DEVELOPMENT OF HARDWARE AND SOFTWARE FOR A DIGITAL TACHOMETER WITH ON-BOARD COMPUTER FUNCTIONS

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Abstract: the paper presents the structural cheme and capabilities of a tachometer with the functions of an on-board computer. The relevance of the development of this device is shown. The presented tachometer has the following features: measuring the frequency of the generator and bringing it to the speed of rotation of the crankshaft; frequency indication using a seven-segment indicator; frequency indication using an LED ruler; temperature measurement and indication of three zones (street, interior, engine); non-volatile clock; measurement of mains voltage; brightness adjustment of indicators; a number of consumer functions (alarm about high engine temperatures, etc.). An ATmega88 microcontroller in a TQFP type enclosure was used to implement the tachometer. The software module under development provides the following operating modes of the devices and the order of their switching: Tachometer → Temperature inside → Temperature outside → Engine temperature → Voltage → Clock. The microcontroller's control program performs and supports the following device functions: tachometer; clock; engine temperature measurement; outdoor temperature measurement; interior temperature measurement; battery voltage measurement. The software is implemented in the C language in the AVR Studio environment. The data exchange between the microcontroller and the real-time chip is organized using the I2C protocol. The SPI bus is used for programming the microcontroller. The 1-Wire bus allows the DS1820 integrated temperature sensors to be connected to the microcontroller via a serial port. The limitations and advantages of the developed device are presented

Key words: digital tachometer, engine, battery, on-board computer, microcontroller, microcontroller control program, digital signal, ADC, sensor

INVESTIGATION OF FACTORS AFFECTING THE CONVERGENCE AND STABILITY OF A DEEP REINFORCEMENT LEARNING ALGORITHM A2C PERFORMER-CRITIC

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Annotation: the ability of a deep learning algorithm with reinforcement for convergence and stable functioning is the key to high-quality performance of the tasks assigned to it. The unpredictability and multifactorial nature of the surrounding world impose serious limitations associated with the existence of a correlation between the result of execution and a variety of method parameters, each of which has a certain, but in most cases unpredictable effect. In the context of applied tasks, this fact manifests itself in the difficulty of identifying and configuring significant indicators of the algorithm that can guarantee stable and sustainable functioning. Using deep reinforcement learning in real-world applications implies online interaction with the environment. The use of neural network apparatus for generalizing input data is associated with an increase in the number of factors and an increase in the complexity of system analysis. The object of the study was an agent implementing a deep learning method with reinforcement Advantage Actor Critic or A2C (performer-critic). The factors influencing the convergence and stability of the functioning of the corresponding algorithm were considered as the subject of the study. The agent placed in the OpenAI gym CartPole-v0 environment, in the process of solving the problem of stabilizing an inverted pendulum, was selectively changed at a certain point in time by a specific parameter with constant values of the rest. As a result, graphs of the distribution of the total remuneration for the specified number of episodes were obtained, used as a quality metric demonstrating the impact of the change undertaken. They allowed to study the convergence and stability of the A2C algorithm and to identify the factors influencing these characteristics

Key words: deep reinforcement learning, performer-critic, neural networks, algorithm stability, hyperparameters

DEVELOPMENT OF A WEB APPLICATION FOR CREATING A SPORTS SCHEDULE ONLINE

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Abstract: this article is devoted to the development of a web application for the formation and further monitoring of a sports schedule. The article considers the process of designing and creating a web application intended for sports organizations, coaches and athletes. It also considers the features of interface design, schedule data management, notification implementation and adaptive design. The web application is developed based on Angular technology. This program uses an extensive collection of well-integrated libraries that cover a wide range of functions, including form management, routing, interaction between the client and server parts and much more. The application is made single-user, to simplify the work of employees and athletes. They do not need to enter their personal data in the profile. To add yourself to the competition database, you can fill in the data of the dialog box. When the user logs in, he is given the opportunity to view, add, edit, delete data. The interface also includes: a sidebar with the ability to open and close, navigation with links to sections (Calendar, Responsible Person, Sports Discipline, People Statistics), a table with data on people and actions, buttons for opening dialog boxes and dialog box components. The presented approach will help improve the organization of sports events, increase the effectiveness of training and simplify interaction between members of the sports community

