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P.O. Box 38, Odessa, 65001Ukraine

Telephone: +380667901205

e-mail: orgcom@sworld.com.ua

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J11307-157

Goloskokov K., Goloskokova N.K., Chirkova M.J.

**TECHNOLOGY OF FORECASTING OF THE TECHNICAL
CONDITION OF INFORMATION SYSTEMS**

St.-Petersburg State Engineering-economic University, St.-Petersburg

In article questions of application of methods of mathematical programming to forecasting a technical condition of complex systems are considered.

Keywords: reliability, forecasting, a technical condition, information system.

Introduction.

The problems of forecasting the technical status of the products attract more attention of specialists in the various branches of engineering. This is due to the fact that in connection with an increasing role of the automatic and automated systems increases the value of foresight of their condition. Without foresight it is impossible to manage the state of the system cannot be timely prevent emergency situations. In the paper the method of analytical forecasting of multidimensional processes on the basis of the recognition of images with the use of mathematical programming. The task of clear separation of the two classes for training sample is this: there are two sets of vectors x_1, \dots, x_m and y_1, \dots, y_m . It is known beforehand that x_i refers to the first class, and y_i - to the second. You want to build a decisive rule, that is to define such a function $f(x)$ that if $f(x) > 0$ the vector x refers to the first class, and if $f(x) < 0$ for the second.

Coordinates classified vectors represent the values of certain attributes (properties) of the investigated objects.

This problem arises in many cases: when determining the failures of products of electronic equipment by indirect signs, with the recognition of images and signals, etc. Strictly speaking, are classified not vectors properties, and objects that possess these properties. This observation is important in those cases where there are difficulties with the construction of the decisive rule - for example, when there are belonging to different classes of objects that have similar symptoms. In these cases,

there are several possible solutions:

- 1) look for additional signs, allow separate classes;
- 2) reconciled to the inevitability of mistakes, designate for each type of error of his fine (c_{12} - fine for what object of the first class assigned to the second, c_{21} - for the fact that the object of the second class is assigned to the first) and build dividing rule so as to minimize the the mathematical expectation of the penalty;
- 3) go to a blurring of the classes is to build a so-called "membership function of" $f_1(x)$ and $f_2(x)$ $f_i(x)$ assesses the degree of certainty in the allocation of the object to the i -th class ($i=1,2$), for one and the same x can be like that and $f_1(x) > 0, f_2(x) > 0$.

Linear separation of classes and the α consists in constructing a linear decisive rule that is a vector α (called threshold), that if (x, α) number of > 0 x belongs to the first α class, and if $(x, \alpha) < 0$ - to the second.

The search for such a decision rule can be considered as the division of classes in the projection on the line. specifies the direct, on which orthogonally projected all points, and α Vector 0 point on the line that separates the first class of a α the number of second.

Theoretical aspects of the determination of efficiency of methods of linear programming.

In the methods of analytical and probabilistic forecasting extrapolation of functions of time laid down in an explicit form. If the control is only possible in a limited time frame or in a separate temporary cross-section, then in the beginning of tests there are no preconditions for extrapolation using examined in the first Chapter of mathematical expressions. This is due to insufficient amount of information that can be obtained in the initial period of the testing facilities of electronic equipment. The earlier statement of a task of forecasting by using the statistical classification implies that k parameters ξ_s ,

$$s = 1, 2, \dots, k..$$

characterizing the state of the system, will have the same set of for systems with equal supply of efficiency. In other words, a group of objects, having the same

level of durability, will be different from the objects that are not included in this group, vector, or the function of the state, which describes the coordinates of the parameters, $s = 1, 2, \dots, k$.

In such cases, the elements of the extrapolation methods are formed in the forecasting on the basis of statistical classification of the stable relationships, which arise between classes related reserves of efficiency and cross-section. The process of the statutes of the extrapolation relations is carried out on the basis of a priori information and called a learning process relations. In forecasting the results of the current control of detection and recognition of extrapolation relations is carried out on the basis of a priori information with the help of one or another mathematical model.

Thus, out of the total of the circle are solved by the statistical classification of issues it is necessary to allocate two basic: a quantitative assessment of learning relations and formation of optimal model of recognition.

Let us assume that at the stage of the training on the a priori known information database established and describes the state classes, where class of States characterized by a group of objects with identical degree of efficiency or the same service life.

It is necessary to build between classes hypersurface of $F(\cdot)$, which would, for once again controlled by the examinees the objects of the decision (for $L = 2$):

$$\text{if } F(\vec{A}, \vec{x}) \geq B \text{ then } : \vec{x} \in R_1(x)$$

$$\text{if } F(\vec{A}, \vec{x}) < B, \text{ then } \vec{x} \in R_2(x),$$

where B is the value of the threshold that separates classes. Separating the function, furnished linear combination of the component can be written in the following form:

$$f(\vec{x}) = Ax - B,$$

Where- B a threshold value;

A - is called the weight vector

In the basis of the linear classifier for the two classes put the following decision rule:

- make a decision ω_1 , if $f(\vec{x}) \geq 0$;
- make a decision ω_2 if $f(\vec{x}) < 0$.

Thus attributed \vec{x} to ω_1 , if the scalar product exceeds $\vec{A}^t \vec{x}$ a threshold b .

The equation $f(\vec{x}) = 0$ of a surface of decisions that separates the points corresponding to the decision ω_1 , from the points of the respective decision ω_2 .

When the function $f(\vec{x})$ is linear, the surface seems to be a hyperplane.

If \vec{x}_1 , and \vec{x}_2 belong to the surface of the solutions, the true expression:

$$\vec{A}^t \vec{x}_1 - b = \vec{A}^t \vec{x}_2 - b;$$

$$\vec{A}^t (\vec{x}_1 - \vec{x}_2) = 0;$$

So \vec{A} - there are normal to any vector lies in the hyperplane. In the General case of a hyperplane H divides the space of features two half-spaces:

- the area of efficiency R_1 , to ω_1 ;
- region efficiency R_2 , for ω_2 .

Linear separating the function $f(\vec{x})$ can be written in the following form:

$$f(\vec{x}) = \sum_{j=1}^k a_j x_j - b,$$

Where the coefficients a_j are the components \vec{A} . Adding to the equation member containing the product of the two components of the vector \vec{x} , we obtain the quadratic separating function:

$$f(\vec{x}) = b - \sum_{j=1}^k a_j x_j + \sum_{j=1}^k \sum_{j=1}^k a_{jj} x_j x_j.$$

Such thus, in the quadratic formula separating functions include $k(k+1)/2$ additional

factor, it allows to obtain more complex dividing surface. Dividing the surface is a surface of the second order.

Continuing to introduce additional members, such as, $a_{j_1 j_2 \dots j_m} x_{j_1} x_{j_2} \dots x_{j_m}$ etc., you can obtain a number of polynomial sharing functions.

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J11307-158

Reliability of Distributed Computer System Akhmetov Bekturgan

Kazakh national technical university named K.I. Satpaev Almaty, Kazakhstan

Development and improvement of distributed computer systems (DCS) is one of the general trends in nowadays' computer science and information processing.

The core of such systems is a set of processor's modules (PM), carrying out a parallel processing of the information and cooperating by means of any subsystem of communication.

Keywords: distributed computer systems (DCS), processor's modules (PM).

Introduction

As a rule, modern information and operating systems concern DCS.

Today they became the integral component of responsible technical complexes:

it's impossible to operate without such a system, its subitaneous trapping leads to a full stop of operated object at the best (frequently at the big material losses), and to failures with catastrophic consequences at worst.

The requirement of extremely high reliability of distributed computer systems that is a part of such technical complexes (technological installations, power supply systems, communication systems and transport, aerospace systems, etc.), is obvious, but not easily achievable.

The chain of severe accidents proceeds, despite of continuous improvement of quality and reliability of components of distributed computer systems (DCS), even at their careful selection for applications [1-3].

It means that as a result of extremely rapid growth of complexity of DCS, an increase of reliability of the integrated circuit can't solve completely a problem of their reliability if the structure of RVS is that a unique element is detected all system does not operate.

So, it is supposed that attempts to "close" a reliability problem, based on a technological progress, is not possible. It is obvious that to solve a problem of reliability of the real difficult systems without mentioning their structure and the organization of operations is impossible.

The decision of this problem lies on a way of creation of failure-safe systems, i.e. the systems are capable to carry out the functions, and it is possible with admissible loss of quality, at refusals of certain number of elements.

In this direction (certainly, at the account of achievements of technology system of large information systems), all basic researches and elaborating in the field of creation of highly reliable systems are conducted.

It is important to notice that the leading foreign companies that create responsible operating and information systems pay a paramount attention to a fault tolerance problem

Certainly, there are traditional methods of construction failure-safe (distributed or not distributed) computing systems in practice.

These methods take an important and strong place both in practice and in the new advanced projects which have emerged and developed for all time of existence of computer facilities and programming.

Among traditional methods there are the following:

- Various kinds of reservation.
- N -modular redundancy with voting.
- Duplication of processor modules with comparison of results, etc.

These methods are improved and developed at present. However, in the pure state they don't take into account distribution of structure of the modern DCS that contain a "natural" hardware and a time redundancy which can be used for fault tolerance maintenance.

In consequence of at high requirements to reliability of DCS an application of these methods leads to excessive redundancy and the big additional expenses, and often doesn't allow to reach the requirements of reliability at a set of cost, hardware, weight -dimensional, technological and other restrictions.

This circumstance stimulates development of such approaches to construction failure-safe of DCS which consider their structural and functional distribution and allow using the natural superfluous resources which are a consequence of a distribution.

It is reached by flexible change of a structure of DCS at its processor modulus cutoff. The purpose of this structure is to block of the refused processor modules and redistribution of objectives between not refused processor modules.

An admissibility of functioning of DCS with the indicators of quality worsened in the prescribed limits ("gradual degradation") is taking into account.

Sufficiently large quantity of researches is executed and a number of practical workings out are created in this direction.

However, the integral concept of failure-safe of DCS on the basis of these properties has started only last years. Models and methods of rational (i.e. optimized) redistributions of problems at processor modulus cutoff occupy an important place.

In the given work the followings are done:

- The basic categories of the fault tolerance of DCS are systematized.
- Fundamentals of the concept of construction failure-safe of DCS on the basis of rational redistribution of problems and reconfiguration of system structures at the account of an admissibility of its gradual degradation are considered.
 - A number of the methods developed within the limits of given concepts of construction failure-safe of DCS;
 - Possible variants of an estimation of reliability are resulted by a method of imitating modeling and their comparison;
 - The choice of the most perspective variants for realization is stipulated.

1. Reliability evaluation of DCS using simulation modeling

Simulation modeling is used intensively in DCS design stage for the following tasks:

- prediction the performance of the system followed by analysis of its structure;
- the development and debugging of distributed programs on a detailed model of the equipment;
- verification of logical properties of parallel algorithms on the basis of the same description of the system;
- optimization of the DCS structure on a given criterion;

Since, as seen at the design stage model is created that takes into account the structure of developed DCS, as well as hardware and software components of the system, then there is the idea of using this simulation model to assess the reliability of the DCS.

The main stages of a simulation experiment:

- A description of the model;
- Run the model (simulation);
- Analysis and interpretation of experimental results.
- We estimate the necessary changes to the scheme of simulation experiments to assess the reliability at each stage.

For further consideration we should distinguish between two possible options of initial data on the reliability of the system components:

- Absence of reliability characteristics of some components;
- Full availability of DCS components' reliability characteristics.

It should be noted that at the stage of designing the first situation occurs quite often. This happens because the hardware components of DCS at the design stage may not yet exist.

If at the second case we can develop the existing methods for assessing the reliability, at the first it is necessary to use an entirely new methods. The possible approaches are shown at Figure 1 and described below.

1.1 FAULT INJECTION METHODS

As one of the methods of solving the problem of reliability evaluation in case of absence of certain components' characteristics it is proposed to adapt a method of Fault Injection. The point of fault injection methods is to conduct a special test of software and hardware part of the DCS. This testing is performed by faults injection in the software or hardware parts of the system, followed by consideration of the ability or inability of the system to detect and eliminate this failure. In fact, in this way we test the effectiveness of fault tolerance mechanisms used in the system. This approach was used to study the reliability of Ericsson's telephone networks.

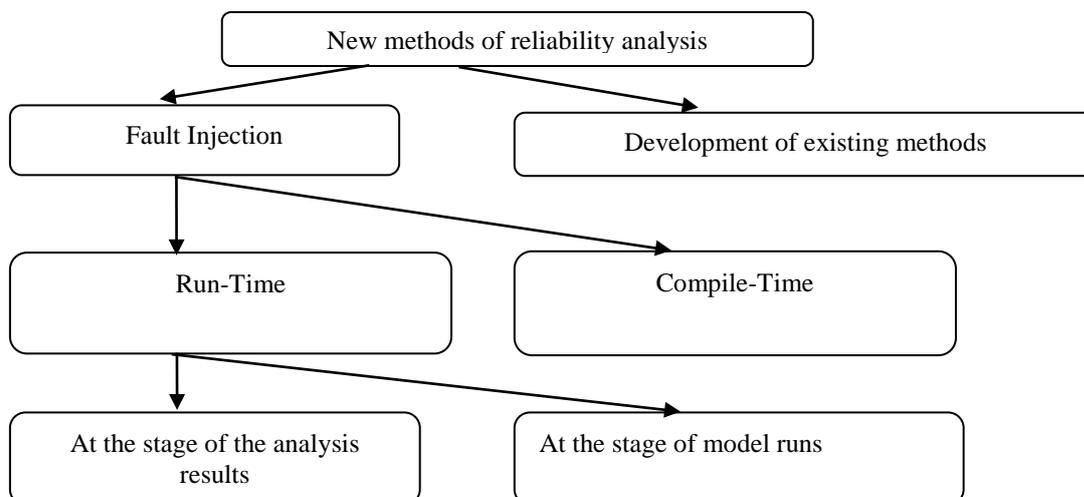


Figure 1. Suggested approaches for reliability analysis

Fault injection methods can be divided into the two groups of Run-time and Compile – time. In the methods of compile-time failure is injected directly into the description of the system, and at the methods of run-time in the system during its operation. These methods are actually used to assess the reliability of full-scale software and hardware, let's consider the possibility of using these methods for models of software and hardware. Adapted methods of failure injection must meet the following requirements. First, the initial model to assess the reliability must change minimally, and secondly, the reliability characteristics obtained in the simulation, should give a smaller error compared to the actual values than in existing methods.

In applying compile – time method for the problem of assessing DCS reliability there will be need to inject changes to the model at the stage of model description. These changes depending on the type of failure should be entered either into the description of the equipment in the simulation model, or in a description of applied load. This method is labor intensive in terms of writing code and the subsequent compilations and model runs. Also, while using this method when you change the structure of the model you have to rewrite that part, which models the system reliability.

In applying run-time method for the problem of assessing DCS reliability there will be need to inject changes either on the stage of model running or on the stage of simulation results analysis.

In applying changes on the stage of models running there will be need to significantly change of that part of the simulation environment, which is responsible for the simulation of described models. The main drawback of this method is that in case of necessity to test the stability of the system to a new type of failures you will have to remake “heart” of simulation modeling environment. The apparent advantage of this approach is that models that do not require evaluation of reliability, the availability of certain features in a simulation environment related to the assessment of reliability will not be noticeable and in the case of rewriting the model, in contrast

to the method of compile-time, will not need to rewrite the code associated with the assessment of reliability.

