MATHEMATICAL MODELING

DEVELOPMENT OF AUTOMATED SYSTEM FOR DIAGNOSING LIVER CIRRHOSIS AND SELECTING THE OPTIMAL TREATMENT OPTION

page 4–8

This research is devoted to developing the automated system of diagnosing liver cirrhosis, the number of which according to WHO data increases every year.

Despite the large number of existing achievements in the field of mathematical simulation of liver disease, creation of diagnostic models based on simple laboratory evidence is still relevant, because most of them don't consider the possibility of qualitative signs or require complex laboratory tests.

The object of research is the process of identifying and analyzing the course of liver cirrhosis treatment using information technologies.

The aim of research is development of information system for diagnosing and analyzing the course of liver cirrhosis treatment on the basis of mathematical simulation.

An array of observations in 412 patients was applied as the clinical material, in the presence of informative consent of patients, who were divided into two groups according to the degree of liver damage. The analysis of general information about the patients, the results of biochemical blood tests and prescribed treatment was allocated a number of informative signs used in the simulation. The correctness of the chosen informative signs confirmed literature data and high accuracy of the mathematical models. It was determined that the indicators included in the stage of developing models affect the availability of liver disease with high degrees ($p < 0{,}001$).

The mathematical models estimate the probability of liver disease with high degree (including liver cirrhosis) and probability of liver disease with high degree (including liver cirrhosis) in the remote period after treatment.

The automated system developed for the practical implementation of obtained mathematical models and designed to the diagnosing and selecting an optimal treatment of liver diseases.

Validity of an automated system that implements mathematical models was confirmed by testing of the independent test sample. The total classification accuracy was 84,9 %.

Keywords: liver cirrhosis, automated system, forecasting, logistic regression.

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THE DEVELOPING OF THE SYSTEM OF EQUATIONS OF REAL BLADES SURFACES AND THE ALGORITHM FOR PREDICTING THE GAS TURBINE ENGINES BLISKS NORMED PRECISION FACTORS

page 8–16

The article is devoted to the developing of the system of equations of real blades surfaces and the algorithm for predicting the gas turbine engines BLISKs normed precision factors. The main aim is receiving the dependencies and the sequence of its utilizing, what is necessary to resolve the product precision predicting and control problems. The assumption, that blades surfaces normed errors are determined by groups of the accessible for control factors: geometrical, kinematic, thermal, force and deterioration was used in the capacity of base idea. These factors are reduced to twenty four reduced primary errors. This has made it possible to obtain the required differential and integral system of matrix equations which reflects the relation between real blade surface radius-vector and above mentioned errors. The radius-vector increment was used as argument in the dependencies for calculating the normed precision factors. Model adequacy was reinforced by the conducted experiments. The obtained system of equations of the real blades surfaces and algorithm for calculating the gas turbine engines BLISKS normed precision factors are applicable for resolving retrieval and project problems, which are connected with product precision increase reserves identification and optimal providing of the precision demands during BLISKS machining technological processes designing. It is the base for creating CAM-systems in the domain of aviation engines manufacturing.

Keywords: machining process, working errors, blades, blisk, gas turbine engine, algorithm.

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DEVELOPMENT OF VECTOR-PARAMETRIC FIFTH-DEGREE B-SPLINE WITH CONTROL POINTS INCIDENT THE SURFACE

page 17–21

Studies in the field of geometric modeling are aimed at the development of the already existing ways of describing spline surfaces, because to be a bit inconvenient to construct smooth contours of the existing methods. A method in which the control points belong to the curve is proposed.

Based on previous research the method of B-spline construction is proposed. B-spline is a vector-parametric surface with control points incident (belonging to) the curve based on the fifth-degree splines in compliance with the smoothness of the first to the second order. To do this, the resulting vector-parametric spline $r = r(u)$ will «stretch» to v, in a direction different from the u, which gives an opportunity to build a relevant «portions» of the surface. Further, to obtain a B-spline with full smoothness order it is necessary to ensure the «gluing» of the respective portions of the surface providing the appropriate smoothness by «gluing» line, i. e. ensure equality of the corresponding (first and second) derivatives. However, to achieve full smoothness of second order (i. e., ensure continuity of the second fundamental form across the surface), it is necessary to provide equal mixed derivatives through «gluing» line. Test examples of bicubic splines are given.