Key words: UML diagram, Angular, FrontEnd, BackEnd**,** Sitbar

DEVELOPMENT OF A SUBSYSTEM FOR CALCULATION OF ANALYTICAL INDICATORS

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Abstract: the article is devoted to the substantiation of the need to develop a subsystem of analytical indicators and software implementation of a solution for automating the calculation, description and reuse of rating calculation indicators when automating the system of assessing the work of a university both in terms of departments and as a whole. Higher education institutions regularly submit a large number of analytical reports to the Ministry of Science and Higher Education of the Russian Federation. These reports are necessary for quality control of the educational process, assessing the effectiveness of universities and distributing funding. Assessing the quality of educational services, as well as the quality of work of university departments, and promptly preparing reports to higher authorities is extremely labor-intensive. To facilitate the preparation of reports and reduce the labor intensity of assessing the quality of the educational process, it is necessary to develop an automated system of analytical indicators. The subsystem of analytical indicators should provide the ability to promptly prepare reports and reuse the indicators used in preparing rating formulas. Analytical systems allow organizations to effectively manage data, identify patterns, predict trends and optimize business processes. The article provides a rationale for choosing a software development environment for a software module, as well as a description of the main objects of the developed subsystem

Key words: analytical indicators, information system, digitalization of the university

DYNAMIC ALGORITHM FOR LOAD DISTRIBUTION BETWEEN COMPUTING RESOURCES OF A DATA PROCESSING CENTER

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Abstract: this article is dedicated to the development of a dynamic algorithm for load distribution and balancing, characterized by nonlinear parameters and a fractal structure, across the computational resources of data processing centers (DPCs) in cloud environments. The justification for applying methods of nonlinear dynamics and chaos theory to this problem is provided, based on the topological similarity between the behavior of deterministic chaotic systems and the input network load of DPCs. The chaotic nature of the load is verified by calculating Lyapunov exponents. To eliminate noise components in network traffic, the principal component method for time series was applied. The phase space reconstruction task was solved using the delay method, based on the embedding theorem and the method of average mutual information. Based on this reconstruction, a method for forecasting load dynamics was developed, represented as a system of discrete mappings connected by an algebraic polynomial, which ensures successful forecasting of irregular time series. This method forms the foundation for constructing the resource distribution matrix of the DPC. The article's goal is to improve the efficiency of server cluster resources in DPCs under fractal network load conditions by developing a dynamic algorithm for load distribution and balancing based on nonlinear dynamics methods

Key words: load distribution, nonlinear dynamics, forecasting, local approximation

ELECTROMAGNETIC FIELD SIMULATION METHOD FOR CORRECT CALCULATION OF SQUIRREL CAGE INDUCTION MOTOR

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Abstract: when it is necessary to design an asynchronous motor in the best way, special attention should be paid to modeling the electromagnetic field. Today, such a method is the numerical method of finite elements. The ability to calculate the electromagnetic field largely determines the resulting effect of successful design of an electric machine when its parameters fully comply with the technical specifications. The finite element method allows you to make the modeling process visual, perform it quickly and with good accuracy. In addition to the finite element method, there is also a traditional method based on substitution schemes and pie charts of an asynchronous machine, however, as will be shown in the article, it is much less accurate than the finite element method. There is a method that can be used without much loss in the accuracy of calculations. To do this, it follows from the verified data of the authors' long-term calculations to plot a graph reflecting the observed pattern. The constructed graph allows you to work with the data more freely. The discretely described seven engine sizes, when using a graph instead, allow for a noticeable advantage in representing the discrete seven options as a continuous relationship. In this way, the following advantages can be obtained in justified cases: reduction of material resources for the purchase of expensive programs implementing the finite element method. Instead of performing calculations using the finite element method every time, you can simply use the existing results. We estimate the loss of accuracy as double compared to the finite element method itself. Based on practical experience, we expect an increase in the calculation error from 1 % to 2 %. Saving time spent on work makes this approach quite attractive and reasonable. If the considered diameter of the rotor is far from those already considered, it will not be possible to avoid direct application of the finite element method