DCS failures injection on the stage of the analysis of simulation results in the first place means the implementation of changes to the route obtained after running the model. The method of analysis of simulation results is the least labor-intensive than other approaches discussed, but in such approach there is no feedback from the simulation, in the other words it is impossible to simulate the operation of the system during working of fault-tolerant algorithms.

Comparing these methods it can be seen that the method of compile – time is more accurate than the other two. This is due to the fact that in the method of introducing changes on the route analysis stage, as shown above, possibility of fault-tolerant algorithms using is not supported, and at the method of introducing changes at the models running stage known to the author the simulation environment does not support dynamic reconfiguration of the system being modeled.

1.2. DEVELOPMENT OF THE EXISTING METHODS

In the case when at least one of the common characteristics of the reliability of all hardware components is known, it is possible to evaluate not only the effectiveness of fault tolerance mechanisms, but also quantitatively calculate the reliability of the DCS.

Let's consider the possibility of using simulation in conjunction with the method calculating the reliability by the structural graph of the system hardware. In this case, the simulation allows you to collect data on the utilization of hardware components that are used to determine the weight with which to consider this or any other hardware in the calculation of reliability, and failure injection method refines the data load.

That is, initially allocated system resources, which are known for reliability characteristics. Then, a run of the model is performed, where the route is gathered. From the route information about utilization of resources is gathered. This information is used to calculate the reliability of a structural graph of the system.

Such a hybrid method for estimating reliability is more accurate than existing methods for estimating reliability. At the same time, a priori, it is rather difficult to compare it with proposed failure injection methods.

2. Comparison of the proposed methods with existing

Reliability of DCS depends on the reliability of its individual components, as well as on those taken in the design decisions.

These decisions include:

- the possible reservation of one or more devices;
- the ability to dynamically reconfigure the system;
- diagnostic testing during system operation;
- the use of fault-tolerant algorithms.

The last three types of design decisions require consideration of software's dynamics.

Despite a number of advantages, none of the existing evaluating reliability methods, does not support all possible design decisions for improving reliability. Thus it is supposed to use one of above methods for reliability research instead of traditional methods. Also one of the advantages of the proposed methods is to use a single mechanism for describing a computer system, as for the problem of reliability assessment, so for the tasks of evaluation the performance and logical analysis.

3. Conclusions and prospects

This paper presents the possible modern approaches to assessing the reliability of the DCS. The possible options for adapting of these approaches to assess the reliability of the DCS in the case of simulation of researched system are given. Advantages and disadvantages of proposed approaches are shown. Identified possible methods for implementation (the method of compile-time, the methods of failures injection, run-time and hybrid methods for assessing the reliability).

The author has partially implemented a hybrid method, which develops a method for calculating the reliability by system's structural graph and possible applicability of a distributed computing system to the problem of estimating the reliability is shown.

The following areas can be pointed as immediate prospects of development:

- mathematical formalization and rigorous justification of the correctness of the selected methods to assess reliability;
- software implementation of the selected methods within a framework of unified approach, at that, at first it is necessary to implement a hybrid method and the method of faults injection on the stage of results analysis, due to their lower laboriousness;
- comparison of results of evaluating the reliability regarding the proposed approaches with the results of existing methods and the real got results.

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J11307-159

Turgenev D.V.

MATHEMATICAL SIMULATION OF GEARLESS WINCH WITH INDUCTION TRACKING DRIVE

National Research Tomsk Polytechnic University,

Russia, 634050, Tomsk, Lenina st., 30

This article compares gear and gearless elevator drives, describes their advantages and disadvantages. The results of mathematical modeling are shown and appropriate conclusions are done.

Key words: low-speed induction motor, tracking drive, elevator

Elevator winches as a means of internal transport are used in passenger, freight and hospital elevators. Development of house building and increasing fleet of winches require improvement of the buildings internal transport based on modern science and technology.

Currently, most electrical elevator winches represented a structure consisting of a multi-speed squirrel cage induction motor, worm gear, braking system and relay-contactor control circuit. Electric drive with gearbox has the following disadvantages of technical and operational matters: the cost of purchase, installation and maintenance of the gearbox, over-capacity of installed motor because of the gearbox, rapid wear of brake system.

Improving quality characteristics of elevator winch is provided by using modern electric drives. Control with frequency converter ensures elimination of sufficient impacts at the beginning and at the end of the movement, accurate positioning of cargo or cabin on landing, eliminates the need of multi-speed motor usage and allows to install gearless drive. The benefits of the gearless drive include lack of gearbox, high operational comfort of the elevator, reduction of noise and vibrations.

Basic operating cycle of the hoisting mechanism based on a multi-speed induction motor consists of two stages: the first stage – the acceleration of the car to rated speed, and the second stage – transition to the reaching speed (by a sensor of prior stop) and stop (by a sensor of accurately stop), and brake overlap. This mode is also applicable for the gearless drive, but according to [1, 2], the transition to the reaching speed may be accompanied by the appearance of resonance phenomena in the mechanics of hoisting mechanism, which would lead to incorrect operation of the control system and mechanical damage, and also presence of range with reaching speed affects to the overall performance of the hoisting mechanism.

This article describes the mathematical modeling of the elevator gearless winch with induction motor.

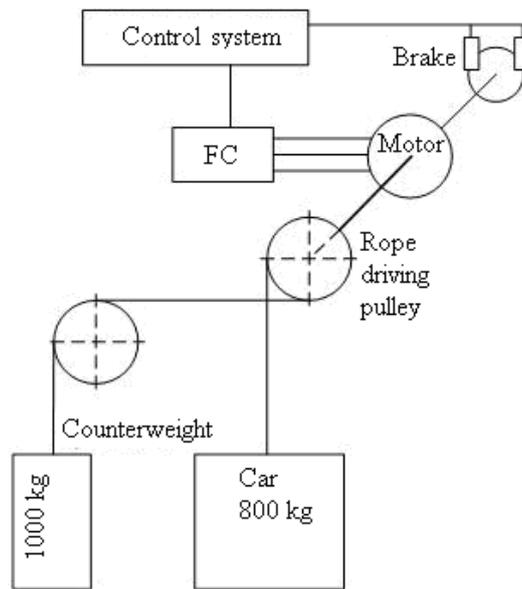


Fig. 1. Functional diagram of the gearless elevator winch

In Fig. 1 the functional diagram of gearless elevator winch is shown. Rope driving pulley is directly installed on the shaft of the low-speed induction motor (LSIM), thereby excluded gearbox.

In Fig. 2 the mathematical model of the gearless winch with induction tracking electric drive with vector control is shown, developed with the help of MATLAB (Simulink) software. Low-speed induction motor (LSIM), the mechanical part of the system and control system are developed as separate blocks.

LSIM block is based on the equations of induction motor in the stationary coordinate system.

The mechanical part of the system is a block diagram of a three-mass mechanical system: LSIM, car and counterweight inertia moments. The system takes into account the changing inertia moment of the car (empty or loaded), and variable natural frequencies of the car and counterweight during the motion.

Vector control with speed and position feedback is used to control the electric drive (fig. 2): PI_{ix} – current regulator for x-axis component; PI_{iy} – current regulator for y-axis component; PI_{ψ} – flux regulator; PI_{ω} – speed regulator; PL – position regulator (traveled distance); S-ramp – S-shaped ramp. Synthesis of the controller parameters is based on the principle of the closed-loop control.

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Kushnereva E.V., Markovski M.G., Guguchkina T.I.

**THE PROBLEM IDENTIFICATION NATURALLY SEMI-SWEET AND
NATURAL MEDIUM DRY WINES**

*SSI North Caucasus Zonal Research Institute of Horticulture and Viticulture
Agricultural (SSI SKZNIISiV RAAS) Krasnodar, str. 40 Years of Victory, 39*

This report deals with the formation of the chemical components of natural and semi-natural and semi-sweet wines, which can be used to identify them.

Keywords: wine, naturally semi-sweet, natural and semi-dry, the criteria of authenticity, GC, ash, alkalinity.

1. Relevance.

Technology of production of table wines with residual sugar production involves two schemes. The first scheme, the so-called classic, wine production involves partial fermentation of must or pulp. Fermentation must or mash hold up the residual sugar for 10-20 g/dm³ set up in the finished wine conditions. Fermentation stops or by cooling to -50 ° C, or by heating to 80 °C and then cooled. For wine production on the classical technology to use grapes with a high sugar content - over 22 g/100cm³.

Blending scheme provides for the production of fermentation of grape juice or pulp and dry blending with canned wort. [1]

Fundamental differences in the production technology of wines with residual sugar affects the formation of quality wines studied.

In connection with the above, the development of a system of identification of natural and semi-sweet, natural and semi-dry wines is an important and urgent task that can be achieved by establishing the criteria of authenticity and improving control.

2. Objects and methods.

The objects of research were selected wine materials tablespoons white and red harvest 2011. Obtained by the classical scheme of grape wines with residual sugar and blending scheme of production.

The content of the main components of the chemical composition of musts and wines were determined by the methods and GOST: GOST R 51653-2000 - the volume of ethyl alcohol, GOST 13192-73 - mass concentration of sugars, GOST R 51621-2000 - mass concentration of titratable acid, GOST R 51654-2000 - mass concentration of volatile acids, GOST R 51620-2000 - mass concentration of the above extract. Mass concentration of aromatic substances was determined by gas-liquid chromatography using a device "Crystal 2000M." Mass concentration of the ash was determined according to GOST R 53954-2010.

3. Results and discussion.

In the experimental conditions were obtained naturally semi-sweet, natural and semi-dry table wine and cooked blended method with the use of concentrated grape must. All the wine samples were subjected to physico-chemical and sensory analysis. Also in wines by gas mass spectrometry was established composition of volatile components. Research results obtained using the methods of mathematical planning and mathematical analysis of the experimental data showed that the mass concentration of the ash in the wine, cooked blended method varies from 2.1 to 2.9 g/dm³, while the wines with residual sugar - 1.5-2.0 g/dm³.

The composition of grape must is very complex and multicomponent. Concentration of must amino acids are included in it along with the sugars involved in the reactions and undergo transformation, increased density and viscosity.

It was revealed that the fermentation of grape must glycerol at a concentration in the finished wine ranges from 3 to 11 g/dm³. Using gas chromatography showed that in blended wines range of variation of the mass concentration of glycerol is 3,4-4,9 g/dm³, at the time, as wines produced stop fermentation, contain glycerin within 5,2-6,8 g/dm³. In addition, as a result of fermentation of grape juice into wine produced a number of volatile components, which form the flavor of wine. Studies indicate that the addition of grape must in table wine leads to the appearance in the volatile components of substances such as ethyl-2-furoate, 5 - hydroxymethylfurfural, furfural, and the ratio of these components - a constant and is 1:3:6 . In wines with residual sugar, cooked stop fermentation, identified furfural and ethyl-2-furoate in the ratio of 1:2.

Thus, the results of the research have established criteria for the authenticity of natural and semi-sweet (semi-dry) wines on the content of glycerol, the ratio of volatile components and ash.

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UDK 130.3: 004

J11307-161

K.S. Rushelyuk, I.G.Borisenko, A. K. Tolstikhin, V.V.Dergach
PROBLEMS OF EDUCATION IN RUSSIA. ANALYSIS OF
EDUCATION REFORM

*Institute of Education, Psychology and Sociology of the Siberian Federal
University, Krasnoyarsk, Svobodny 76*

The article deals with the negative impact of the reform of education, including middle and high school. Research shows students' abilities in terms of orientation in the information space are the possible ways to address not the ability to use information based on educational, scientific literature and the Internet.

Keywords: education, school, student, teacher, reform, information, unified state exam.

One of the important problems facing any civilized society - improving knowledge for all its layers. Nor any reform in any area of the state is not possible without the highly educated people involved in them.

However, with the introduction of reforms - Unified State Examination (USE), the Bologna process (BP) in Russia, there was a sharp decrease in the level of education.

At the present stage of education is under the watchful eye of the Ministry of Education. All sorts of disciplines, themselves disciplines that students learn, are determined by officials from the Ministry of Education. To quote Hesse: "From being the university as a center of scientific knowledge, freely explores and teaches the truth, the natural outcome of his government and samopopolnenie. Indeed, nothing is more contrary to the idea of the university as a system of bureaucratic control and custody of the state "[3, p. 322].

Analyzing several curriculum developed at the Institute on the basis of ministerial programs, Siberian Federal University, the enlarged group, 150,000 "Metallurgy, machinery and metal" and adding up the total number of hours, it appears that more than half discharged discipline that has general educational nature, not related to specialty. For example, the study of the Russian language (it is in the higher-education), valeology, culture, the curriculum is given the same number of hours as a discipline to study descriptive geometry and engineering graphics, the basis of the engineering education, which forms the basic knowledge necessary for the study of special subjects [2]. For specialty 151600.62 Applied Mechanics (qualification (degree of "Bachelor")), students need to learn in one semester subjects: descriptive geometry, technical drawing and computer graphics. And it is for mechanics, for which drawings are the main "writing" by which communicate engineers and workers. Note that in most secondary schools drawing abolished and a BA (not a secret that the bachelors take those who could not go to the specialist or master) does not guarantee a high stock of knowledge. Indeed, in the present, about

80% go to technical college, unfortunately, did not learn in school drawing, are not fluent in geometry, do not have a spatial representation, are not able to organize independent work. [1] The question is, can we really, for 54 hours normally learn three subjects that are necessary to examine not only the technical disciplines, but also special? The conclusion - with this approach, we can not get highly educated engineers, that is, in our opinion: the universality leads to loss of a particular specialist, an engineer in the traditional sense of the term, which, in this case, hardly realizes itself in another area ie unlikely to be a universal specialist. [2]

These reforms are intended (according to the Minister of Education) on the creation of a civilized consumer. Hence the purchase of weapons abroad. Purchase of French helicopter "Mistral" was motivated by the desire to acquire the technology of their production, which indicates that the state does not want to invest in the development of advanced manufacturing technologies weapons.

The main problem of higher education - a low level of knowledge of students and it is not associated with low levels of education of secondary school teachers. The main problem - USE. Perhaps one should not dwell on the fact that most of the balls, students receive in the first part of the exam, which is not in any way does not measure knowledge of schoolchildren. Here, you can guess the answer [4], or remember the answers. All this does not allow the development of the ability to analyze, to reason, to think abstractly, use language to represent and understand all of what we call mental intelligence (IQ). In addition, if prior to the exam, for admission to the university needed two months to prepare for the exam, thus significantly increase the level of knowledge, after the reform - within two months of waiting for the results entrant distribution in various universities of the country of their documents and manages to forget , what is taught in school.

The school requires highly educated teachers. Where to get and how to train them, if pedagogical universities accept students who have received the CSE 26 points? Low wages in the education sector are not attracted to the work of the most talented young people. Moreover, the trend in high school fooling grows. Cancellation required for further activity of subjects (astronomy, drawing, etc.), or

communication to the secondary status, in particular the literature [10], in high school difficult to get a well-trained workforce. It seems that education reform is to reduce the cost of education. At the same time, most children receive secondary education reformers in the elite schools, and higher - abroad and remain there to work and live. And of course, what happens in schools, universities officer knows only by the numbers of reports. Thus, the money is invested not in national education, and overseas, leading to a threat to national security.