Keywords: vector-parametric spline, B-spline, spline with control points incident the curve, smoothness.

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MODELING PASTILLE PRODUCTS RECIPE USING UNCONVENTIONAL RAW MATERIALS IN ACCORDANCE WITH PREDETERMINED QUALITY INDICATORS

page 21–27

The article is devoted to the spread of diabetes and iodine-deficient condition among population. To expand the range of products with reduced carbohydrate loading and rich in minerals, including iodine, the author proposed rationalization of pastille products recipe using new raw material, namely pastille with an aqueous extract of stevia, stevioside, elamin under predetermined quality parameters, which was the aim of this article.

Pastille is a traditional confectionery of CIS region, in the range of foreign countries these products are available. However, its calorie content is quite high, due to high content of white sugar and restricts the use of products.

Pastille recipe composition was rationalized through mathematical modeling by using new raw material for partial removal of the mass fraction of white sugar with simultaneous iodine fortification of products.

To achieve this aim it was defined concentration of agar $C_{ag.} = 3$ % and water extract of stevia $C_{wes} = 1{,}0$ % during cooking sugar syrup to reduce a mass fraction of white sugar without loss of quality characteristics of semi-finished products. In parallel it was set range of rational concentration for stevioside $S_{stev} = 1{,}5 \ldots 2{,}5$ % by mechanical impact during $\tau = 5 \ldots 7 \cdot 60$ s by replacing white sugar. The results helped to rationalize the

recipe ratio of components according to predetermined quality parameters for pastille using unconventional materials: $x_1 = 14,5$; $x_2 = 1,2$; $x_3 = 0,12$; $x_4 = 10,0$, which is the recommended settings for pastille production candy.

Keywords: modeling recipes, pastille products, pastille, white sugar, sweetener, stevia, elamin.

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MECHANICAL ENGINEERING AND MACHINE BUILDING

THERMODYNAMIC CYCLE OF RAMJET IN COORDINATE P-V, T-S CALCULATION

page 28–32

Thermodynamic cycle of ramjet in coordinate P-V, T-S, which is represented in the modern theory of air-jet engines (AJE), is performed with flow laws liquids and gases violation, because in zone H-B negative (against the flow) gradient of static pressure takes place, which make impossible gas flow coming it to the engine. This is connected with that while formula of thrust air-jet engine calculation in zone of control contour H-d paraboloid zone of braked flow generation had not be taken in to care, as a physical phenomenon, static pressure on the periphery of which, $P_н^*$, is a maximum in zone H-B, providing on any of air-jet engine's work regime positive (by the flow) static pressure gradient, even with the presence of negative (against the flow) static pressure gradient in measure of supersonic fly speed inlet nozzle that provides gas flow moving into the engine don't breaking all mechanic laws of liquids and gases expiration, which say that air flow moving into the engine is possible only with positive(by the flow) static pressure gradient existence.

In this paper, taking into account paraboloid zone of braked flow generation in control contour H-d as a physical phenomenon, is given a correct description of the operating principle of the ramjet, and on this basis, developed the correct thermodynamic ramjet cycle in coordinate PV, TS, which is the fundamental basis of the progressive «United propulsion theory on continuous flow».

Keywords: paraboloid zone of braked flow, kinematic analysis.

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FINITE ELEMENT ANALYSIS OF DYNAMIC STATE METALWORKING TECHNOLOGICAL SYSTEM

page 33–39

Based on the analysis of the literature it was found that with cutting and turning speed increase during processing (spindle frequency) resonant phenomena that significantly affect the performance of cutting tools and quality (roughness) of finished surface can occur. The aim of the work is to determine the dynamic characteristics of metalworking system on the design phase that is without a full-scale experiment. This paper describes a stand based on constructed 3D model of modernized machine tool mod. 1700VF30 (spindle frequency 10000 rev/min) and the method and algorithm of development of finite-element model of dynamic state of designed 3D models of machine tool is proposed. With the help of developed model the modal analysis of the machine tool mod. 1700VF30 using the method of finite elements that can let to detect the resonant frequencies of oscillations within any range of the setting of the cutting was made. The finite element method using ANSYS executed a complex research of amplitude-frequency characteristics of constructed 3D model depending on the speed of the spindle rotation and frequency at which resonance phenomena occurs. Adequacy of the developed analytical model of dynamic state of the elements of a manufacturing system based on the upgraded machine tool 1700VF3 was proved experimentally. Results, received with its help differ from the experimental ones less than for 5 %.