Key words: asynchronous machine, motor operating mode, squirrel cage rotor, parameters of the substitution scheme, finite element analysis, electromagnetic field, methods of designing an induction machine

DESIGNING NETWORK STORAGE ON SMALL-CONSUMPTION EMBEDDED OF ARM COMPUTERS

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Abstract: this paper investigates the possibility of using single-board computers to reduce the overall cost of maintaining network storage. The paper firstly examines the shortcomings of a previously installed system and then analyses the system discussed in the paper. The paper proposes a processor that meets the necessary requirements for interface speed and has hardware acceleration of video encoding suitable for streaming video recording from surveillance cameras. The paper goes on to consider methods of connecting discs in conditions where SATA controllers and full-fledged PCI-e slots are missing, including from the point of view of reliability, fault tolerance and possibility of recovery after a failure, as well as hot-swapping of discs. Methods of multiplying the maximum number of connected drives using SATA and USB multiplexers are analysed and tested, and a system architecture for connecting full hard drives is proposed. The advantages and limitations of the proposed architecture and connection methods are analysed through linear write and read speed testing, and the anomaly of constant restart of disc drives caused by the disc monitoring system is considered and the method of its solution is described. The hardware video encoding capabilities are tested, and a perspective on streaming surveillance video with low cost and low power consumption using a particular ffmpeg build is offered

Key words: network-attached storage (NAS), single-board computer, ARM architecture, embedded computers, hard disk drives, performance, NAS efficiency

ANALYSIS OF METHODS AND DEVELOPMENT OF A MODULE FOR INVENTORY MANAGEMENT WITH MONITORING AND STATISTICS IN CROSS-PLATFORM APPLICATIONS BASED ON FLUTTER

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Abstract: the object of this study is an inventory management system. One of the approaches to solving this problem is the use of forecasting methods that allow predicting stock levels based on past inflows and outflows. The purpose of this work is to develop and implement mathematical software for forecasting inventory using moving average methods (SMA, WMA, EMA) and to create a mobile cross-platform application based on Flutter for real-time integration of these methods. The study considers three inventory forecasting methods: simple moving average (SMA), weighted moving average (WMA), and exponential moving average (EMA). The module, developed using the Flutter platform, provides the user with a convenient interface for monitoring current inventory and generating forecasts based on the selected moving average method. The visualization of the data allows users to easily track changes in stock levels and make decisions regarding inventory replenishment or optimization. The conducted calculations demonstrate that the proposed forecasting methods provide accurate predictions, which allow businesses to effectively manage their stock levels, minimize the risk of stockouts or overstocking, and optimize storage costs. The work also highlights the potential for further adaptation of the proposed system for other inventory management processes