Puzzling desire to oust the Ministry of experienced teachers and replace them with young inexperienced. Officials believe the less the average age at the university, the more effective training.

If, before the reform of the education training can be found on the training courses (FPK) out of work, now this system of training on the job, often in their own university. Also not included in the FPC incentive bonuses. It was out of work and in the leading universities of the country allows in fact improve the skills of the teacher. Here we have the ability to communicate with many teachers of the country, to enrich teaching material. Due to the fact that most of the leading universities in Moscow, St. Petersburg, the significance was not least raising the cultural level of the teacher is part of the intellectual level required for a teacher.

A few words about the internship. The lack of plants does not allow to pass probation. Hence the need to pass them to other cities. However, this is not possible, since in most cases the training on the job and are not paid. Young teachers make do with textbooks, scientific literature, the Internet, not knowing the practical side of his subject. Veterans departments (working in production) are not interested in raising a young teacher by stimulating supplements. So, if we talk about the activities of the Ministry of Education, we can say the following, "A big part of what we call management consists in creating difficulties preventing people to work" [6, p.91].

It should be noted that the younger students practically developed "self-knowledge, self-awareness, social sensitivity, empathy and the ability to communicate effectively with each other. This sense of timeliness and social relevance, as well as the courage to admit weakness, to express and to respect

different opinions "[7, p. 68]. Note that these qualities in the future are the most important for successful communication students.

This article discusses the research to address some of the above disadvantages. A partial solution to these problems are presented in [9] for a discussion on issues related to the methodological support and the organization of training.

The first lesson the student is issued a work plan for a semester [8] which states that a student can decide how to carry out this plan - early or yourself using the information field, not waiting to be considered or that topic in lectures and practical classes. As a result, in the first semester early to take an examination of descriptive geometry at 5%. Which indicates that the student is able to independently solve problems using information from books, the Internet. In the second semester of prematurely passed the credit increases to 30%. Student has already learned to find the necessary information. Moreover, these students normally learn not only the subject, but, as a rule, on the other. He knows how to use the information and turn it into knowledge.

Thus, on the basis of the above, we can draw the following conclusions are disappointing.

First, the current state of education is deteriorating dramatically through no fault of teachers, as a result of reforms, namely:

- Problems with the number of educational subjects, with their content and volume of training programs to show "distortions" in the curriculum developed for the new educational standards [2];

- The introduction of CT and BP leads to "mental debilitation" of society, the members of which are easier to manipulate the ruling elite and the most dangerous, destructive elements. In the end, we can say that the corrupt state, is not interested in improving the mental level of its citizens.

Second, most of the younger students are not able to navigate in the information field.

To overcome these shortcomings requires individual work with the student, which allows the teacher to find out the actual level of knowledge (and not

"egeshny") and, at the same time to teach him how to use the educational and scientific literature, that is, to navigate in the information space, which is the main and most important component of education [5].

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J11307-162

Machekhina D. V.

**MODERN INFORMATION TECHNOLOGIES IN GRAPHIC
DISCIPLINES STUDY ON THE EXAMPLE TOPICS "SKETCHING"**

*Polytechnic Institute of the Siberian Federal University Krasnoyarsk,
st. Kirenskogo, 26*

This article discusses the use of modern information technologies in the educational process, exemplified by frame breakdown of the material.

Keywords: sketching, electronic slides, multimedia software lectures by frame breakdown of the material.

We live in an era of rapid mutual penetration and rapid increase in the interaction of social, political, economic, cultural and ideological spheres. Marked the beginning of the XXI century new scientific and technological transformations.

The present level of production, introduction of new technologies aimed at creating competitive products, as well as socio-political and economic transformation of Russia are placing greater demands on education and training, the approach of their training to the international level and competitiveness.

The institutions actively spread modern computer equipment and software, a growing number of teachers are needed the experience of information - all contribute to increased penetration of information technology in various areas of educational activities.

Descriptive geometry and engineering graphics are the basis of engineering education, forming the basic knowledge needed for further study of special subjects. Considering the problem of improving the quality of the training of descriptive

geometry, a general professional engineering disciplines, we can not exclude such important parts of the process as a creative activity and personal self-development. [2]

Prepare students for independent play more hours, which is made possible by computer technology, based on the ever-improving training facilities, partially replacing the teacher, who had previously belonged entirely to training function.

To address the challenges posed by modern society to higher education and considering the above issues at the Department of Descriptive Geometry (NMS) of the Siberian Federal University (SFU) is carried out and implementation of new forms of learning.

Psychological foundations of man are such that a full perception of the material to make the most of the senses, making depends completeness learning. Maximum amount of information one receives through your eyes. On this basis, it can be concluded that the more clearly presented the material, the greater the volume of the acquired information.

One of the most important means of teaching graphic disciplines, recently obtained the highest recognition from teachers and students, is the use of modern information technology is the most effective of these is the use of three-dimensional computer graphics, animation and slides. This video series is built around the text of the lecture, as his comment.

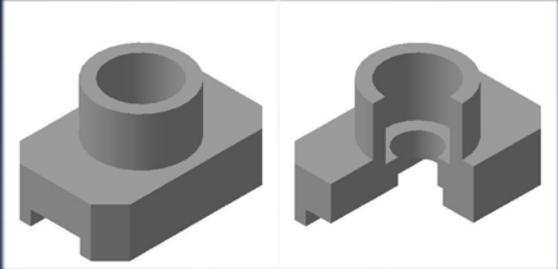
Multimedia software lectures not only provides an opportunity to diversify the illustrative material, but, thanks to the use of new technologies, allowing students to present and understand complex theoretical material. Lectures are more diverse, causing an increased interest in the audience, which generates increasing cognitive activity of students. The use of animation and electronic slides enhances students' awareness of the various display of spatial objects in the plane, the development of spatial thinking and raise the level of assimilation of the material. [1]

The use of modern computer technology provides a great opportunity to both teachers and students can address a range of problems, such as the release time of the teacher, the implementation of the individual approach, the promotion of independent

and creative work of the student support team work. With the help of the computer activates the students' work with the material, increasing their activity, and develop creative skills. [3]

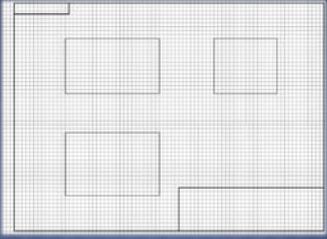
Effective use of electronic slides with frame breakdown of the material to be to convey to the students, clearly shown in the performance of practical classroom work on "sketching details."

The preparatory phase



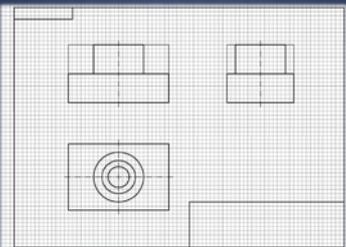
At the preparatory stage, you need to carefully inspect the item, to understand its structure, function, technology manufacturing.

The main stage
Markup format Bounding Box



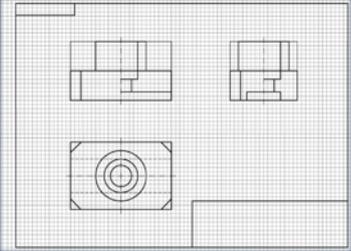
After selecting the format size, causing the inner frame and place scheduled for the title block. About selecting the scale, they needed to identify placement of the drawing with a bounding box so that the image was evenly distributed in the format.

Imaging of species within a bounding box

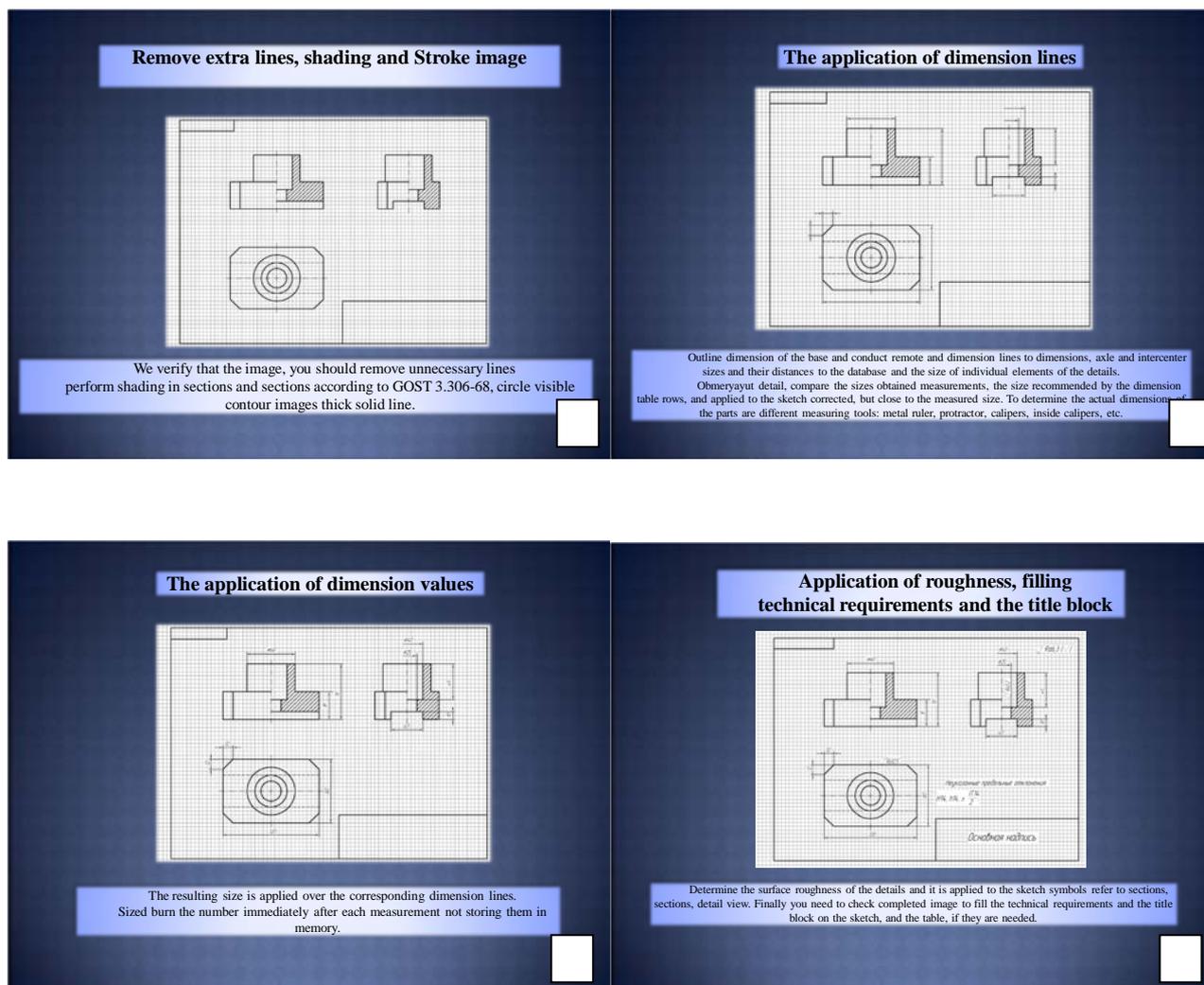


Build an image of pre-causing axial and center line, if necessary.

Imaging the inner surfaces of parts



Selected sections are drawn and cross sections.



Drawing 1 "Sketching details with frame breakdown of the material"

By frame breakdown of the material with a brief explanation of each frame can more clearly and intelligibly show students staged a quest to select the size of the paper and the choice of the optimal number of species to finalize the sketch.

Thus, the use in practical classes thematic presentations, slides, which differs from traditional methods of teaching clarity, improved performance of students has significantly decreased during the time period. Overall performance in the groups where teachers use modern techniques and technical training is significantly increased.

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Tuch V.V.

THREE-DIMENSIONAL MODEL OPERATION IN STUDYING OF ENGINEERING GRAPHICS

Polytechnical institute of the Siberian federal university,

In article innovative technologies in the organization of educational process are considered when teaching engineering graphics. The author focuses attention to roles of model operation of three-dimensional objects in development of technical creativity of students promoting deepening of fundamental knowledge.

Key words: *innovative technologies, three-dimensional model operation, computer graphics, engineering graphics*

Problem solving on creation of new technique, development of the modern high technologies, the organization of production and operation of the modern objects demands a high level of professionalism of the modern engineer. Quality of graphic preparation of the expert is estimated by ability to embody technical idea in graphic images (drawings), after all graphic activity is inseparable from design work of designers at all its stages.

In educational process of technical colleges there is an introduction of new efficient computer technologies of three-dimensional model operation when studying a course of the engineering graphics, the developed traditions demanding judgment, i.e. introduction of elements of associative projection of the simplified designs without calculations, by analogy to substantial products.

Computer technologies and three-dimensional graphics develops space imagination, ability to fix in drawings a design embodiment of idea, promote development of technical creativity. Three-dimensional model operation is the most visual, precise and complete source of information on object with which use design documentation can be created and issued.

Development of informational technologies constantly make new demands to the modern design engineer. Informational technologies cardinally changed constructioning principles literally for the last decade: process of development of products became more intensive; their reliability and accuracy considerably increased. Design activity became more attractive to youth. The automated was allocated in separate branch therefore the constructioning sphere thanks to high technologies became more efficient.

One of the primal problems, facing the modern teacher of graphics – creation of new efficient technologies of studying of a course of engineering graphics with an exit to concrete technical solutions. And, effectiveness of process of education directly depends not only on professional level of the teacher, his ability to master an innovation [1].

Introduction in educational process of a course of engineering graphics of tasks on implementation of drawings with use of elements of constructioning possess a number of advantages before traditional is the best visual representation of projected products, a split-hair accuracy of projection of the composite space objects, and also unlimited possibilities and ease in editing of three-dimensional model in the course of projection and at any stage. The established associative connection: product model – the drawing – documentation on a product, in education allows to correct a carried-out task at any stage. At modification of 3D-model, it is automatically displayed in other documents bound to this model – for example, the drawing and the specification. In this regard the considerable economy of time for projection is reached.

That experimental and research activity of students to make more attractive and efficient use in educational process of means of tutoring based on the modern

informational technologies is necessary. It is necessary to note that computer model operation is the productive tool, after all «constantly growing volume of knowledge offered students at decrease of clocks of auditory occupations demands optimization of time of educational process» [2].

In design work of students the considerable possibilities of model operation of three-dimensional objects among a COMPASS-3D, the most suitable for creation of three-dimensional solid-state computer models open. At the disposal of the modern to 3D-system there is a set of effective remedies of model operation which allow to create three-dimensional models of the composite details and assemblies. And the algorithm of projection often reproduces technological process of manufacture of a detail, knot or the mechanism [3].

Development of three-dimensional model – enough complex process which demands not only knowledge of computer programs and projection bases, and also a quick mind and extraordinary thinking. Huge value has a choice of a rational way of constructioning of a detail, as much as possible using possibilities of graphic programs. For this purpose it is necessary to develop and enter into educational process of a course of engineering graphics of a task on implementation of drawings with use of elements the constructionings developing these qualities at students. It is possible to carry a task to such tasks on implementation of the drawing «Gear cylindrical drive».

In the course of tutoring the modern student should: to know about the object, process, projection system; to understand the processing device; to be able to analyze initial information on object, process, system, environment; it is good to be guided in mathematical model operation, in methods of searching of the optimal decision, in the corresponding software of systems of an automated; loosely to own computer aids.

