt. The results of the numerical researches revealed the advantage of the proposed robust modifications over the classical version of the maximum likelihood criterion and showed their efficiency as a whole. The comparative analysis of the effectiveness of these modifications (the values of the relative error of estimation in the parameter space were considered) performed at random and grouped nature of the location of anomalous observations allowed to detect the most successful of them and recommend it for practical application

Key words: parametric identification, robust estimation, maximum likelihood estimation, outliers, nonlinear continuous-discrete system

STUDY OF TRACKING SYSTEM WITH ASTATIC MODAL REGULATOR IN MATLAB

A.P. Kharchenko, Yu.S. Slepokurov, Yu.N. Karevskaya

Abstract: when mobile transport systems (MTS), for example, a mobile industrial robot, are operating in tracking mode of movement at maximum speed, it is important to reduce the speed error in the control and disturbing effects. In the classical theory of automatic control, the velocity error can be reduced to zero by using an astatic tracking system of 2nd order (TS), which is structurally unstable. In this case, special corrective devices are used or an isodromic link is used, which compensates for an additional phase shift in the logarithmic phase frequency characteristic due to the introduction of a force-integrating element into the first-order astatic TS. The modal regulator (MR) is a static (proportional) regulator. The possibility is studied of using an astatic MR with an observer (OB) in a single-loop astatic static TS of 1st order to reduce the speed and acceleration error for a given speed under the influence of interference in the negative feedback circuit (NF) and the input signal with typical input standard signals. Astatism of MR is provided by the introduction of integrating links in the feedback on the components of the state vector (X1, X2, X3 and X4) of TS. A study was made of the influence of the coefficients of an astatic MR TS on the velocity error and the error in acceleration while maintaining a given response speed. A comparison of the quality parameters of TS control with astatic and static MR is given. Transmission of controlled and control information signals in the presence of interference is associated with noise immunity or restoration of the useful signal during reception and transmission. Recovery of the useful signal in the reception and transmission of control and controlled signals of TS is provided by the use of a Kalman filter. In single-loop of TS with astatic MR and OB, the error in disturbing influence is much less than the error in controlling action

Key words: mobile transport systems, tracking system, speed error, acceleration error, block diagram of a single-circuit system, static modal controller, astatic modal controller, observer, Kalman filter, transfer function

CONTROL SYSTEM AND ACCESS CONTROL IN THE ENTERPRISE: CONCEPT, CHARACTERISTICS AND BASIC REQUIREMENTS

A.E. Kozlov

Abstract: the task of automating access control and management, as well as recording the working time of enterprise personnel, is one of the most pressing issues in the current business environment. In modern times, man has invented gates, barriers, and turnstiles designed to restrict the passage of people and the passage of vehicles. However, the problem of creating an electronic access control system and using it both in small enterprises and large ones engaged in the production and production of high-precision and high-tech products remains relevant. Without proper access and internal control regimes, it is impossible to maintain enterprise security and employees' responsibility for following the rules of internal labor regulations at an appropriate level. The main questions answered in this article are what a modern access control system is, what the requirements for it are, what its purpose for industrial enterprises is and how it is connected with the system of working time and payroll

Key words: employee monitoring, reader, access control, electronic time management, CSAC

STORAGE OF PROCESS DATA IN INFORMATION SYSTEMS OF SPECIAL PURPOSE

D.V. Terekhov, A.D. Danilov

Abstract: the article considers the problem of the development of the principles of storage of process data with high temporal resolution over an extended period of time. This task was solved within the framework of the basic executing information complex PORTAL, designed to provide all the functions of monitoring the processes of operation of nuclear units, in the form of a system of archiving HIST. The primary method of archiving with this option is asynchronous archiving, which allows client applications to add information about a process variable. The structure of data processing by the archiving system is proposed. It is shown that the HIST process can perform the functions of a "single server" (excluding redundancy). In this case, the system is responsible for all read and write operations. You can also run two archive servers on the same PORTAL node. The archiving system stores the entire history of the configuration data of the process variables (that is, for each process variable there can be several “configuration sets” sorted by their period of validity). The system provides two types of requests to the archive: receiving "raw data" and calculated accumulations based on equidistant time intervals. The proposed principles of storing process data with high time resolution allow one to reduce the amount of stored information due to the possibility of extrapolation of variable trends, to store text information in the actual size, but not the maximum allowable length; perform dynamic configuration of the archive, with each configuration option can be interpreted as a separate archive. The system operates successfully at the Novovoronezh NPP