Key words: inventory management, control module, inventory forecasting, Flutter

MESH SEGMENTATION FOR BOOLEAN OPERATIONS

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Abstract: the paper considers the problem of splitting three-dimensional meshes based on sets of their intersections and the problem of segmentation of three-dimensional meshes based on intersection contours with subsequent classification. Meshes of arbitrary topology are considered, they can be both open and closed. Meshes of arbitrary topology are considered, they can be both open and closed. The main part of the work focuses on mesh bodies that do not have triangles as partition elements, which have fewer than two neighbors along the edges. Solving the segmentation problem allows you to define operations regardless of the characteristics of the meshes – only taking into account the relative position of the segments. Five classes of meshes have been obtained, which form components for Boolean intersection, union, and subtraction operations. The paper defines a set of operations for segmentation and classification tasks, and provides constraints. The resulting algorithm with a set of abstract operations can be used to implement a module of Boolean operations. The paper defines the operation of "adding" meshes, the implementation of which varies depending on the requirements for the resulting meshes. This operation can be used to preview a mesh in which extra vertices do not affect its display in any way. The article discusses the transitions between the tasks of splitting three-dimensional meshes and segmentation tasks and demonstrates the results of solving intermediate tasks. The resulting segments can be used for more complex algorithms working on open meshes or bodies with cavities. An analysis of the algorithm's operation and test results were obtained in a system written in the C++ programming language using the OpenGL API

Key words: mesh intersection, mesh union, mesh difference, triangulation, segmentation

DEVELOPMENT OF A METHOD OF LOAD BALANCING IN DISTRIBUTED DATA PROCESSING SYSTEMS

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Abstract: the issue of load balancing in data processing centers is crucial for distributed systems that handle large volumes of transmitted data. An analysis of existing algorithms has highlighted the need for the development of modified load-balancing algorithms aimed at ensuring an even distribution of load among proxies and enabling the rapid adjustment of routing schemes in the event of the failure of one or more proxies. This study focuses on the creation of a mathematical model and the development of algorithms to facilitate efficient load balancing in such systems. The primary objective of the research is to enhance the efficiency of data transmission and processing in distributed systems. The article presents a mathematical model of the load-balancing process, which considers the operation of a system that transmits large volumes of data through proxies with limited bandwidth. The proposed model accounts for parameters such as the attributes of incoming data messages, the queue size of the m-th proxy server, and its maximum throughput capacity. Additionally, load-balancing algorithms based on a multithreaded task distribution approach are proposed, ensuring the allocation of data messages among proxies within the server based on message processing time, priority, and cost. The conducted experiments have demonstrated the effectiveness of the proposed load-balancing algorithm and confirmed its feasibility for use in systems facing challenges in data distribution

Key words: distributed data processing system, mathematical model, load balancing, proxy server, flows, algorithm

INVESTIGATION OF THE INFLUENCE OF LORA MODULATION PARAMETERS ON THE NOISE IMMUNITY OF THE COMMUNICATION CHANNEL

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Abstract: the features of the modulation method and the Long Range data transmission protocol (LoRa) in the tasks of creating noise-resistant radio communication systems are considered. The existing research on this topic is analyzed and their shortcomings are noted. The main parameters of the modulation are described - the bandwidth (BW), the spectrum expansion coefficient (SF) and their effect on the noise immunity of the data transmission system. Theoretical justifications are given to demonstrate the effect of these parameters on the system's ability to withstand external interference. An experimental stand based on the LoRa SX1276 hardware module and a software-defined HackRF radio is described. This test bench makes it possible to evaluate the dependence of the loss of information packets on the bandwidth and the coefficient of spectrum expansion when exposed to white Gaussian noise with varying intensity on the communication channel. Experimental measurements were carried out with variations of SF = {7; 12} and BW 125, 250 and 500 kHz. It has been found that an increase in the spectrum expansion coefficient combined with a decrease in bandwidth contributes to a significant increase in signal stability. The results obtained make it possible to select the most effective modulation parameters depending on the current electromagnetic environment

Key words: LoRa, noise-resistant communication, communication channel, linear frequency modulation, software-defined radio