Use by students of computer tools increases their interest to a material, forms and deepens theoretical knowledge, promotes more productive educational process and does it to more technological. Realization of knowledge of creation of three-dimensional volume models of the composite form at performance of educational

tasks, the sequence, obviousness, availability and differentiation, will reveal in the subsequent researches in educational process [4] and further creative activity.

Possession of students of means of the computer graphics, put by it design skills, is obligatory with constructioning elements – a necessary condition for successful studying of express disciplines, to formation of creative thinking. That is provided by the concept of the higher education which leaves the common concept of professional education promoting deepening of fundamental knowledge.

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V. Vanin, V. Virchenko, S. Virchenko

***PROSPECTIVE ROLE OF COMPUTER COMBINATORIAL-VARIATIONAL
GEOMETRIC MODELING IN SCIENCE, INDUSTRY AND EDUCATION***

National Technical University of Ukraine «Kyiv Polytechnic Institute»,

The paper presents and analyzes several aspects of the use of modern computer combinatorial-variational geometric modeling for the effective innovations in

science, industry and education. The main prospective tasks have been formulated for these knowledge areas.

Keywords: computer combinatorial-variational geometric modeling, education, industry, science.

Introduction

Structural-parametric approach, which is set out in the articles [1-3], is the scientific theoretical basis for computer combinatorial-variational geometric modeling. The publications [4-6] are the further improvement of this research direction. The developed techniques and their introduction to the science, production and education are discussed in this article.

Results

Science, production and education play a key role for the technological progress of human society. Computer engineering graphics is one of the foundations for the successful development of the outlining areas of life in the present.

Geometric data are essential for various simulation processes. These models are very visible. It allows simple ways to solve very complex scientific and technical problems. This feature has got the further development in connection with the modern increased capabilities of computer equipment.

New graphical information technologies provide flexible and high-performance options for creation different kinds of various technical objects. Combinatorial-variational geometric modeling is one of these scientific fields. This direction founded at the Department of Engineering and Computer Graphics of the National Technical University of Ukraine «Kyiv Polytechnic Institute».

The basic idea of the developed techniques of geometric modeling is to construct complex objects out of individual flexible universal graphic primitives, which are combined with each other the required combinatorial-variational dependencies. Demonstration examples are shown in fig. 1.

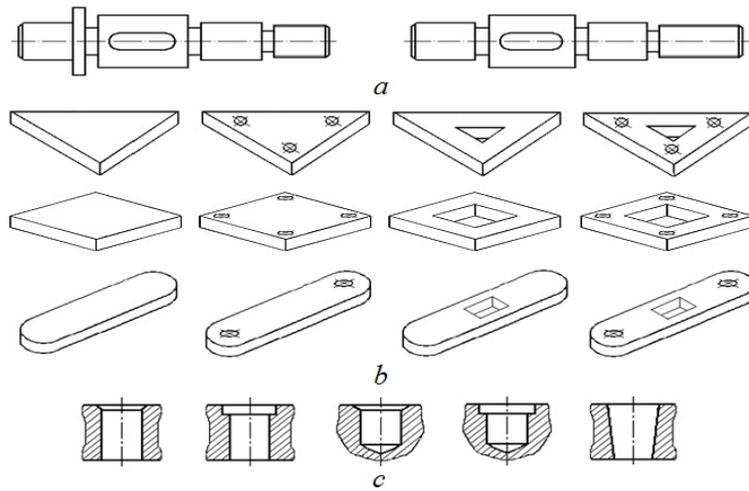


Fig. 1. Some typical mechanical industry parts and elements:
***a* - design modifications of the shaft; *b* - planar parts with triangular, rectangular and curved contour; *c* - types of holes**

The main difference of the proposed methodology to the traditional methods of parametric modeling in modern computer-aided design systems is that, for example, only three combinatorial-variational models (respectively in fig. 1,a; fig. 1,b and fig. 1,c) are used instead of separate models for each image in fig. 1.

New modular geometric modeling techniques are described below. This approach is useful for the construction of engineering objects.

Fig. 2 illustrates one of the possible universal geometric modules. These modules are combination of some surfaces (planes, cylindrical, conical, spherical, etc.) and certain lines that form a closed loop.

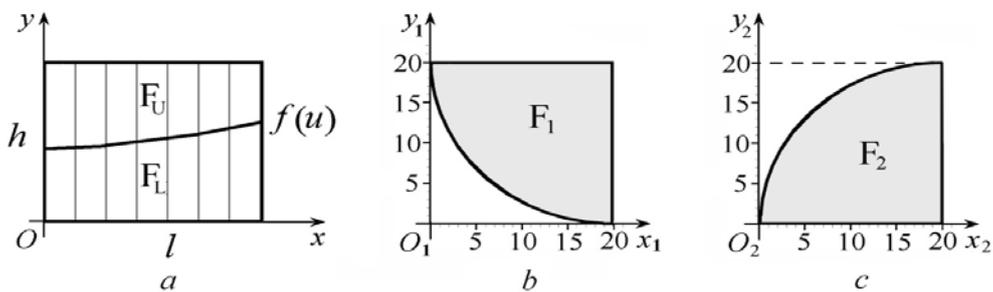


Fig. 2. Variant of universal combinatorial-variational geometric module for forming composite surfaces:
***a* - version of the structure; *b*, *c* - practical examples**

Combining the plane (fig. 2,a) with the external circuit in the form of a rectangle (length l and height h) and monotonous parametrical line $f(u)$, where u - the parameter, is analyzed below. Rectangle F is divided into two parts – F_U and F_L (accordingly the upper and lower in the Cartesian coordinate system Oxy).

The above methods are general in nature, because they apply by analogy to other variational combination of different surfaces and lines.

Examples of use as a parametric function $f(u)$ curves of the second order are shown in fig. 1,b and fig.1,c and described by following expression

$$f(u_i) = \frac{(1 - u_i)^2 \mathbf{r}_{0i} + w_i 2u_i(1 - u_i)\mathbf{r}_{1i} + u_i^2 \mathbf{r}_{2i}}{(1 - u_i)^2 + w_i 2u_i(1 - u_i) + u_i^2}, \quad (1)$$

where $i \in \{1, 2\}$ – number of curve; $\mathbf{r}_{01}=(0,20)$, $\mathbf{r}_{11}=(0,0)$, $\mathbf{r}_{21}=(20,0)$, $\mathbf{r}_{02}=(0,0)$, $\mathbf{r}_{12}=(0,20)$, $\mathbf{r}_{22}=(20,20)$ – radius-vectors of the control points; $w_i=\cos(90^\circ/2)$; $u_i \in [0, 1]$.

Equation (1) reproduces the two arcs of radius 20 with an angular size of 90 degrees. Limited plane areas F_1 and F_2 are defined by dependencies

$$F_1(x_1, y_1) = \begin{cases} x_1(u_1) = ((1 - u_1)^2 x_{01} + w_1 2u_1(1 - u_1)x_{11} + u_1^2 x_{21}) / w_1(u_1), \\ y_1(v_1) = v_1 h_1, \end{cases}$$

$$F_2(x_2, y_2) = \begin{cases} x_2(u_2) = ((1 - u_2)^2 x_{02} + w_2 2u_2(1 - u_2)x_{12} + u_2^2 x_{22}) / w_2(u_2), \\ y_2(v_2) = v_2 h_2, \end{cases} \quad (2)$$

where $i \in \{1, 2\}$ – number of area; $h_i=20$ – height of source rectangle; $u_i \in [0, 1]$, $v_1 \in [((1-u_1)^2 y_{01} + w_1 2u_1(1-u_1)y_{11} + u_1^2 y_{21}) / w_1(u_1) / h_1, 1]$, $v_2 \in [0, ((1-u_2)^2 y_{02} + w_2 2u_2(1-u_2)y_{12} + u_2^2 y_{22}) / w_2(u_2) / h_2]$ – parameters; $w_i(u_i) = (1-u_i)^2 + w_i 2u_i(1-u_i) + u_i^2$.

Process of forming the face for solid computer model of parts is shown in fig. 3. This face includes a set of figures (2), where $i \in \{1, \dots, n \in N\}$.

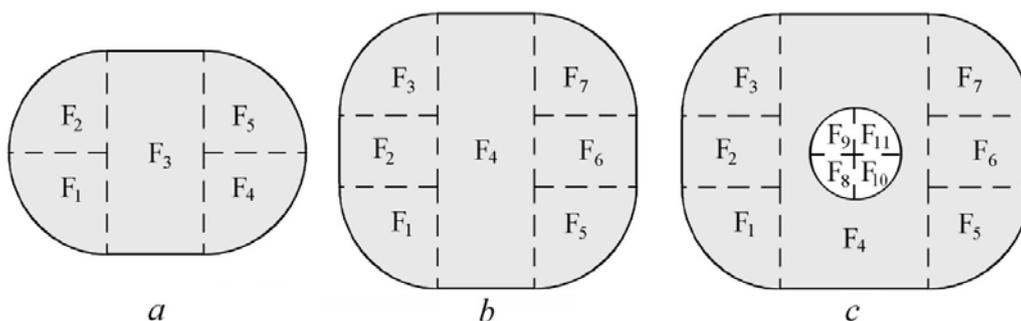


Fig. 3. Combinatorial-variational face for computer solid model of engineering parts:

***a* – source variant; *b* – intermediate version; *c* – final modification**

The side faces of parts (fig. 1, b), using the expression (1), are defined by the following equations

$$\mathbf{r}_i(u_i, v) = \mathbf{r}_i(u_i) + \mathbf{v}t,$$

where $i \in \{1, \dots, n \in N\}$ – number of side face, $r_i(u_i)$ – the initial profile curve, t – combining vector for horizontal planar bases of parts, $u_i \in [0, 1]$ and $v \in [0, 1]$ – parameters.

The inner circle (fig. 2,c) can become a quadrangle or a triangle by corresponding change of parameters in the expression (1).

Transformations of holes in points allow to get simply connected faces of modeled parts.

The described approach is used for lectures and practical lessons of computer engineering graphics, as well as course and degree works by students of NTUU "KPI".

Combinatorial-variational geometric modeling is the subject of further scientific research and implementation of the obtained results into production. The main tasks of computer combinatorial-variational geometric modeling are uniting a variety of other models of technical objects in a single system with purpose to its comprehensive optimization.

Conclusions

The material in this article allows us to formulate some of the most promising areas of modern development in the field of computer geometric modeling and basic tasks of their practical implementation in science, business and education.

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Prokopenko N.N., Krutchinsky S.G., Belich S.S.

**UHF CONTROLLED SELECTIVE AMPLIFIERS WITH LOW
IMPEDANCE DIFFERENTIAL INPUTS.**

*Laboratory of perspective technologies and processes of the Center of
researches of problems of safety of Russian Academy of Science and SRSUES*

*The method of construction of microwave selective amplifier (SA), which allows
for increasing Q -factor and voltage gain on the quasi-resonance frequency f_0 are
considered. The presented architecture SA for SiGe process technology has low
power consumption.*

Keywords: RC-filter, Q-factor, controlled selective amplifier, gain, frequency quasi-resonance f_0 .

In radio systems are now widely used integrated operational amplifiers (op amp) with special feedback elements that form the amplitude-frequency characteristic (AFC) of the resonance type. [1,2]. However, the classical construction of SA is accompanied by significant energy losses, which are mainly in the provision of static mode rather large number of secondary transistors forming the operational amplifier. The proposed architecture of SA can be used in devices AHF filtering radio cellular systems, satellite television, radar, etc. Q control response of the amplifier and the voltage amplification factor (K_0) for quasi-resonance frequency f_0 is implemented in the circuit in fig.1.

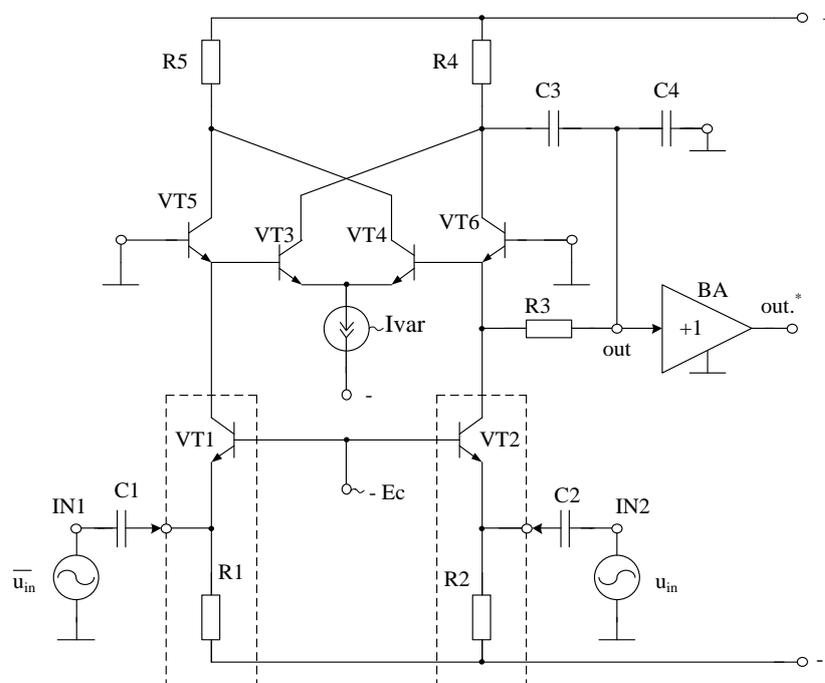


Fig. 1. Architecture controlled amplifier in the basis of the electoral process technology elements SG25H1.

Input source U_{in} changes in differentiating the input circuit (capacitor C2 and resistor R2) the emitter current of transistor VT2, and therefore, the base, emitter and collector currents of transistors VT6, VT4, VT3. Character of loading collector circuit transistor VT6 and VT3, consisting of a resistor R4, the capacitive current divider formed by the capacitors C3 and C4, forming the reactive component of the current in the resistor R3, ensures the implementation of the input buffer amplifier

BA band-pass frequency response characteristic of the selective amplifier. The transfer of part of the collector current VT6 its emitter circuit, the resistor R3, forms a feedback circuit (transistors VT6, VT4 and VT3). Changing the emitter current of transistor VT6 and VT4 base current of the transistor due to its interaction with the emitter of the transistor VT3 provides large-scale change in the current in the collector circuits of transistors VT3 and VT4. Because of the above properties of the load circuit of the transistor character frequency dependencies feedback loop and prisons are the same. It is for this reason that the action of both primary and secondary feedback loops designed to increase quality factor and amplification factor K_0 SA without changing the quasi-resonance frequency f_0 . [3]

Complex transfer SA fig. 1 is given by, which can be obtained by the methods of analysis of electronic circuits:

$$F(jf) = K_0 \frac{jf \frac{f_0}{Q}}{f_0^2 - f^2 + jf \frac{f_0}{Q}}. \quad (1)$$

The frequency of the quasi-resonance circuit f_0 follows from

$$f_0 = \frac{1}{2\pi\sqrt{C_3 C_4 R_4 (R_3 + h_{11.6})}}, \quad (2)$$

and its quality factor Q depends on the depth of the real feedback

$$Q = [D_0 K_i + D_p (1 - K_i)]^{-1}, \quad (3)$$

$$K_i = \alpha_6 + \alpha_3 \frac{h_{11.6}}{h_{11.3} + h_{11.4}} - \text{equivalent factor} \quad (4)$$

$$D_0 = \left(\sqrt{\frac{C_3}{C_4}} + \sqrt{\frac{C_4}{C_3}} \right) \cdot \sqrt{\frac{R_3 + h_{11.6}}{R_4}}, \quad D_p = D_0 + \sqrt{\frac{C_3}{C_4}} \cdot \sqrt{\frac{R_4}{R_3 + h_{11.6}}}$$

- attenuation of zero (D_0) and the pole (D_p) of the load circuit transistor VT6 and VT3;

α_i - current transfer ratio of i-emitter transistor

$(h_{11})_i$ - small signal parameters h-i-th transistor in common base circuit.