Keywords: finite element method, resonance frequency analysis, turning, vibrations.

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INFORMATION TECHNOLOGIES

DEVELOPMENT OF REAL TIME METHOD OF DETECTING ATTACKS BASED ON ARTIFICIAL INTELLIGENCE

page 40–46

The object of the study is security monitoring system of distributed computing system. There is a problem detecting intrusions into computing systems, namely the lack of an effective way of monitoring that will detect distributed attacks for the anomalous behavior of the system in real time.

The proposed intrusion detection system (IDS) is different from existing ones that combine performance of profile IDS and accurate attack detection of abnormal IDS, through the use of computational intelligence to build profiles of attacks (not in real time) based on the archives of security events and their subsequent usage to detect attacks in real time.

The developed model can detect: with high precision — traditional potential attacks, with many errors of the second kind — not obvious attacks, with the mediocre reliability and complexity of obtaining profile — new types of attacks and vulnerabilities.

Unlike standard IDS types, proposed IDS allows evaluating and detecting attacks that have not been explored or identified, but their effects have been found,. According to submitted for entry archive of security events (log of events) genetic programming system is able to find the correlation of certain events and messages that are present in the logs at the time of the attack, and absent in secure condition of the system.

Keywords: security monitoring system, distributed computing system, computer intelligence.

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RESEARCH AND DEVELOPMENT OF SYNTHESIS TECHNOLOGIES OF TRANSPORT ENTERPRISE MULTI-CONTROL NEURAL NETWORK ALGORITHMS

page 46–51

Currently, the problem of designing automatic control systems of dynamically variable objects is characterized by the transition from adaptive management paradigm to intelligent control paradigm. This is caused by continuous complication of objects and conditions of their operation, the advent of new classes of computing devices (distributed computing), high-performance telecommunication channels, and a sharp increase in the requirements for reliability and efficiency of control processes in a significant priori and posteriori uncertainty. Accounting for these factors is possible only through the transition from «hard» algorithms of parametric and structural adaptation to the anthropomorphic principle of forming control.

Given the characteristics of the modern enterprise, when the head and structural units quickly make decisions and monitor its implementation, it comes very clearly understand the need of artificial intelligence as an assistant in the work of transport enterprise. However, existing methods are outdated and not fully perform the role of assistant. The latest trends in this matter are modern methods of creating intelligent systems that can learn in the process, based on neural networks.

The paper proposed synthesis technologies of transport enterprise neural network algorithms. Better use of major resources of the enterprise is possible through the use of self-learning neural networks to control transport enterprise. Using a synthesis of known algorithms may be more correct setup of the whole system and increase the speed of information processing and decision of optimal solution.

Keywords: intelligent system, dynamically variable objects, transport enterprises.

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METHOD MODIFICATION FOR MONITORING THE SCOPE OF DEVELOPMENT PROJECT OF COMPLEX TECHNICAL SYSTEM

page 51–59

The method for monitoring the scope of development project of complex technical system was modified. This method can be used for the interim quality evaluation and financial justification of the result at all stages of development.

The current monitoring methods were analyzed and it was concluded about the need to provide more information on the technical implementation of the project.

The method of earned value got a further development for analysis of the data for the hypotheses and verified solutions offered by designers and technologists in various stages of development of complex technical systems.

The system of inequalities for monitoring indicators of quality of the project content is proposed. This system of equations was taken into account peculiarities of the creation of complex technical systems: quality of these projects is determined by the result — a project product; costs are compensated during the operational phase; payback time shall be compared with the technical resource of project product; resources of the organization should be enough for the project realization.