OPTIMIZATION OF SEMICONDUCTOR WAFER QUALITY ASSESSMENT USING CNN NEUROTECHNOLOGIES

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Abstract: the article shows one of the few modern methods for automating the assessment of the quality of semiconductor plates using neural networks, or rather the introduction of neurotechnologies into semiconductor manufacturing of modern methods for finding defects on semiconductor plates. Modern semiconductor manufacturing is one of the most important industries, and therefore it requires highly accurate and effective quality control methods. One of the key elements of this process is the assessment of the quality of semiconductor wafers - thin disks on which microchips are formed. Traditional quality assessment methods based on manual analysis or simple image processing algorithms no longer meet the growing demands for production speed and accuracy. It is proposed to use artificial intelligence technologies, in particular, deep neural networks capable of learning from large amounts of data and identifying complex dependencies that are inaccessible to traditional algorithms due to excessive amounts of information and, as a result, traditional algorithm methods simply cannot give an accurate assessment. Modern neural networks do not work with information the way simple AI models do. They are able to build algorithms themselves, which of course has its results in a broader way to automate intellectual activity. The neural network will be able to self-study on existing algorithms. Using the ideas of optimization and parallelization used in decoding algorithms, a developed neural network based on the CNN architecture (convolutional neural network) is proposed for automatic assessment of the quality of semiconductor wafers from their photographs

Keywords: CNN, optimization, neural network, automation algorithm, semiconductor wafer

METHODOLOGY FOR CONTROLLING THE PARAMETERS OF THE DIRECTIONAL DIAGRAM OF A LINEAR PHASED ANTENNA ARRAY

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Abstract: the purpose of the study is to develop a technique for controlling the parameters of the radiation pattern (DP) of a linear equidistant phased antenna array by changing the phase shift. The issues of analytical calculation of the radiation pattern of an equidistant linear phased antenna array are considered. A method for synthesizing the phase distribution based on a mathematical model combining the general theory of radiator systems and numerical optimization algorithms is proposed. This approach allows one to form a radiation pattern with a specially shaped main lobe for an antenna array of a given design. A criterion for synthesizing the phase distribution (minimum squared total error) is proposed, based on which the target function is obtained. A technique for controlling the parameters of the radiation pattern of a linear equidistant antenna array has been developed. The results of a comparative analysis of calculating the radiation pattern of an antenna array using linear and synthesized phase distributions are presented

Key words: linear equidistant phased antenna array, synthesized phase distribution, control of radiation pattern parameters, particle swarm method

INVESTIGATION OF THE EFFECT OF COMPOUNDS ON THE CHARACTERISTICS OF A PLANAR TRANSFORMER IN A POWER SUPPLY MODULE

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Abstract: the problems considered in the work affect the main functional node of any pulsed power source. Using software tools, it was possible to detect the dependence of the location of the cores relative to each other in space on the electrical and magnetic properties of the power transformer. Differences in the quantitative indicators of such physical quantities as magnetization inductance, scattering inductance, magnetic permeability, and the coupling coefficient between the windings are revealed. The vulnerabilities in the design of power supply modules with a planar transformer are identified, and the main causes of defects in the structure are considered. An assessment of losses in case of structural failure of a planar transformer using modern computer-aided design systems has been carried out. Experiments have also been carried out in full to identify the most optimal compound for use in production. As a result of the study, a methodology has been developed to determine the properties and composition of the "ideal" compound for fixing transformer cores and for filling power supply modules. The results obtained by modeling the system or calculations are only theoretical in nature, therefore, the full performance of this method must be checked on prototypes. This is especially important for mass production, so that the percentage of error is minimal

Key words: planar transformer, gap, core, optimal compound, loss estimation, magneto-wire

ANTENNA ARRAY BASED ON A SERIAL ARRAY OF PATCH ANTENNAS

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Abstract: a phased array antenna representing a sequential patch array consisting of 16 centrally powered elements at an operating frequency of 4.99 GHz is considered. In the CST STUDIO automated design system, two design options for an antenna array with metal and dielectric polyamide bushings between the patches and the ground were considered. The antenna array is powered at one central point, structurally symmetrical, with a 50 ohm coaxial cable. The results of the study of a phased array antenna consisting of 16 patch antennas connected in series, located at an estimated distance from each other and in the same phase, show a high cumulative gain and directional properties at a frequency of 4.99 GHz, which makes it possible to effectively use this phased array in the data transmission channel of autonomous mobile unmanned complexes. To confirm the results obtained, tests of a prototype antenna were carried out. The advantage of this design is also the low cost of manufacturing. The obtained measurement data of the phased array antenna confirms the simulation results at a frequency of 4.99 GHz