Key words: archiving system, data model, compression algorithm, reading interface

Radio engineering and communication

USING SOFTWARE AND HARDWARE TOOLS IN THE DESIGN OF DIGITAL ELECTRICAL MEASURING DEVICES

N.N. Tsybov

Abstract: the article considers scheme-based technical solutions in designing portable multifunctional high-precision electrical measuring devices using digital components of analysis computer equipment, whose hardware and software components enable to perform the mathematical processing and storage of information. When designing portable multifunctional electrical measuring devices, the use of multi-stage ADC with multiple integration and expensive ADC with balancing or charge balance (the new name is ‘delta-sigma conversion ADCs’) is not advisable due to the integral nonlinearity of the transient peculiarity of the operational amplifier and integrator, as well as their low speed. The article proposes scheme-based technical solutions aimed at achieving accuracy parameters using the examples of designing electrical measuring instruments developed on the basis of computing modules without using expensive high-precision ADCs. The following scheme-based technical solutions are applied for this purpose: the use of normalizing scaling signal amplifiers on ADC’s inputs; inclusion of a precision integrator into the device with an analog-digital converter as its component; inclusion of the input ADC into the input analyzer’s composition, as well as positive half-wave ADC and negative half-wave ADC into the composition of the half-wave analysis block; organization of parallel operation of three ADCs and two controllers of amplitude and duration of half-waves; inclusion of decade amplifiers into the devices

Key words: multifunction, precision, ADC, integrator, amplitude and half-wave duration controller, decade amplifier, scaling amplifier

ANNULAR ANTENNA GRID OF PISTOLKOR LOOP VIBRATORS WITH RESISTANT LOADS IN THE CURRENT CIRCUITS

A.V. Ashihmin, L.N. Korotkov, Yu.G. Pasternak, P.V. Pershin, Yu.A. Rembovskiy, S.M. Fedorov

Abstract: a design of an annular antenna array consisting of Pistolkor loop vibrators with resistive loads in current path loops is proposed for use in radio direction finder complexes. An antenna array is a collection of several joined antennas that work together as one antenna to transmit or receive radio waves. Separate antennas (called elements) are usually connected to one receiver or transmitter using feeder lines that feed the elements in a particular phase relationship. The radio waves emitted by each individual antenna are combined and superimposed on each other, adding together to increase the power emitted in the desired directions, and subtracting to reduce the power emitted in other directions. Similarly, when used to receive, individual RW currents from individual antennas are combined in the receiver with the correct phase ratio to amplify signals received from the desired directions and subtract signals from unwanted directions. The antenna array may have a higher gain, that is, a narrower beam than a single element may have. In general, the greater the number of antenna elements used, the higher the gain and the narrower the beam. The paper presents the results of a numerical study of the proposed antenna array design

Key words: Pistolcors loop antenna, radio direction finding

MODERN CONDITION OF CAD/CAE SYSTEMS FOR THE ANALYSIS OF ELECTROMAGNETIC COMPATIBILITY IN THE PROBLEMS OF OPTIMAL DESIGN OF RADIO ELECTRONIC FACILITIES

M.A. Romashchenko, D.S. Seimova

Abstract: the main step in the design of electrical devices are CAD tools for determining the emission of radio frequency interference and sensitivity with sufficient accuracy, based on the design parameters of the radio electronic element. The use of CAD systems will provide an opportunity to use appropriate technologies for providing EMC and help avoid further costly development. With an increase in the quality of pre-topological and post-topological analysis, the probability of creating a correct development in a shorter period of time increases. Designed radio-electronic equipment assumes the presence of a minimized number of errors or their complete absence. When developing high-quality radioelectronic equipment, it became necessary to ensure undistorted signal transmission, therefore, no printed circuit board can be manufactured without the use of specialized software that facilitates the search for interference and ensures electromagnetic compatibility. The article presents an analysis of the most common CAD systems for research in the field of EMC and signal integrity in order to present the capabilities of application programs in this area. The possibility of using a virtual prototyping method to create interactive electromagnetic compatibility modeling (EMC) is illustrated

Key words: electromagnetic compatibility (EMC), noise immunity (NI), modeling of electromagnetic processes, prototyping, radio-electronic means (REM), CAD, electromagnetic interference (EMI)