Feature of the scheme is the possibility of realizing the positive ($K_0 > 0$) and negative ($K_0 < 1$) amplification factor SA for quasi-resonance frequency. So by using the login "IN1"

$$K_0 = Q(D_p - D_0) \frac{\alpha_1 h_{11.6}}{h_{11.1}} K_i + \frac{\alpha_2 h_{11.6}}{h_{11.2}}, \quad (5)$$

- and when using input "IN2"

$$K_0 = Q(D_p - D_0) \frac{\alpha_1 h_{11.5}}{h_{11.1}} (K_i - \alpha_6). \quad (6)$$

These relations are valid when the inequalities and demonstrate the ability to handle not only the differential, and common-mode signals.

$$C_1 = \left(\frac{R_1 h_{11.1}}{R_1 + h_{11.1}} \right) \gg 2\pi f_0, \quad C_2 = \frac{R_2 h_{11.2}}{R_2 + h_{11.2}} \gg 2\pi f_0 \quad (7)$$

Thus, the two-phase operation ($\bar{u}_{BX} = u_{BX}$) amplification factor SA to quasi-resonance frequency reaches significant values (while ensuring identical modes of transistors VT2 and VT1) and implemented a quality factor is determined::

$$K_0 = Q(D_p - D_0) \frac{\alpha_2 h_{11.6}}{h_{11.1}} \alpha_6 + \frac{\alpha_3 h_{11.6}}{h_{11.2}}, \quad (8)$$

The second distinguishing feature of the scheme is the ability to configure a functional amp. As can be seen from (2) the need to adjust the value of f_0 can change the emitter current (I_{36}) transistor VT6:

$$h_{11.6} \approx \varphi_m / I_{36}, \quad (9)$$

where φ_m the temperature coefficient

So either the voltage changes by the E_c or the implementation of a resistor R2 as a controlled current source I_{36} can be the choice of parametric conditions $R_3 \approx h_{11.6}$ required to realize the value of f_0 . Relations (4) - (3) show that the change in the operating mode transistors VT3 and VT4 can provide the desired value and set value K_i Q while maintaining quasi-resonance frequency f_0 :

$$K_i = \alpha_6 + \alpha_3 \frac{I_{var}}{4I_{\alpha 6}}, \quad (10)$$

where I_{var} - current regime-defining current source.

An important property of the scheme is the ability to implement SA low parametric sensitivity of its merit. Thus, with $C3 = C4$ and $K_i = 1$ we obtain

$$Q^{-1} = 2 \sqrt{\frac{R_3 + h_{11.6}}{R_4}}, \quad (11)$$

$$K_0 \approx Q^2 \alpha_2, \quad (12)$$

$$S_{C_3}^Q = S_{C_4}^Q = 0; \quad S_{R_4}^Q = \frac{1}{2} = -S_{R_3}^Q. \quad (13)$$

Consequently, the implementation of the set point and K_0 does not require stringent conditions on the stability of the capacitors $C3$ and $C4$. In this case, the capacitors $C3$ and $C4$ can be used for almost neiteratsionnoy adjust f_0 .

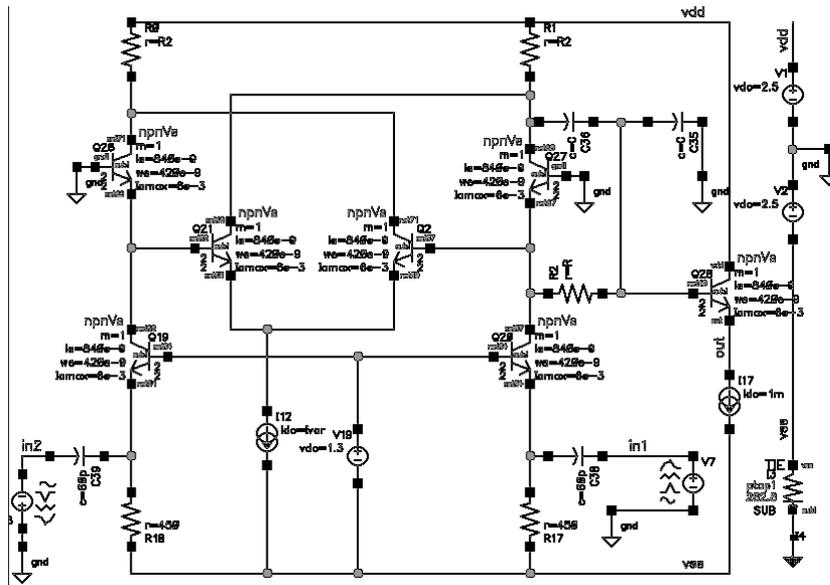
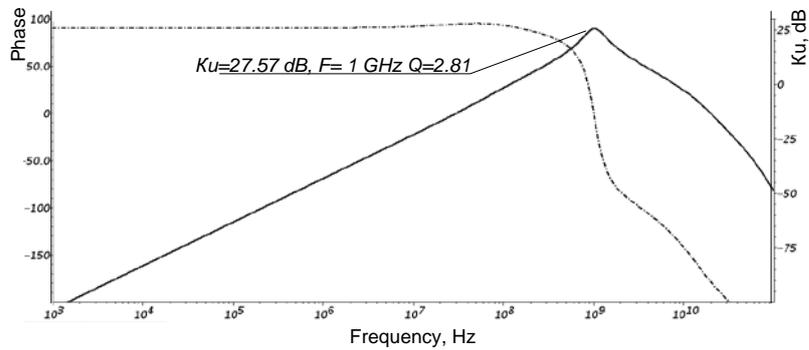


Fig. 2. IU scheme Cadence simulation environment for integrated models SiGe transistor technology SG25H1.

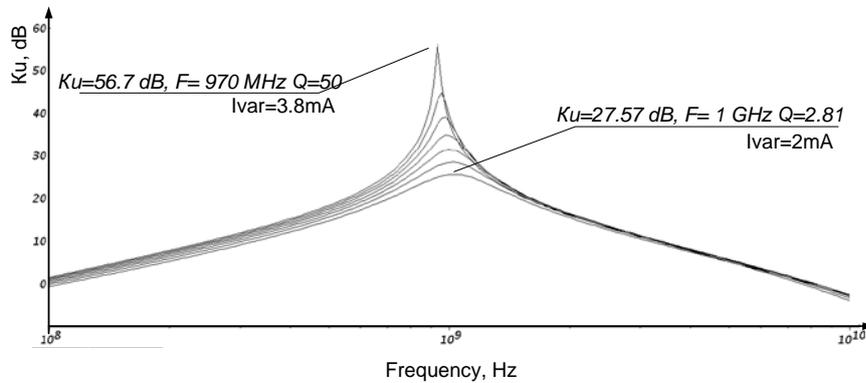
Terms of sale Q (3) and K_0 (4) can be used for technological principle ravnonominalnosti resistive and capacitive circuit elements SA. Indeed, for $C=C_3=C_4$; $R=R_5=R_4 \gg h_{11.5}$

$$Q = \frac{1}{3 - K_i}, \quad K_0 \approx 3Q, \quad f_0 = \frac{1}{RC}. \quad (14)$$

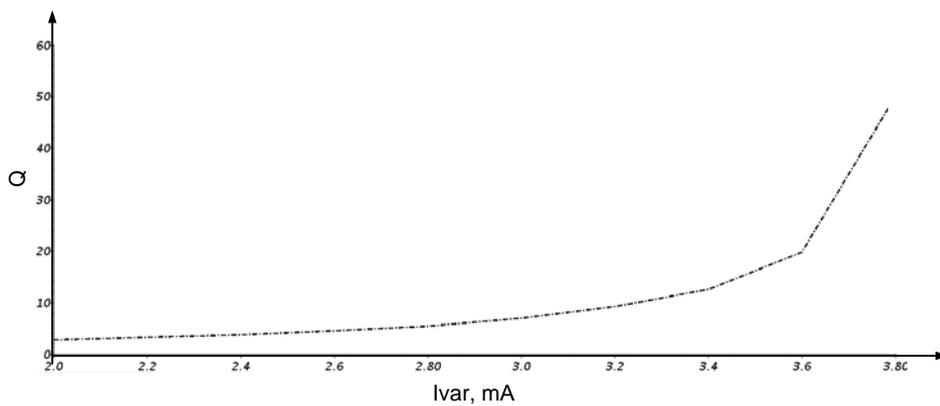
In this case, possible to implement the necessary values of the basic parameters by choosing SA ratio between the currents I_{var} and I_{32} . These findings support the theoretical plots of fig. 3, fig. 4.



a)



b)



c)

Fig. 3. The frequency dependence of voltage gain SA and a phase shift a), the dependence of voltage gain IU on the magnitude of the control current I_{var} b), the dependence of Q on the magnitude of the control current I_{var} c).

Thus, the proposed SA characterized by increased values of Q resonant amplitude-frequency and voltage gain at the frequency of quasi-resonance f_0 , as well as the creation of conditions for electronic control of the quantities K_0 , Q at $f_0 \approx 0$.

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**Bozhko S.D., Ershova T.A., Mukhortov S. A., Alekseev N. N,
Tekutyeva L.A., Son O. M.**

New range of dry vegetative porridges

Far Eastern Federal University Scientific and production company «Altay bouquet»

This report examines the development of gluten-free food products, including dry plant cereals. Recipe developed multicomponent dry gluten – free cereals.

Key words: gluten – free cereals, dried vegetable cereal , gluten - free, gluten-free products, dry cereal flakes.

Gluten-free products are becoming more popular. The main reason for this - increasing the number of people suffering from allergies, in which the consumption of any product containing gluten potentially dangerous. Gluten sensitivity- is an autoimmune disorder, which means that when a person consumes food containing gluten, their immune system reacts to it dramatically. Unlike many other types of allergies, allergy to gluten can cause serious disruption of the gastrointestinal tract and cause harm to the body. About 1% of the population is allergic to gluten.

Gluten- a protein that is found in the greatest numbers in the rye, wheat and barley. It consists of two components: gliadin and glutenin. Gluten is found in many carbohydrate foods, including bread and. It is used as an additive to other products for their stabilization. It can be a variety of products, such as ice cream or ketchup. Gluten is often added when preparing food to make it more viscous.

Corn, potatoes, rice, soybeans, buckwheat, millet is considered free of gluten. In this regard, the current task is the food industry to develop new technologies multi gluten-free products with a long shelf life. In this case, the most important condition for the creation of prescription formulations should be their high nutritional and biological value, with both low cost. These products can be fully attributed dry vegetable porridge.

Dry vegetable porridge, is a product consisting of a mixture of different grains (cereals), fruit and vegetable supplements, dried fruits, berries, sugar or sweeteners, milk proteins, prebiotics, or mechanical mixture of ingredients are intended for use in food as cereal dishes. The diet of the population, they hold one of the priorities and are in great demand.

The main component of the developed gluten-free cereals - cereals: wheat, rice in different combinations. Grains and cereals, as well as their by-products - cereal, rich in proteins, minerals, vitamins, carbohydrates, including polysaccharides, but the quality and quantity of their unequal. The basic ingredients are mixed powder formulations carrots, dried gourds, apples, apricots, blueberries, cherries,

strawberries, flax flour, etc. The combination of these additives can be extremely varied. In this sense, the cereals significantly differ from other food concentrates rich in complex nutrients: protein, fat, carbohydrates, minerals and vitamins. In addition, a significant proportion of raw material for cereals are grains and cereals, with the human body getting dietary fiber. This makes it possible for people to recommend porridge to prevent disease of the gastrointestinal tract, cholesterol metabolism, and other metabolic disorders.

We have developed a new range of dry plant cereals. When developing recipes of oatmeal into account the availability of local raw materials, the basic rate of consumption of nutrients, especially the technology of the product and consumer characteristics of the finished product.

Sample № 1 - gluten-free vegetable porridge 2 cereal

This composition is characterized by well-balanced mineral composition (sufficient iron, magnesium, potassium and phosphorus), vegetable supplements carrot and pumpkin supplement and mineral content (iron, cobalt, magnesium, potassium, phosphorus, calcium, copper), and especially vitamins (C, E, K, β -carotene, B, PP), the addition of pumpkin porridge enriched in protein, fiber, sugars,.

Sample № 5-2-gluten cereal porridge with pumpkin, apples and apricots

This composition is characterized by well-balanced mineral composition, vitamins (group B, E, PP, β -carotene), sufficient fiber. The addition of pumpkin porridge enriched in protein, fiber, sugar, pectin, vitamins (group B, E, K, T, β -carotene, vitamin C). Minerals - iron, calcium, potassium. The addition of apples and apricots enriches mineral composition of potassium, iron, sodium, and vitamins - vitamin C, β -carotene, simple sugars.

Sample № 6 - gluten-free 2-Grain cereal with strawberries, cherries and blueberries

This composition is characterized by well-balanced mineral composition (sufficient iron, selenium, potassium, phosphorus, magnesium and calcium), vitamins (group B, E, PP, β -carotene), sufficient fiber. Berry supplements enriched porridge

simple sugars, pectin, antioxidants. Mineral composition is enriched with sodium, potassium, calcium, iron, magnesium, vitamin - vitamin C, PP, V.

At this range of dry cereals developed a standard of organization and technological instructions for their production.

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Kulyk A.Y., Krivogubchenko S.G., Krivogubchenko D.S., Ivanov Y.Y.

**THE SOFTWARE IMPLEMENTATION OF TURBO DECODER WITH
METRIC PROCESSING BY MAP ALGORITHM**

Vinnitsa National Technical University, Vinnitsa

In this report we describe the software, developed for the optimal MAP turbo-codes decoding algorithm with metrics processing, on high-level language C++. The research of BER and energy efficiency for this algorithm is performed.

Key words: turbo-code, MAP, AWGN, bit error rate, log-likelihood ratio, "hard" and "soft" decisions, C++ programming language.

To combat with the noise in data transmission systems is used error-correcting encoding, that allows to make data protection in computing device memory. Error-correcting turbo-code is a powerful method, which has an important advantage, that allows to provide reliable communication with the efficiency, which is very close to the theoretical limit of maximum noisy channel throughput. Therefore the researches of this promising code is required to improve the speed and reliability of data transmission in distributed computer systems of different purposes [1]. Turbo-codes are used in satellite and mobile systems (DVB-S/RCS, W-CDMA), wireless broadband access services (WiMax) and digital television (ViaSat, HDTV) [2]. This code allows to encode volume information messages for high-speed transmission with high error-correcting.

An important practical problems are the software and hardware implementation of computational procedures for information processing (especially decoding

algorithms), which is received with the usage of this code, as well as research of the probabilistic-energy data transmission characteristics with using hardware tools for working with turbo-codes.

One of the methods, that solves the difficult problem of turbo-codes decoding is the MAP algorithm (Maximum A posteriori Probability), which reduces the computational complexity of this procedure, and forms the optimal symbol-by-symbol decoding basis with bit error rate (BER) minimization.