LVDS RECEIVER AND TRANSMITTER BLOCKS FOR 180 NM PROCESS

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Abstract: the article presents two IP blocks for integrated circuits: a low-voltage differential signaling (LVDS) receiver and transmitter. The section of the article devoted to the LVDS transmitter contains a detailed description of the IP block structure and electrical circuits of its components, simulation results, and the main electrical parameters of the device. Special attention is paid to the features of the circuit solutions used in the design. The section devoted to the IP block of the LVDS receiver contains a brief description of the electrical circuit, simulation results, and the main parameters of the block. The IP blocks were developed on the basis of a domestic technological process with 180 nm design standards. The circuit and topology were developed in a specialized CAD system for integrated circuits. Mathematical models of semiconductor devices provided by the manufacturer were used to simulate the circuit. The generator topology has successfully passed verification for compliance with design rules check (DRC) and conformity of the topology to the original schematic (Layout vs. Schematic, LVS)

DEVELOPMENT OF A MIMO ANTENNA SYSTEM WITH A TOROIDAL RADIATOR PATTERN FOR INTERFERENCE-RELIABLE CHANNELS

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Abstract: the article presents the results of development and study of MIMO antenna system with toroidal radiation pattern for communication systems with unmanned aerial vehicles. The design of antenna based on coaxial waveguide with polystyrene filling is described, providing operation in the frequency range of 5.95-6.2 GHz with the possibility of forming two orthogonal circular polarizations. The results of electrodynamic modeling of the main characteristics of the antenna system are presented, including S-parameters, radiation efficiency, voltage standing wave ratio and radiation patterns. It is shown that the developed antenna provides a gain of up to 9.5 dB with a radiation efficiency of no worse than -0.3 dB in the entire range of operating frequencies. The features of radiation pattern formation for various operating modes and frequencies are analyzed. Particular attention is paid to the analysis of the antenna characteristics in the angular plane, where the width of the main lobe of 9.7° is achieved with a side lobe level of -11.1 dB. The possibility of effective channel separation in the MIMO system by using orthogonal circular polarizations is demonstrated. The proposed technical solution ensures high noise immunity of the communication channel under conditions of multipath propagation of radio waves with minimal weight and size characteristics of the antenna system

LDPC-FPGA-BASED DECODER WITH ULTRA-LONG CODES

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Abstract: the decoder architecture is presented, which is characterized by high performance, low complexity and high speed for ultra-long quasi-cyclic LDPC codes. The architecture and operation of an LDPC decoder implemented on an FPGA are described. Special attention is paid to the structure of reading and writing data in the process of iterative decoding, where a simple counter is used to address PCM memory (Phase Change Materials, phase transition materials), and parallel I/O is controlled by a lookup table. The mechanism of reading and writing is considered in detail, with an emphasis on their reordering before processing in NPU (Node Processing Units). A decision-making module is described that checks the success of decoding by comparing the calculated syndrome with the received one, as well as a module that generates output bits based on signed ones. Simulation results are presented demonstrating decoder performance through bit error (BER) parameters, average number of iterations, bandwidth and resource consumption. It is shown that the performance of the sum-product algorithm (SPA) is superior to that of the minimum sum algorithm (MSA), although MSA has less complexity. The dependence of the average number of iterations on the signal-to-noise ratio (SNR) is noted, as well as the insignificant influence of fixed-point numerical schemes on this parameter. The results show the achievement of low SNR values for successful decoding due to the extremely long code length and low encoding speed. The presented decoder architecture has good performance with a signal-to-noise ratio (SNR) reaching -0.6 dB