Experimental data of using this method in a scientific research institute of physical modeling problems were obtained. Using a modified method reduced development time up to 21 %.

Keywords: earned value method, complex technical system, project product's quality.

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DEVELOPMENT OF METHODS FOR SEPARATION OF BINARIZED FRAGMENTS OF ETCHING PITS OF SEMICONDUCTOR WAFER

page 60–68

The article is devoted to the search of successful methods for separation of fragments belonging to the supposed etching pits of dislocation loops.

The developed methods are revealed binarized fragments of etching pits among of the many other elements of surface image of a semiconductor wafer.

The filtration method of binarized fragments of etching pits of wafer dislocation uses a roundness index of the specified range, received on the base of reference line width of dislocation loop at a ratio of 1:4. This optional feature allows separating fragments similar to lines of loops of etching pits on the basis of their size and shape.

The method of removing the micro-defects loops reduces the number of fragments by eliminating of loops without signs of loops of etching pits. It is based on the use of the XOR subtraction operation between the binarized image of dislocation areas and the image with accentuated loops of the fragments.

The criteria for allocation of the main significant loop fragments allow form the selection rules for the further processing of binarized image.

The criteria for allocation of the main significant loop fragments, method of binarized fragments filtering, method of removing the loops of micro-defects of the semiconductor wafer are the part of a package of measures to carry out tasks on production management organization and creation of technical diagnostic system of output production quality.

Keywords: etching pits, dislocation, loop fragments, gallium arsenide, digital image.

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ENERGY, ENERGY-SAVING TECHNOLOGIES AND EQUIPMENT

RESEARCH ON DEMAND SIDE MANAGEMENT PROGRAMS AND ANALYSIS OF THEIR USAGE EFFICIENCY

page 69–73

Modern trends in Smart Grid systems aimed on intellectualization of existing electricity supply networks, energy supply and creating local Microgrid systems ensure a high level of reliability and power quality. As part of the Smart Grid concept demand side management applications play an important role in solving technical and technological problems arising in the practical implementation of this concept. The network must implement a catena of demand side management programs by providing various services according to the situation, requirement contracts, forecasting of consumption/demand and collect information about energy savings.

An important need in demand side management programs implementation is an adequate indicator for actual power consumption to relatively optimal, as a variant of this indicator should be used an indicator based on Frieze power, as it takes place on uneven terms of processes even in the absence of reactive elements in the network.

The concept of Frieze power $Q_Ф$ for the grid period is distributed, which helped to get value for optimal assessment processes taking into account voltage and current deviations and ripple coefficients. Variant of usage of $Q_Ф/U_1^2I_1^2$ indicator is an illustration of the real power consumption to optimal, because it takes place even in absence of reactive elements in grid.

Keywords: Smart Grid, demand side management, peak load, power, energy efficiency, Frieze power.

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The efficiency of the heat pipes (HP) is largely dependent on the characteristics of capillary structures (CS) used therein. Due to the composite materials developed in Institute for Problems in Materials Science (IPMS) of NAS of Ukraine, which were used as the CS, Ukrainian heat pipes with high hydrodynamic and thermal characteristics were developed. The aim of the experimental work of the authors was the comparison of thermal characteristics of heat pipes that are based on composite porous structures with similar HP characteristics with fiber porous structures (which are considered to be the most effective view of insert HP). The results showed that HP with composite CS provides better thermal characteristics, especially when the heating of pipes was from the top, and cooling — from the bottom. In this position, a composite HP with CS steadily functioned under heat load up to 25 watts, whereas HP with fiber CS stopped stable operation at a load of 15 watts. As with the horizontal and vertical arrangement of the pipe (at «below» heat input), the value of thermal resistance (R [K/W]) for pipes with composite CS did not exceed values R that are typical for HP with fiber porous structures. Thus, thanks to the authors, it was found that the new composite structure is more appropriate to use when placing the HP at an angle to the «upper» heat supply than fiber HP.

Keywords: heat pipes, capillary structure, composite porous material, fiber porous materials.

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