During the work with this algorithm is necessary to use the transitions metrics concept from one trellis code state to another. Metrics rib calculating is performed by the formula [2, 3]

$$\gamma_i^{(j)}(m', m) = p\{\bar{U}_i = j\} \cdot \delta_{ij}(m, m') \cdot \exp\left(-\frac{1}{N_0} \cdot \sum_{q=0}^{N-1} (\bar{r}_{i,q} - \bar{X}_{i,q})^2\right). \quad (1)$$

where \bar{U} – initial information sequence; \bar{X} – information sequence, which is transmitted in channel with additive white Gaussian noise (AWGN); $\delta_{ij}(m, m') = 1$, if $\{m, m'\} \in \Theta_i^{(j)}$; $\delta_{ij}(m, m') = 0$, if $\{m, m'\} \notin \Theta_i^{(j)}$; \bar{r} – data, which are received by the decoding device, after demodulation; N_0 – noise power spectral density.

Forward path metrics on the code diaphragm has the form

$$\alpha_i(m) = \sum_{m'} \alpha_{i-1}(m') \cdot \sum_{j=0}^1 \gamma_i^{(j)}(m', m). \quad (2)$$

Defining of the backward path metrics is possible by the expression

$$\beta_i(m) = \sum_{m'} \beta_{i+1}(m') \cdot \sum_{j=0}^1 \gamma_i^{(j)}(m', m). \quad (3)$$

MAP decoding idea lies in calculating some a posteriori probabilities of information symbols based on log-likelihood ratio (LLR), which can be written in the formula

$$LLR(\bar{U}_i) = \ln\left(\frac{p(\bar{U}_i = 1 | \bar{r})}{p(\bar{U}_i = 0 | \bar{r})}\right) = \ln\left(\frac{\sum_m \sum_{m'} \alpha_{i-1}(m') \cdot \gamma_i^{(1)}(m', m) \cdot \beta_i(m)}{\sum_m \sum_{m'} \alpha_{i-1}(m') \cdot \gamma_i^{(0)}(m', m) \cdot \beta_i(m)}\right). \quad (4)$$

Programming model of information transmission with the usage of MAP decoding algorithm for turbo codes [4] is advisable to research in the software package MatLab, and additional procedures, which are required to work with this code, to implement on the high-level programming language C++, for example, in the DLL libraries form [5].

Signal noise ratio (SNR) indicators and BER values during simulation process with the usage quadrature phase-shift keying (QPSK) and channel with AWGN for MAP decoding algorithm are shown in fig. 1. Logarithms metrics are used to reduce the MAP algorithm computational complexity and BER [2].

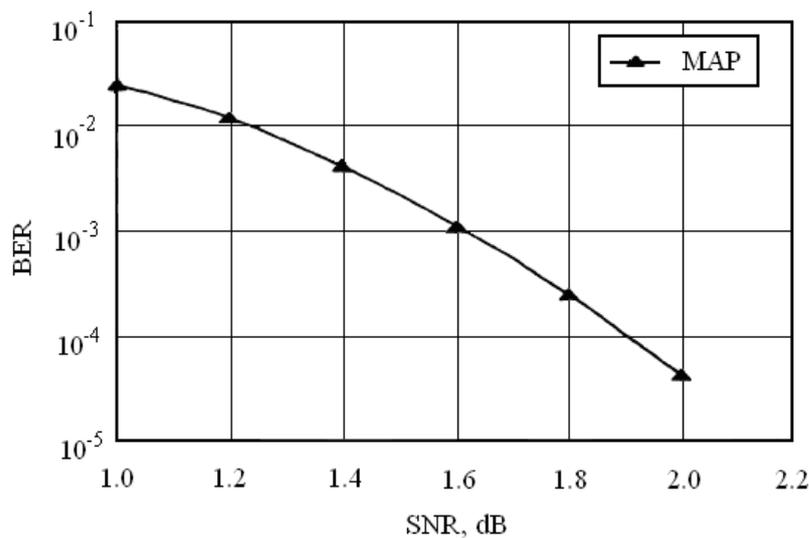


Fig. 1. Simulation of energy efficiency and BER values

The software modules implementation are performed on one of the most common, among software developers, programming language C++. Program graph-diagram is shown in fig. 2., where void generate_table () – method for generating encoder state table, void turbo_encode () – turbo-encoder, void MAP () – LLR calculation for MAP algorithm, void turbo_decode () – turbo-decoder, void save_data () – saving data in a file, int main () – function, that runs the program for execution.

For correct work of the product is needed the following minimum system requirements: an operating system Microsoft Windows XP or Seven, the keyboard and mouse availability, the main processor clock speed not less than 1000 Mg, RAM – 512 Mb, video memory – 128 Mb, HDD – 10 Gb.

The input data for this program are the turbo code block length N , the input sequence in a form of array $X[N]$, the variance σ for channel with AWGN, the trellis states number M , the variable NOISEOFF for setting the noise level in the channel (0 – no noise, 1 – AWGN), the number of parity bits from encoder 1 and 2 in the form of arrays Parity_1[N] and Parity_2[N], pseudorandom permutation, which is given by the data sequence for array permutation[N], the number of turbo-decoder iterations (N_ITERATION).

The output data are the symbol sequence $X_h[N]$ on the channel output with noise or without it (the "soft" decisions of MAP decoder outputs, which are obtained during the last iteration with the usage of algebra logarithm of the likelihood function, can be transformed into the "hard" decisions or initial information sequence –).

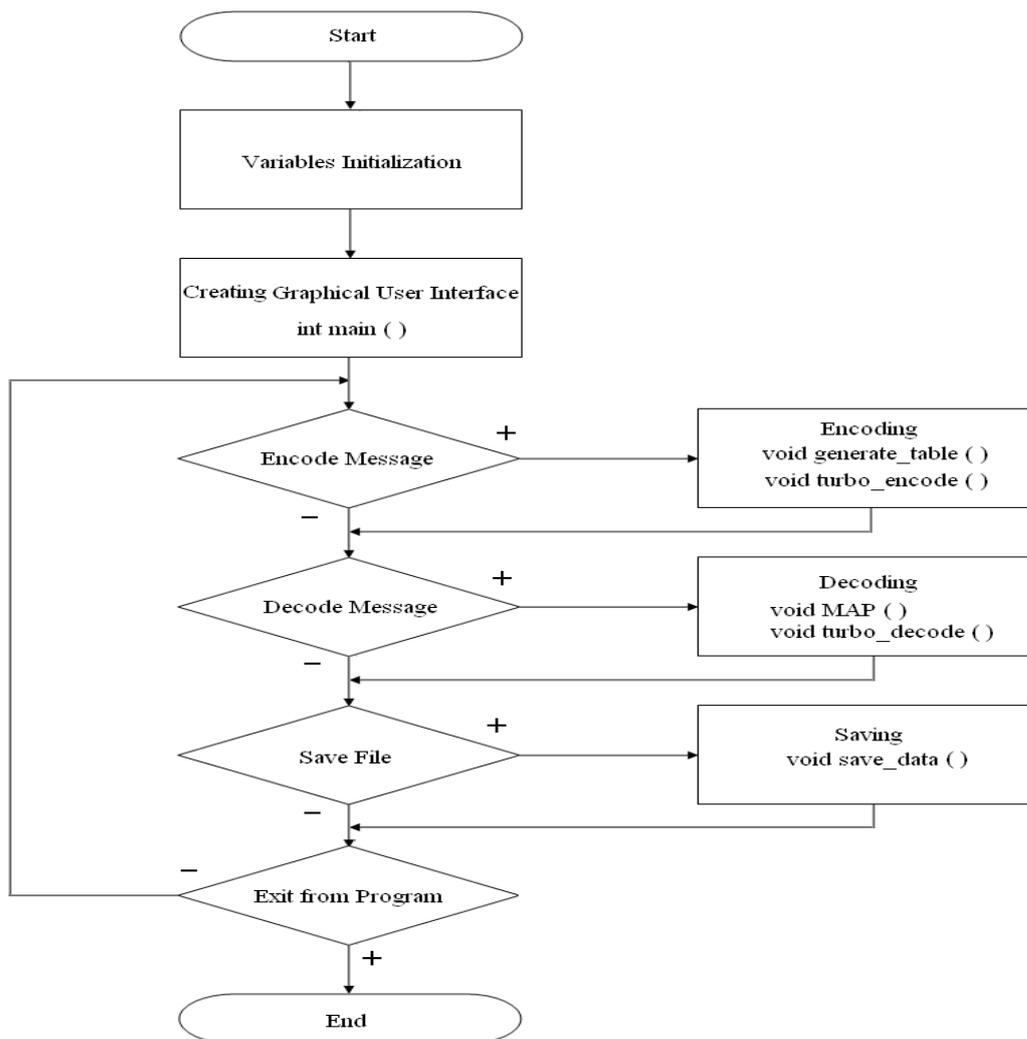


Fig. 2. Simplified program graph-diagram

To perform program operations the user must enter the data, which are required turbo-encoder and MAP turbo-decoder, and the program will evaluate the "hard" and "soft" decisions for user-defined operating conditions (given input information sequences, noise level in the channel, number of iterations, transmitted data volume, parity bits). Program listing fragment to find the rib metrics and forward path metrics on the code diaphragm is shown in fig. 3.

```

for(k = 0; k < N_ITERATIONS; k++)
{
    for(j = 0; j < M; j++)
    {
        for(i = 0; i < 2; i++)
        {
            X_hard = i ? +1 : -1;
            Parity_hard = Parity[j][i] ? +1 : -1;
            Gamma[k][j][i] = exp(0.5*(LLRp[k] * X_hard +
                LLRc * X_d[k] * X_hard +
                LLRc * Parity_d[k] * Parity_hard));
            Gammae[k][m][i] = exp(0.5*(LLRc * Parity_d[k] * Parity_hard));
        }
    }
}

alpha[0][0] = 1;

for(j = 1; j < M; j++)
    alpha[0][j] = 0;

for(k = 1; k <= N; k++)
{
    index = 0;
    for(j = 0; j < M; j++)
    {
        alpha[k][j] = Alpha[k-1][Previous[j][0]] * Gamma[k-1][Previous[j][0]][0] +
            Alpha[k-1][Previous[j][1]] * Gamma[k-1][Previous[j][1]][1];
        index += alpha[k][m];
    }
    for(j = 0; j < M; j++)
        alpha[k][j] /= index;
}

```

Fig. 3. Computer program listing fragment

i=1	Le1_l[0]=5.372011	Le2_ip[0]=0.586152	L[0] = 11.890361
i=1	Le1_l[1]=4.172210	Le2_ip[1]=3.346572	L[1] = 7.054056
i=1	Le1_l[2]=0.892082	Le2_ip[2]=5.582099	L[2] = 5.188527
i=1	Le1_l[3]=-1.159335	Le2_ip[3]=-5.076678	L[3] = -4.571119
i=1	Le1_l[4]=0.089277	Le2_ip[4]=5.281488	L[4] = -4.845143
i=1	Le1_l[5]=-2.786418	Le2_ip[5]=-6.631708	L[5] = -1.007678
i=1	Le1_l[6]=2.877265	Le2_ip[6]=1.999470	L[6] = 5.737179
i=1	Le1_l[7]=-2.335599	Le2_ip[7]=-7.462615	L[7] = -11.283876
i=2	Le1_l[0]=-14.356018	Le2_ip[0]=0.598120	L[0] = 20.886335
i=2	Le1_l[1]=-10.686100	Le2_ip[1]=18.149921	L[1] = 28.371296
i=2	Le1_l[2]=-9.218450	Le2_ip[2]=-13.6622937	L[2] = -23.379898
i=2	Le1_l[3]=-11.2293807	Le2_ip[3]=-7.733732	L[3] = -17.362645
i=2	Le1_l[4]=-8.702215	Le2_ip[4]=13.189754	L[4] = 21.366347
i=2	Le1_l[5]=-10.825407	Le2_ip[5]=-18.196686	L[5] = -30.681645
i=2	Le1_l[6]=-12.633854	Le2_ip[6]=4.809137	L[6] = 18.303435
i=2	Le1_l[7]=-12.029338	Le2_ip[7]=-20.020198	L[7] = -33.535198
i=3	Le1_l[0]=-17.392651	Le2_ip[0]=0.598120	L[0] = 23.922969
i=3	Le1_l[1]=-18.623655	Le2_ip[1]=18.631027	L[1] = 36.789956
i=3	Le1_l[2]=-19.978933	Le2_ip[2]=-13.697797	L[2] = -34.175239
i=3	Le1_l[3]=-14.852592	Le2_ip[3]=-7.734680	L[3] = -20.922781
i=3	Le1_l[4]=-21.371852	Le2_ip[4]=13.237728	L[4] = 34.083958
i=3	Le1_l[5]=-19.729996	Le2_ip[5]=-18.247584	L[5] = -39.561132
i=3	Le1_l[6]=-15.303208	Le2_ip[6]=4.809560	L[6] = 20.972264
i=3	Le1_l[7]=-21.083355	Le2_ip[7]=-20.069675	L[7] = -42.638692
i=4	Le1_l[0]=-17.393596	Le2_ip[0]=0.598120	L[0] = 23.923914
i=4	Le1_l[1]=-18.671605	Le2_ip[1]=18.631027	L[1] = 36.837906
i=4	Le1_l[2]=-20.027943	Le2_ip[2]=-13.697797	L[2] = -34.224250
i=4	Le1_l[3]=-14.852995	Le2_ip[3]=-7.734680	L[3] = -20.922781
i=4	Le1_l[4]=-21.445313	Le2_ip[4]=13.237729	L[4] = 34.157420
i=4	Le1_l[5]=-19.759758	Le2_ip[5]=-18.247585	L[5] = -39.596895
i=4	Le1_l[6]=-15.303208	Le2_ip[6]=4.809560	L[6] = 20.973211
i=4	Le1_l[7]=-21.130649	Le2_ip[7]=-20.069675	L[7] = -42.685985
i=5	Le1_l[0]=-17.393596	Le2_ip[0]=0.598120	L[0] = 23.923914
i=5	Le1_l[1]=-18.671605	Le2_ip[1]=18.631027	L[1] = 36.837906
i=5	Le1_l[2]=-20.027943	Le2_ip[2]=-13.697797	L[2] = -34.224250
i=5	Le1_l[3]=-14.852995	Le2_ip[3]=-7.734680	L[3] = -20.922781
i=5	Le1_l[4]=-21.445313	Le2_ip[4]=13.237729	L[4] = 34.157420
i=5	Le1_l[5]=-19.759758	Le2_ip[5]=-18.247585	L[5] = -39.596895
i=5	Le1_l[6]=-15.303208	Le2_ip[6]=4.809560	L[6] = 20.973211
i=5	Le1_l[7]=-21.130649	Le2_ip[7]=-20.069675	L[7] = -42.685986
L_h[0] = 23.923914			
L_h[1] = 36.837906			
L_h[2] = -34.224250			
L_h[3] = -20.922781			
L_h[4] = 34.157420			
L_h[5] = -39.596895			
L_h[6] = 20.973211			
L_h[7] = -42.685986			
X_h = 11001010			

Fig. 4. The results of turbo-decoder operations

The results of the MAP turbo-decoder algorithm ("hard" and "soft" decisions) in the channel with AWGN for 5 decoding iterations with transmitted information sequence of 6 data bits and 2 additional bits are shown in fig. 4.