SPHERICAL LUNEBERG LENS ON THE BASIS OF PRINTED BOARDS WITH ELECTRICALLY SMALL DIFFUSERS

K.A. Bykov, L.N. Korotkov, Yu.G. Pasternak, R.E. Rogozin, S.M. Fyedorov

Abstract: the article deals with the realization of the Luneberg 3D volume lens made on dielectric disks made of FR-4 thin fiberglass with a printed periodic structure, which is an electric small diffuser. Based on the analysis of open sources, an equivalent scheme of a

printed periodic structure is considered, which allows us to visually demonstrate the idea being realized. This method of manufacturing the Luneberg bulk lens will significantly reduce the mass, which is an actual problem at the moment. To implement the proposed idea, the paper presents a technique for measuring the dielectric constant of a homogeneous artificial insulator based on the use of a rectangular waveguide excited by the fundamental mode of a type H wave and filled with a measured medium. This technique allowed one to synthesize the necessary law of changing the refractive index for the realization of the Luneberg bulk lens. The dependence of the refractive index on the size of the electric diffuser obtained in the course of modeling as well as its approximation is given. Directed characteristics of the obtained lens in the azimuth plane in the frequency range from 1 to 2 GHz are obtained. Conclusions are drawn about the dependence of the coefficient of the directed action of the lens on the rotation of the irradiator relative to its center in the azimuth plane

Key words: Luneberg lens, refractive index, relative permittivity, directivity factor

Mechanical engineering and science of machines

FEATURES OF TECHNOLOGY DEVELOPMENT OF ELECTRO-EROSE-PLASMA APPLICATION OF METAL COATINGS

E.V. Smolentsev, **M.V. Kondrat'ev**, **O.G. Men'shikova**

Abstract: the article discusses the combined technology of applying coatings on metals using electromagnetic fields. The considered method is based on a combination of thermal effects due to the simultaneous effects of electroerosive and plasma treatments. On the basis of patents for inventions obtained by the authors and theoretical substantiation of the process, it was possible to create equipment and technological process, which allows one to improve the technical and economic indicators of the processes of hardening new parts or repairing worn out ones, which is a current task for many engineering enterprises in Russia. The developed model and testing of the process experimentally, and then in industrial conditions allowed one to develop recommendations for the purpose and calculation of the technology modes of combined production of electroerosion - plasma coatings for the process of applying wear-resistant thin coatings. The authors' studies on the wear resistance of coatings that combine different metals, carbon and oxides confirmed that the combined coatings can many times increase the wear resistance of parts in friction units, including in corrosive environments, at higher contact loads, in the presence of abrasive particles, high temperatures, typical for cutting with a blade tool, where the application of such a coating can increase the resistance by 1400 percent

Key words: combined treatment, EDM, plasma, setting, coating

TECHNOLOGY OF COMBINED PROCESSING OF THE WORKING CHANNEL IN HIGH-RESOURCE NOZZLES FROM MINERAL CERAMIC MATERIALS

S.V. Safonov, E.A. Saltanaeva, O.V. Skrygin

Abstract: the paper considers the technology of manufacturing working channels in the nozzles for fuel supply from mineral ceramic materials. It is shown that the use of combined processing methods allows one to create new types of technologically advanced injectors with a flow part in which previously unattainable requirements of designers were implemented when designing high-resource injectors. High production manufacturability is achieved, where by using the combined effect of anodic dissolution of the metal insert and ultrasonic beam

pulses in the combined process, the required mass transfer is achieved when the nozzle is formed with a geometry that meets the operational requirements for modern energy machines. The results of testing nozzles on standard and special installations are given. It is shown that the developed combined process of manufacturing channels in the nozzles stably ensures the specified operational requirements for the quality indicators of the nozzle flow part in terms of accuracy and quality of the surface layer. At the same time, the use of mineral ceramic nozzles ensures the stability of fuel combustion within + -5%, and the nozzle life increases by 2-3 times, which fully compensates for the additional costs of manufacturing channels, and by reducing operating costs, a large economic effect is achieved, especially in the system power supply

Key words: nozzle, mineral ceramics, combined methods of processing, heat resistance, channel manufacturing technology