COMPARATIVE ANALYSIS OF THE EFFICIENCY OF DETECTION OF BREAST CANCER NEOPLASMS USING DIFFERENT TYPES OF ANTENNAS

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Abstract: the article considers the efficiency of detection of breast cancer neoplasms by using the electrodynamic method. Application of such a method is possible due to the change of dielectric characteristics of tissues due to changes in the characteristics of cells. In the study we compared the detection efficiency of the simplest antennas: horn antennas, Vivaldi antennas, planar two-layer patch antennas. The main requirement for antennas that are used to apply this method is to ensure broadband to minimize false characteristics. It is shown that the use of the electrodynamic method allows the detection of a new formation by measuring S21-parameters, signal characteristics on the receiving side, as well as the construction of Fourier spectra on the receiving side. Thus, the study is carried out both in time and frequency domain. It is shown that the development of the electrodynamic method of neoplasm detection allows to provide detection of the disease by a cheaper and safer method in comparison with MRI and SCT, which are connected with irradiation of the patient or high level of magnetic field or by application of X-rays of high intensity. The results obtained show the dependence of the field measurement characteristics on the types of antenna. The results obtained are illustrated by the dependencies of field characteristics on the types of antennas used in the detection of neoplasm in tissue structures

Key words: electrodynamic method, dielectric characteristics, horn antenna, Vivaldi antenna, planar patch antenna

CURRENT STATE OF DEVELOPMENT OF TECHNOLOGICAL PROCESSES AND EQUIPMENT FOR FORGING AND STAMPING PRODUCTION

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Abstract: in modern conditions, along with enterprises of a closed production cycle, small enterprises are emerging that produce products of forging and stamping production. As a rule, such enterprises have a certain range of forging and stamping machines. Depending on the scale of the enterprise, they can be equipped with crank hot stamping presses (CHSP) or a section for stamping parts using cold volumetric stamping (CVS) methods and a machining section. Currently, there is a renewed need to increase production productivity to ensure large-scale production of products for various purposes. The main problem of forging and stamping industries as part of small enterprises is the low-efficiency use of existing diverse basic technological equipment. One of the ways to increase the efficiency of using the main technological equipment is the possibility of implementing the technological processes of CVS on CHSP, i.e. on machines that were not originally designed for this. In other words, if for some reason there is a simple CHSP, then it can be reconfigured to produce forgings / parts made by CVS methods, in particular, direct and reverse extrusion. From a theoretical point of view, the possibility of this is also confirmed by the nature of the theoretical graphs of changes in the technological loading of the press in relation to volumetric stamping operations: hot stamping, hot extrusion, cold extrusion and cold calibration-stamping. Specialized software allows to significantly reduce the design time and increase the efficiency of decision-making: the Mech-press computer support system for engineering decision-making (CSSED). The software package developed by the authors of the article has a modular structure and is designed to solve the problems of designing and performing verification calculations of assembly units of mechanical presses for various technological purposes

Key words: Ishikawa diagram, cold forging, hot forging, crank hot forging press, forging, detail, extrusion, CSSED Mech-press