Thus, considering the complexity of decoding and implementation tasks for MAP turbo-decoder, were defined solution features with the usage of "soft" and "hard" decoding schemes. Introduced software product can be used to build hardware and software tools for decoding signals in communication systems.

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Brzhozovsky B.M, Martynov V.V., Zinina H.P., Starinnova V.O.

**ANALYSIS STRENGTH PROPERTIES OF THE CUTTING TOOL
MODIFIED BY AFFECTING OF LOW-TEMPERATURE PLASMA**

The Saratov State Technical University named after U. Gagarin

Presents the results of the analysis of a changeable polyhedral carbide plates coated with TiN, modified by affecting of low-temperature plasma of the combined discharge of the diminished pressure executed on their materials endurance of trials are introduced.

Keywords: «carbide plates», «plasma modification», «micro hardness», «anterior surface», « the cutting edge».

The introducing. One of the basic tendencies of progressing of modern machine building is use of a high capacity hard-wearing cutting tool. The use of such a tool has direct economic benefits for enterprises, because it leads to reduction of costs for the acquisition of a new instrument, increasing the processing speed, reduce the run-time of auxiliary operations.

Production of the tool with improved by operating characteristics has caused progressing of many technological directions, including plasma modification of its effective surfaces for the purpose of increase of hardness at the expense of regulation of the sizes and the form of structural members (fragments, grains, crystals), up to forming nanostructure in its near-surface strata.

For an appraisal strength properties of the modified tool have been held endurance trials of 2 replaceable many-sided carbide plates from alloy T15K6 with coating TiN in the course of manufacturing on the automatic lathe with CNC 16K20Φ3C5 parts from bearing steel IIIХ-15 at following values of arguments of a technological mode: a cutting speed – 100 mines⁻¹, supply – 0,26 ... 0,38 mm/rev, depth of cut – 2,5 mm. Results of tests on hardness tester PMT-3 micro hardness measuring of the Vickers (HV₂₀ and HV₁₀₀) on anterior surface of plates along an auxiliary cutting edge and internal ridge of a ribbon

have been executed. Measurements were executed on the minimum spacing interval from ridge; the spacing interval between replicas compounded 0,03 mm.

The results of measurements showed that the values of micro hardness on the front surface along assist the cutting edge 1 of the plate change with alternating highs and lows of the strength characteristics of the surface layer. It is possible to identify areas of significant reduction of micro hardness at a distance of 0.7 and 1.7 mm on the radius of the rounding, in which it comes to the AC of 7.0 HPa.

In coating TiN (HV_{20}) and exhaust (HV_{100}) lengthwise an auxiliary cutting edge essential distinctions have allocation of values of micro hardness. So, on length of a cutting edge from 0,7 to 1,7 mm strength properties coating surfaces (HV_{20}) are in limits 13,0 HPa where as in an precoat on the same piece of value of micro hardness compound order 18,0 HPa. Outside of this zone observed a return oil painting: micro hardness of coating has raised on the average to 14,0 HPa, and strength properties precoat were slashed to 16,0-17,0 HPa that argue about variation of processes proceeding on a surface.

Comparison of the distribution of micro hardness values with character defects on the cutting edge and the front surface, located in the specified wavelength range, established the following.

1. The failures of micro hardness up to 6.7 of 7.8 HPa near the cutting edge at a distance from the rounding radius of 0.7 and 1.7 mm caused by the deformation processes in the areas of the front, adjacent to the large blazes, formed by cutting on the back surface of the plate.

2. Contact interplay of a separable material with coating TiN on anterior surface near to a cutting edge at length of ~2,0 mm causes extension of coating without its break off from a hard-alloy ground. Thus forming of similar pulling stresses in a precoat is not observed.

3. In the area of returns chips, situated at a distance of AC 1,7-2,6 mm on the radius of the rounding, seal coating caused by the accumulation in the surface layer of the smallest particles of the processed metal and wear particles. It leads to drop of defensive functions coating and to beefing-up of a distorting offloading on precoat.

4. On internal ridge of a ribbon of value of micro hardness in a central part have drop strength properties of a near-surface stratum that coincides with the trouble which has been located in this zone. Besides, micro hardness drop at HV_{100} before trouble (on spacing interval of 0,7-0,9 mm on the radius of the rounded) also caused by the accumulation of wear particles.

5. The values of micro hardness HV_{20} metered on a surface of troubles and on their boundary, have allowed to erect range of stability of modified coating TiN at an extension which one lies above an upgrade of values of the micro hardness metered on troubles, i.e. above 10,8 HPa, and below the minimum value of micro hardness received on adjoining coating, i.e. more low 11,1 HPa that compounds order 10,95 HPa.

The distribution of micro hardness along assist the cutting edge 2 plate shows a slightly different picture: synchronous wave-like change of the strength characteristics of the coating of TiN (HV_{20}) and exhaust (HV_{100}). Thus significant drop of micro hardness to ~4,0 ГПа in areas located at a distance of approximately of 0,58 and 2,23 on the radius of the rounding, occur for different reasons: in the first case, the measurements were carried out on the surface of the defect, in the second – on the stuck metal. Besides, lower values of micro hardness of coating TiN (HV_{20}) and sub layer (HV_{100}) on a piece to 0,58 mm of 2 plates in comparison with values of micro hardness on the same piece of 1 plates indicate near brow deforming loads in the annual cycle areas, causing stretching not only coverage, but also to the underlying layers.

The values of micro hardness metered on internal ridge of a ribbon, point distinctions in nature of allocation of micro hardness in coating TiN (HV_{20}) and an sub layer (HV_{100}). So, on length of internal ridge of ~0,35 mm strength properties covering are augmented with ~6,0 to 10,0 HPa, then on a piece to 1,2 mm of value are stabilized nearby 7,0-8,0 HPa. The nature of the distribution of the HV_{20} the entire length of the edge of repeated distribution of HV_{100} in the subtle form of the form, in the exhaust on the whole interval values of micro hardness is in the range of 18,0 HPa. In the area of returns chip observed the simultaneous increase in the values of micro hardness in the coating and exhaust.

Comparison the distribution of micro hardness values with character defects on the cutting edge and the front surface of the two plates allowed establishing the following.

1. The boundary surface of contact interplay of a separable material and a zone of derailing of a shaving drives on the trouble formed on anterior surface.

2. Reduction of the strength characteristics at a distance of 0,58 and 1.0-1.2 mm auxiliary cutting edge caused by the deformation processes with the formation of blaze. Between blazes on spacing interval equal 0,7-0,9 mm smooth compaction of coating surfaces is observed.

3. The periodic increase and the decrease of the micro hardness segment of length 1,2-2,2 mm also led as education designed for the so and the accumulation of wear particles in the zone of the descent of the chip.

4. The contact area, situated on the inner edge of ribbons, reduction of micro hardness (HV_{20}) due to the formation of the front surface of the film wet material, as well as accumulation on her metal particles, and the smallest particles wear products.

The comparison of the distribution of micro hardness in depth on the plates of the typical points of the surface, along the cutting edge of the blazes, in the middle of the cutting edge (the defect) and in the zone of returns chips, clarified the differences in the processes occurring on the front surface when interacting with a detachable material and chips in different cutting conditions.

So, on the surface of the 1 plate at these points is present in a greater degree of compression of the component. Separated material has been growing compressive impact on near brow area of the distance from the zone of the incision. The most extended area of the cutting edge is located in the area of blazes, and the processes of the cutting edge and the inner edge of the ribbon differ only slightly. The distance from the blaze surface layers of compressed, micro hardness of them increases.

The anterior surface of 2 plates in the course of interplay with a separable material and a shaving is under the influence of stronger pulling stresses in surface layer. The coating surfaces in a zone blazes are most extended. The sub layers keep the high values

of micro hardness. Fields of a surface of the cutting edge removed from blazes, test smaller tensile loadings and in a zone of derailing of a shaving pass in the shrinking.

Micro hardness studies (HV_{20}) bonding contact pads in a zone of contact to a separable material (in a middle part along lines of a course of a separable material on spacing interval of 0,076 mm from ridge) and in a zone of derailing of a shaving (across a ribbon) have demonstrated the following.

1. Allocation HV_{20} to bonding contact pad in a zone of contact to a separable material for both membranes has communal nature. Coating is in bonding contact pad mid-range under the influence of pulling stresses which one before trouble sharply changes on the shrinking. It is probably linked to up building of products of deterioration before trouble that conducts to peephole compaction of coating.

2. In a zone of derailing of a shaving crosswise micro hardness at a cutting edge has a zone of the enhanced hardness, and the micro hardness maximum lies within 0,05 mm. At removal from a cutting edge of value of micro hardness are slashed.

Thus, in the process of cutting impact of the separated material and chips on the surface layers of solid carbide material changeable polyhedral plates causing complex responses, related both to the local stretching surface, as well as with its local compression. With the extension concentrated in the micron surface layers and may have different local areas. The stability of the modified layer is determined by the resistance of the coating to tensile stresses. The alternation of tensile and compressive impacts leads to local changes the geometry of the cutting edge, which affects the accuracy of the indicators of the process of cutting. The role of plasma modifying processing in these conditions is determined by an improved ability strengthen cover (if available) and lower layers to restructuring in the narrow spatial volumes without education Deplete the defects. Even then, when there was a formation of defects on the surface or cutting edge, the structure of modified layer remains stable and independent from local changes adjacent areas. This contributes to the formation of layers in the integration of TiN coating to the substrate material.

Conclusion. The received results allow concluding, that the specific character of the properties of the modified surface leads to a need to search for the conditions in

which these properties cutting will occur most effectively. This requires a mathematical description of the mechanism of enhancing the resilience of the modified instrument processes of creep and wear with the purpose of substantiation:

- approach to the optimization of the process of cutting;
- optimization criterion, and the main directions of its practical use.

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M.B. Brovkova, B.M. Brzhozovsky, I.N. Yankin

Assessment of Cutting by the Signal Accompanying Oscillatory Process

Abstract. Modern computerized integrated manufacturing is based on the automated technological complexes that appear to be complicated technical systems within which mechanical and electronic subsystems should properly coact. The successful performance of such equipment requires a nonstop flow of information from different structural machine tool subsystems in real time.

One of the most important sources of information is a channel that transfers the tooling process data to the machine operating system. This information should be of high validity rate since it determines the operating system decision on the efficient processing conditions.

The validity requirements are particularly relevant for the technological complexes that use adaptive control systems. The report examines a way of extracting relevant tooling state data from the oscillation signal embodiment in the tool zone. The specified data is necessary for stable tooling and for gaining high quality characteristics of the finished pieces.

The algorithm of oscillating signal processing and working out the guiding solution includes the following continuously executed instrumental operations and computations: conversion of an analogue oscillating signal portion to its digital form; spectral content calculation for the initial oscillating signal; derivation of speed and misalignment arrays from the spectral function; the phase diagram computation for the oscillating process within the “misalignment-speed” frame of axis; calculation of

the contour density rate of the oscillating movement; processing equipment dynamic status estimation; making the guidelines and decisions for the technological complex operating system.

The specified algorithm has been approved for polishing operations and proved its efficiency.

Article Quality control in automated processing technological complexes is based on the continuous flow of information about the machine and its dynamic system state. Modern computerized integrated manufacturing is based on the automated technological complexes that appear to be complicated technical systems within which mechanical and electronic subsystems should properly coact. The successful performance of such equipment requires a nonstop flow of information from different functional machine tool units in real time.

One of the most important sources of information is a channel that transfers the tooling process data to the machine operating system. This information should be of high validity rate since it determines the operating system decision on the efficient processing conditions. The validity requirements are particularly relevant for the technological complexes that use adaptive control systems.

The article examines a way of extracting relevant tooling state data from the oscillation signal embodiment in the tool zone. The specified information is necessary for stable tooling and for gaining high quality characteristics of the finished pieces.

During the process of cutting materials the machine undergoes large dynamic loads. This perturbation affects the machine nodes and gives rise to oscillations. They may have a significant impact on the quality of machined parts. In this regard, the main task of the machine control system is to ensure such processing conditions that do not produce a deterministic vibration. The emergence of deterministic vibration can arise, for example, due to the tool wear and the formation of build-up on its working surfaces.

Figure 1 shows the stages of the deterministic vibration formation that occurs in the case of deterioration of the cutting properties of the instrument due to the build-

up on the front surface of the tool. The phase diagrams of the oscillatory process are shown in Fig. 1. They represent the trajectory of the tool vibration within the 'shift-speed' frame of axis. The formation of build-up on the tool involves a change in the nature of the oscillatory process. It changes from the stochasticity state to deterministic domain.

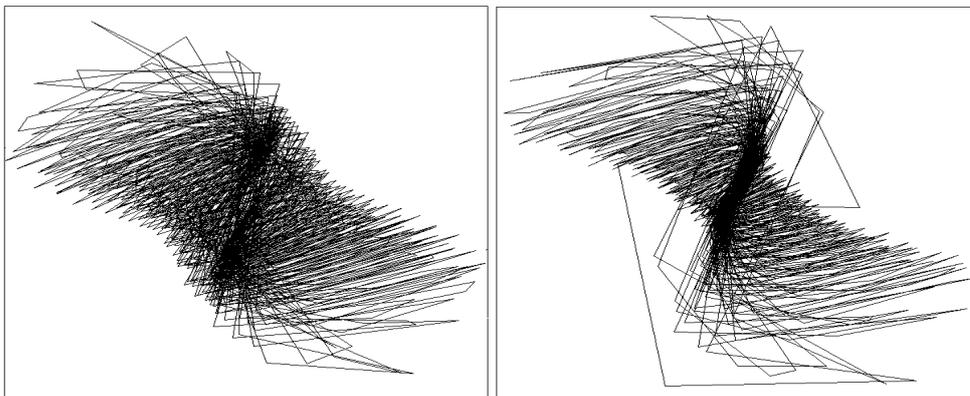
The analysis of the diagrams shows that the formation of deterministic vibration is characterized by the density increase in the trajectories of the representative point. Fig. 1a demonstrates a minimal density of trajectories. Then, from Fig. 1b to Fig. 1e, there is an increase of the density of trajectories. Fig. 1f is characterized by a high degree of trajectory reiteration and the maximum of their density.

These diagrams demonstrate the process of self-oscillating mode in the machine that is considered unacceptable in processing parts since it can lead to rejects.

Thus, the occurrence of specific situations in a dynamic system of the machine can be detected by changes in density of the trajectories of the phase diagram. This important property of phase diagrams has been used to identify adverse trends in the processing of parts. It laid the basis for developing an algorithm of the controlling or an alarm signal for the machine control system.

The process of control signal generation is carried out according to the scheme shown in Fig. 2.