MECHANISM OF FORMATION OF HIGH-LIFE HEAT-RESISTANT COATING

V.P. Smolentsev, A.I. Portnykh, E.V. Panichev

Abstract: the application of the method of atmospheric plasma deposition of coatings resistant to thermal shocks to the high-temperature zone of the combustion engine block of heat engines is considered. The considered heat-resistant coating consists of several layers: internal metallic, in contact with the base part or substrate, and external mineral and ceramic, including granules of oxide ceramics and metal powder. Calculation schemes were constructed to demonstrate the mechanism of capillary reduction of the sublayer level during the application of the main coating layer. It was established that during the formation of the outer layer, the flow of molten metal obeys the laws of movement of non-Newtonian liquids as they flow in capillaries formed between adjacent granules. Mathematical dependences of the change in the height of asperities of the surface depending on the size of the applied sublayer and coating are given. The effect of such phenomena on the strength of fixing the applied particles in the coating and the change in the height of asperities of the surface layer are shown. The factors leading to a decrease in the adhesive strength of the applied coating are given, and the influence of the technological parameters of the deposition process on the durability of the coatings during firing tests of products with the reduction of the dependence determining the minimum sublayer thickness is disclosed

Key words: coating, granules, capillary phenomena, surface roughness, granule size, durability, granule fixing strength

DESIGN OF THE GAS DYNAMIC TRACT OF THE DISC NOZZLE OF A LIQUID ROCKET ENGINE WITH REVERSE FLOW IN AN ANNULAR COMBUSTION CHAMBER

K.V. Kosovyagin, G.I. Skomorohov

Abstract: to date, the evolution of chemical rocket engines has almost reached its maximum. This is reflected in the operation of such propulsion systems under the conditions of the limiting energy possibilities of the fuel. The ways to significantly increase the specific impulse should be sought in other areas, such as improving the shape of the nozzle to reduce the size and weight of the engine, not only without harming the proper expansion of the flow of combustion products, but also making it more independent and effective. The principle of operation of a traditional Laval nozzle is based on the acceleration of the gas flow due to the transformation of the geometry in accordance with the changing physical properties of the combustion products. Obviously, such a profile is not the only solution to the problem of accelerating the working body. Thus, in the present work, a comparative

analysis of Laval form liquid-propellant rocket engine (LRE) nozzles with non-conventional nozzles with external flow expansion and justification of the choice of the oxygen-methane fuel pair for efficiency were carried out. The stages of the computational method for the approximate design of the geometry of the contour of an axisymmetric dish-shaped nozzle with an annular combustion chamber are set forth on the example of a calculation based on the engine of JSC KBHA RD-0162. When designing the chamber, gas-dynamic features of the flow and the generated heat flows were also taken into account. The development of advanced design methods based on modern digital technologies was carried out, the result of which is a 3D model of the resulting camera

Key words: annular combustion chamber, disc nozzle, central body, gas dynamics, liquid-propellant rocket engine

AUTOMATION CHOOSING AND DESIGN OF THE CONTROL SYSTEM ELEMENTS OF FLEXIBLE AUTOMATION MANUFACTURE

J.F. Mamedov, Q.S. Abdullaev, Sh.T. Mamedova, B.A. Valieva, O.I. Popova

Abstract: based on the analysis of software products for the creation of a database, their main functions for designing, structuring technical indicators with the aim of their further effective search and selection are determined. On the example of the automation manufacture of a machine-building enterprise with the use of a DBMS, a mobile search and selection of non-standard elements of control system and industrial robot of a flexible automated cell for blowing up channels of flat blanks are performed. The stages of practical implementation of problems on the development of database of non-standard controls and power supply of flexible automation manufacture and the creation of search queries from a ready-made database are given. The databases of non-standard elements of the flexible automation manufacture control system have been developed which are carried out on the basis of ready-made technical indicators and the calculated parameters obtained by means of mathematical and algorithmic methods. A database has been developed for searching and selecting types of sensors for a flexible automation manufacture control system, which are included in the subsystem for automated design of non-standard elements of flexible automation manufacture control system

Key words: flexible automation manufacture, sensor, control system, data base

PROCESS CONDITIONS FOR PLASMA LAYING OF MULTILAYER PROTECTIVE COATINGS

A.I. Portnykh, V.P. Smolentsev, E.V. Panichev

Abstract: the conditions for the use of thermal protective multilayer coatings applied by atmospheric plasma spraying are considered. The scheme, methods of calculation and selection of technological modes of applying coatings, assigned according to operational requirements, are given, where the working conditions of parts with a thermal protective coating applied to high-temperature zones of aircraft engines are taken into account. The coatings consisting of several layers, the combination of which provides high adhesive strength and erosion resistance of the coated surface of the product, are considered. The purpose and effect of the metal underlayer on the formation of the main coating, as well as dependencies to determine its minimum value, ensuring the maximum performance of the coating, are shown. Based on the above mathematical dependencies, the choice of regime parameters for the movement of the plasma torch nozzle, the rational consumption of powder materials, the optimal size of the used granules and the energy parameters of spraying, as well as the amount of allowance for polishing the transitional areas of the

coating is justified. When developing modes for the first time, features of the flow of molten metal of the coating sublayer were taken into account for the formation of technological indicators of the process of applying a two-layer coating, the outer layer of which contains mineral-ceramic granules based on oxide ceramics