EVALUATION OF HEATING OF SHEET METAL WORKPIPE DURING «COLD» MOLDING IN THE PRODUCTION OF LARGE-DIAMETER PIPES

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Abstract: the temperature response in the cold forming zone of a sheet blank from the action of the punch of a tube-forming press is analyzed. The thermal effect is estimated depending on the strain rate within the framework of the linear theory of elasticity. The classical approach to modeling the thermomechanical environment near the punch and integrally throughout the volume of the sheet blank is used. Supplements are made to the equations of elastic-plastic deformation in the conjugate version with a modified heat conductivity equation. It is proposed to use a simplified approach for engineering assessments, consisting in replacing the source term in the equation for deformation with a heat source with a power that is localized in the contact area of the punch. In this case, there is no need to identify the coefficient of conversion of the power of the pipe-forming press into heat, which does not obviously depend on the crystal lattice of the sheet blank, its chemical composition and latent defects of the structure. The formulation of the mathematical model in 3-D format is formalized by the heat transfer equation according to the heat conduction mechanism with a nonlinear source term with the assignment of free-convective heat exchange on surfaces without edges. The nonlinear initial-boundary value problem in dimensionless form of recording is reduced by the procedure of coordinate averaging to the Cauchy problem for the average volumetric dimensionless temperature depending on the relative time. An analytical solution is obtained whose parameters are the Biot numbers, the dimensionless power of the heat source, and the geometric dimensions of the sheet blank. The computational experiment was carried out for the initial data characteristic of the cold forming section of the enterprise JSC "Liskimontazhkonstruction". The results of the computational experiment on the kinetics of the change in the dimensionless temperature during the deformation cycle taking into account the heat losses into the surrounding space of the sheet blank after the forming operation were about 10℃, which was confirmed by full-scale experiments using a mobile thermal imager

Key words: temperature field, thermal conductivity, elastic-plastic deformation, "cold" forming

ANALYSIS OF THE FEATURES OF THE FORMATION OF PROTECTIVE COATINGS IN MACHINE-BUILDING PRODUCTION

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Abstract: the analysis of the features of the formation of various types of functional coatings used in machine-building production to obtain the required performance properties of parts is presented. Various methods of forming functional protective coatings on the surface of mechanical engineering parts are considered in detail. It has been established that the most promising method of coating formation in the manufacture of a combined electrode-tool (EI) for electrical processing methods is the electroplating method, which allows the formation of metal coatings. Such coatings represent the distribution of a thin, non-porous layer of one material over the surface of another, which protects the metal base of the tool from the effects of an aggressive technological environment. The possibility of forming a conductive coating on the surface of an electrode-tool made of a current-carrying material using additive technologies is considered. To obtain a wear-resistant conductive layer of the required thickness (up to 40 microns) on the surface of the EI, which guarantees the flow of electrical processes in the interelectrode gap during electrochemical treatment, a new approach to electroplating copper is proposed and described in detail. A distinctive feature of the formation of such a coating on the surface of the conductive base is the presence of an intermediate conductive layer made on the basis of graphite varnish. The proposed method will significantly expand the technological capabilities of electrical processing methods in single and experimental production

Key words: protection of parts, coatings, methods, process, properties, durability, hardness, electrode-tool, electroplating

ANALYSIS OF THE INFLUENCE PARAMETERS OF VOLUMETRIC STAMPING TECHNOLOGICAL PROCESSES ON THE PRODUCTIVITY OF FORGING AND STAMPING PRODUCTION EQUIPMENT

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Abstract: due to the fact that the modern basic technological equipment of forging and stamping production was manufactured using imported components, these enterprises are currently faced with a significant increase in production time associated with circumvention of existing restrictions. But there are still reserves that will significantly reduce the time required for the development and manufacture of mechanical presses and improve quality. This task is solved by clarifying and supplementing the design methodology, developing specialized software that will reduce the design time. The work of this computer program should be based on the widespread use of databases, which will allow making design and technological decisions at any stage of design based on previous experience. The ultimate goal of the work carried out is to improve the quality of forging and stamping products, which is achieved on the basis of a single system with its own structure and function. The work performed made it possible to identify a number of design parameters of mechanical presses and determine their relationship with the parameters of technological processes of metal processing by pressure (MPP). Based on the proposed graph of the structure of mechanical presses, many variants of their layout can be synthesized. A methodology is proposed to substantiate the implementation of the implementation of hot forging technological processes at the crank hot forging press in order to eliminate equipment downtime and increase the load factor. The algorithms are based on the methods of structural synthesis of basic parts and technological processes of cold forging

Key words: cold forging, hot forging, crank hot forging press, forging, detail, extrusion, graph, synthesis, CSSED Mech-press