Key words: technological modes, plasma coating, heat coatings, granules, layers, capillarity

SHAPING WING PANELS OF A LONG-HAUL AIRCRAFT

D.S. Grebennikov, V.I. Maksimenkov

Abstract: the analysis of the design features of the main types of long wing panels of modern aircraft, affecting the complexity of shaping, is presented. The nature of the elastic springback effect, which negatively affects the labor intensity of the shaping processes and their accuracy, is described. The main methods of forming single and double curvature panels are considered, such as free bending on press equipment, bending, rolling on roller machines and shot hammering, their main advantages and disadvantages are revealed. A method has been developed that provides for local heating of a section of the panel before bending on press equipment, which allows reducing the laboriousness of the bending process due to a significant decrease in the value of elastic springing, which entails a reduction in finishing work. The existing equipment for heating long panels is considered from the point of view of energy efficiency of. An installation for heating the workpiece with infrared radiation, equipped with quartz lamps as heating elements, has been developed. The analysis of the effectiveness of the proposed method was carried out, which showed a significant reduction in the effect of elastic recovery on the process of bending the workpiece using a press

Key words: panel, shaping, springback, bending, heating

ANALYSIS OF THE MODERN CONDITION OF DEBURING DETAILS HAVING SMALL GROOVES AND HOLES IN THE MEDIA OF FREE ABRASIVES

M.A. Tamarkin, E.V. Smolentsev, E.N. Kolganova

Abstract: the article proves the relevance of studies of finishing-enviable processing of small-sized parts of electronic equipment. Data on complex technological problems of such processing are given. A review of methods for removing burrs and rounding of sharp edges of parts in an environment of free abrasives is presented. Vibroabrasive treatment is shown to be the most effective method of removing burrs from small-sized parts with difficult-to-reach surfaces and has several advantages over other methods, since the treatment of such parts is a complex, difficult task due to difficulty in accessing the working environment and burrs holes. The results of theoretical and experimental studies of vibration processing of parts with small grooves and holes in various media, including organic, are given in the form of dependencies of the time of removal of the burr on the mechanical properties of the material being processed, thickness of the burr at the base and characteristics of the working environment. The experiments carried out confirmed the possibility of studying the treatment in media of organic origin using mixed granules of different sizes with a small specific gravity. The research tasks are aimed at increasing the efficiency of vibration processing of small-sized parts having grooves and holes

Key words: vibration treatment, medium of organic origin, roughness, microroughness of the surface, burrs, edge rounding

MACHINING MODELING TO OPTIMIZE PROCESS PARAMETERS

D.M. Chernykh, Yu.S. Tkachenko, V.S. Tsyganov

Abstract: the article considers the problem of machining gray iron SCH18-SCH25 without the use of coolant. The purpose of this work is to simulate and calculate on its basis the temperature on the front surface of the instrument through the development of a mathematical model to optimize the operating parameters during mechanical processing. To determine the temperature in the cutting zone and on the front surface of the cutting tool, the finite element method was used using the Deform 3D Machining. To solve the problem of nonlinear programming, an evolutionary method was used; the temperature on the front surface of the cutting tool, the spindle speed, and the cutting power were used as constraints for rough boring. A technique was developed to optimize cutting conditions for the volume of material to be removed. In the course of modeling, the dependence of the temperature on the front surface of the cutting tool on the regime processing parameters was determined. With the help of an evolutionary algorithm, based on the developed model of nonlinear programming, the regime processing parameters were determined, allowing us to achieve maximum material removal performance. The simulation was performed by the method of finite elements of machining the workpiece, namely, boring the hole in the case of gray cast iron SCH25, using Deform 3D Machining. The coefficients of the regression equation for the dependence of the temperature on the front surface of the cutting tool and in the cutting zone on the cutting depth, cutting speed and feed were determined. On the basis of the developed mathematical model, the regime processing parameters were determined, at which the volume of material to be removed will be maximum without exceeding the temperature of redness of the tool material. We obtained the data to determine the optimal operating parameters of machining when developing control programs for CNC machines

Key words: machining simulation, finite element method, Johnson-Cook model, temperature, optimization, nonlinear programming