Fig. 1. Stages of the phase diagram change in deterministic vibration:



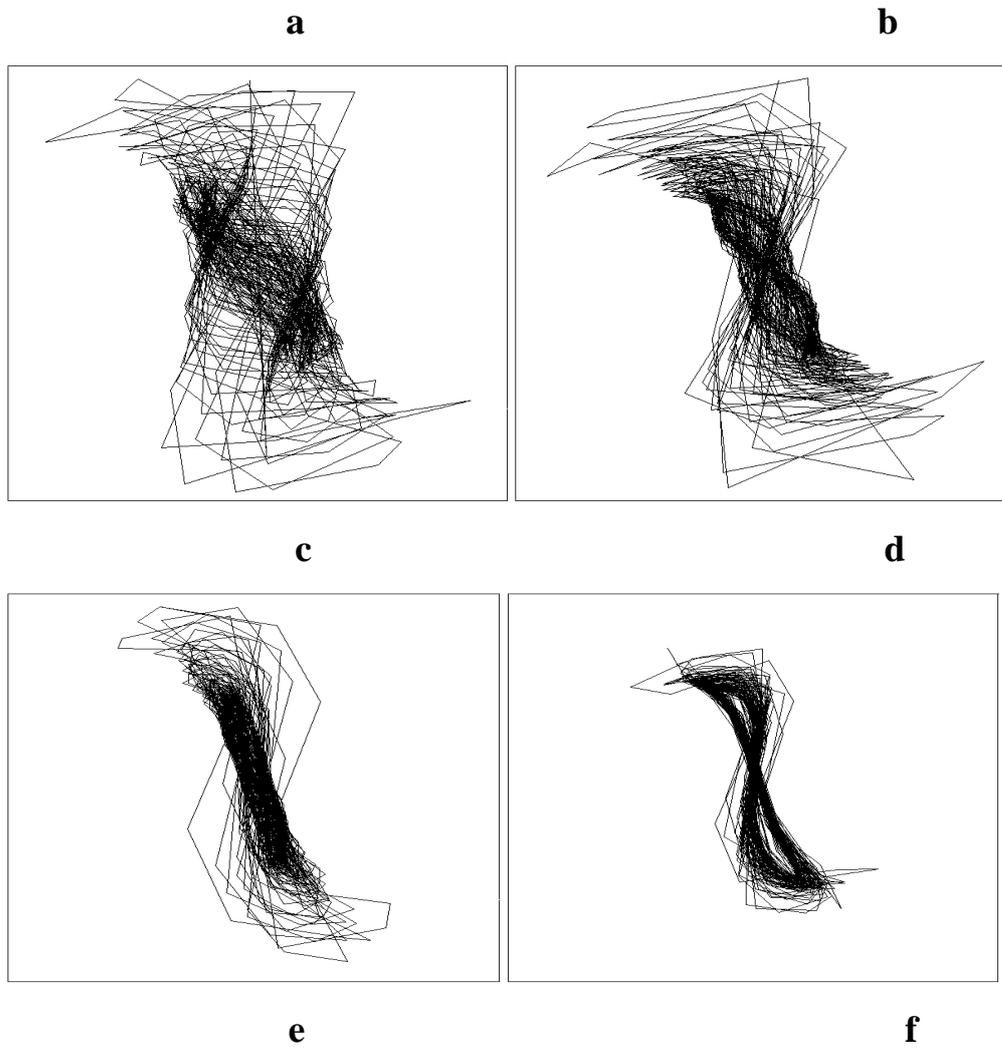
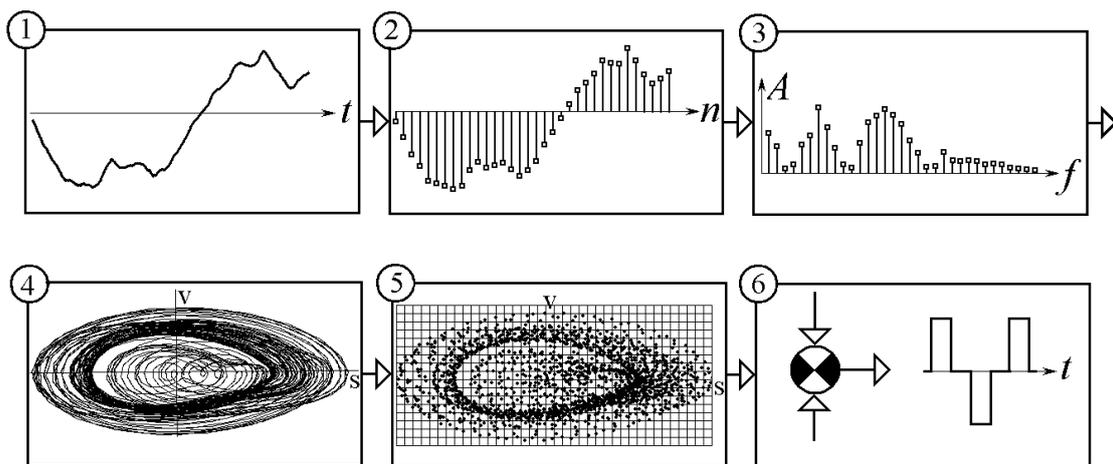


Fig. 2. The algorithm of the control signal generation:



In the first phase fluctuations of the instrument are converted into an electrical signal. For this purpose, reliable and stable piezoelectric sensors are used. They produce a signal proportional to the acceleration of vibrating object.

In the second phase the signal from the sensor is digitized with the help of analog-digital converter and stored in the memory of the microcontroller. Each implementation of vibrate signal is described by an array of ordinates $[x_1 \dots x_n]$ in the time interval $T = n \cdot \Delta t$, where Δt - sampling period; n - the number of points in the signal implementation.

In the third phase arrays of Fourier coefficients are calculated by the classical spectral transformation method:

$$A_j = \frac{1}{n} \sum_{i=1}^n x_i \cdot \cos(2 \cdot i \cdot j \cdot \pi / n); \quad \Phi_j = \frac{1}{n} \sum_{i=1}^n x_i \cdot \sin(2 \cdot i \cdot j \cdot \pi / n), \quad j = 1..n/2, \quad (1)$$

where we have: i - ordinal number of points in the implementation of the oscillatory process; j - number of harmonics.

In the fourth stage the arrays velocity v_i are formed and displacement s_i based on the following formulas:

$$\begin{aligned} v_i &= \sum_{j=1}^{n/2} \frac{1}{j} \cdot \left[-A_j \cdot \cos(2 \cdot i \cdot j \cdot \pi / n) + \Phi_j \cdot \sin(2 \cdot i \cdot j \cdot \pi / n) \right] \\ s_i &= -\sum_{j=1}^{n/2} \frac{1}{j^2} \cdot \left[A_j \cdot \sin(2 \cdot i \cdot j \cdot \pi / n) + \Phi_j \cdot \cos(2 \cdot i \cdot j \cdot \pi / n) \right] \end{aligned} \quad (2)$$

The two obtained arrays after normalization make it possible to construct the phase diagram of the dynamic system motion. The current position of the image point in the phase diagram is determined by a pair of coordinates with the same indices in the arrays S and V.

At the fifth stage the vibration distribution field is constructed in the coordinate system S-V and the number of its hits in each cell of the field size m_n is defined. As a result, the array $p_1 \dots p_{m_n}$ is formed; it reflects the shape of the trajectories of the vibrational value at the time of the cutting-length T. The resulting array can serve as a basis to identifying of deterministic constitutes in an oscillatory process. As a criterion, the value of the dispersion of values in array $p_1 \dots p_{m_n}$ can be used. It

characterizes the degree of irregularity in the oscillatory ingress values in the distribution field cells. For stochastic oscillatory process which is preferable processing, the variance is close to zero. The appearance of the deterministic component in the vibrational process causes a spike of the dispersion value.

At the sixth stage of the calculated dispersion is compared with the reference value. A positive difference indicates that in the current period of time machine dynamical system becomes unstable. When fixing a series of successive unstable states, micro-controller generates proper information for the machine control system. Reaction to it may be, for example, relaxation of cutting mode or stop the machine for changing tools.

Thus, submitted in the article oscillatory process signal processing method for the presence of a deterministic constitutes can be used in manufacturing equipment control systems to ensure quality processing.

UDC 658.382.3

J11307-171

Sosnina E.N., Masleeva O.V., Pachurin G.V.

ANALYSIS NOISE LEVEL OF POWER TRANSFORMERS

Nizhny Novgorod State Technical University n.a. RE Alekseeva

Greater attention is now being paid to the assessment of adverse effects of power on the environment, including the impact of noise generated by power equipment. Increased noise affects the nervous system, cardio - vascular system, the human ear can cause insomnia and rapid fatigue. Power transformers are one of the sources of noise in industrial areas and the surrounding area. The noise is caused by vibration of transformer active part, as well as cooling fans. Significant effect on the noise of the transformer have resonance phenomena in its individual elements. The estimation of noise exposure transformer station, which will be equipped with 3 dry transformer of 400 kVA - 1pc, with capacity of 1000 kVA - 2pcs voltage class 10/0, 4 kV. Calculations have shown that the noise generated by the transformer substation,

will be below normal for the area immediately adjacent to the university. Therefore, special measures to reduce the noise is not required.

Keywords: transformer, substation, noise, adjacent territory.

Power transformers are the main elements of the power supply circuit. Transformers are the source of the noise which negatively impacts on the environment and humans. Noise disease is characterized by a complex of symptoms: reducing auditory sensitivity, changes in digestive function, cardiovascular failure, neuroendocrine disorder.

Noise in transformers is caused by magnetoacoustic oscillations of electrical steel plate transformer core. Generated vibration is transmitted through the oil, and pockets of resistance with active part of the tank to the tank itself and from it to the air in the form of sound waves, vibrations of different frequencies. Especially a lot of noise comes from the tank cap. Additional sources of noise are the vibrations of the tank and its associated structures.

There is the calculation of noise transformer substation (TS), which will be installed in the courtyard of the academic building Technical University. TS is located in a brick building, which has dimensions of 6 * 6 * 4 m. TS building has a metal door of size 2 * 1 m, two metal gates measuring 2.5 * 3 m. 3 dry transformer will be installed on the TS with the nominal power 400 kVA – 2 pcs, 1000 kVA - 1 pcs voltage class 10/0, 4 kV. Transformers are manufactured by CJSC "Energomash (Yekaterinburg) - Uralelectrotyazhmash." The levels of sound power of transformers are indicated in the data sheet. It constitute to 400 kVA power $L_{PA} = 68$ dB, for 1000kVA $L_{PA} = 73$ dB.

Acoustic calculation of sound pressure level on the outside of the building TS is made in accordance with SNIP 23.03.2003 "Protection against noise."

There are the following basic data for calculation: the coefficient that takes account of the near field: $\chi = 2$, the noise source directivity factor: $F = 1$ (for sources with a uniform radiation); the solid angle of the radiation source: $\Omega = 2\pi$ rad (for a noise source located on the floor); coefficient allowing for violation of the diffuse sound field in the room: $k = 1,25$; average sound absorption coefficient: $\alpha_{cp} = 0,15$;

area of i -th surface: $S = 64\text{m}^2$, the equivalent absorption area $a = 9.6\text{ m}^2$; acoustic permanent premises: $A = 11.3\text{ m}^2$.

The calculated equivalent sound levels are as follows: a brick wall - 25.26 dBA, a brick wall with a metal door - 39.61 dBA, a brick wall with two gates - 48.22 dBA. According to CH 2.2.4.2.1.8.562-96 "Noise in the workplace, in residential and public buildings and residential areas" the allowable noise level in home and buildings in the area around is 50 dBA.

Thus, the comparison of numerical results with the permissible noise levels showed that the noise generated by the planned substation 10/0, 4 kV with three dry transformers total nominal capacity of 1800 kVA, from either side of the building will be below of the allowable for the area directly adjacent to the Technical University. Therefore, special measures to reduce the noise are not required.

UDC 372.8

J11307-172

Machehina F. V.

**USING THREE-DIMENSIONAL MODELING IN TEACHING STUDENTS
MECHANICAL ENGINEERING**

Polytechnic Institute of the Siberian Federal University, Krasnoyarsk, Kirenskogo 26

The author focuses on the role of new information technologies to upgrade the education system, the need for three-dimensional modeling technology in education of students of engineering disciplines, preparing them for further project activities to meet the requirements of modern industry.

Key words: educational process, the computerization of education, three-dimensional modeling, production.

The modern concept of higher education requires quality training, meet the new requirements of the modern profession. Informational education a prerequisite for the universalisation of interdisciplinary connections and resources and means of implementation, offering the means, methods and forms. The purpose of this process

is the formation of a system of scientific thinking of students, environmental, and information culture, creativity and high morals - qualities that will enable them to successfully adapt to live and work in a global information society. [2]

To improve the professional competence of future professionals need to implement the main ideas of the reform of higher education, one of the areas which is the introduction to the educational process of computer technology. Information technologies have a great influence on the preparation for future careers. As a result of their use in university educational process increased emotional response of students to the learning process, learning motivation, the interest to learn new knowledge, skills and their practical application, promotes the development of students' abilities, stimulates thinking. It is a three-dimensional modeling in creating drawings can, starting with the first course, students form an image of the object.

To date, almost the only discipline, "... learning it is the best means of our imagination, but not quite developed imagination, no substantial technical creativity, ie design ". Descriptive geometry is the basis of the engineering education, which forms the basic knowledge necessary for the study of special subjects. [1]

But at the same time, the main obstacle is the development of descriptive geometry complexity of perception drawing projection, since the projection is formed in the mind of the brain, and for the processing of graphics information given in summary form, need to be connected not only logical thinking, but also imaginative. Creative thinking does not only subjective, natural abilities, but also experience the perception of images (art, drawings, paintings, etc.). Using three-dimensional modeling in graphics packages task visual representation of geometric objects much easier.

The use of three-dimensional modeling to create a visual image of the object, the use of color, animation, but, nevertheless, should not distract students from the task. The ability to analyze the orthogonal drawing geometry, dismember his complex form to simple geometric components of the body - make it easy to move from 3D-models to flat drawings, while greatly simplifying the process of editing drawings. Of course in CAD, CAE - systems created for 3D-model drawings are secondary form of

display object. Drawing language - the language of production, including the experience and knowledge accumulated by generations of engineers. And not knowing descriptive geometry, engineering drawing is impossible to have an engineering mindset.

The use of three-dimensional modeling to create a visual image of the object, the use of color, animation, but, nevertheless, should not distract students from the task. The ability to analyze the orthogonal drawing geometry, dismember his complex form to simple geometric components of the body - make it easy to move from 3D-models to flat drawings, while greatly simplifying the process of editing drawings. The development and application of modern graphics packages in studying graphic disciplines determined by the specifics of education students Engineering, require the project activities of spatial thinking, the ability to perceive and produce graphics.

Three-dimensional design of products is one of the urgent tasks of engineering production. Creating a computer model is similar with layout product or the first sample, but with a much lower cost of materials and labor. Based on three-dimensional computer model of a constructive process all the elements and components of the product, identifies gaps, changes are made.

It is known that the development of products - the most complex process in its life cycle in terms of the quality of the products. It is at this stage of the life cycle is laid level of product quality, which is then provided in the production, support, appears and is in use or consumption. Known rule of "70:20:10", whereby the successful solution of the problem of product quality by 70% depending on the quality of its design, 20% - from manufacturing and 10% - from exploitation, namely product quality determines its competitiveness. "A prerequisite for the realization of the concept ZHTSI is the transition in the design of two-dimensional paper and electronic records to solid-state 3D-modeling of products and their components in the CAD-environment. Created at design virtual product model contains information about the topology and geometry of the parts and products in general, physical and mechanical characteristics of the material ". [3]

In a world of two-dimensional modeling of the resulting data are design drawings, which is a constant work throughout the product life cycle. When a three-dimensional modeling key element - solid model. The drawings are only one type of model views. According to the model is much easier to imagine a product before, as it will be physically manufactured. But the best visual representation of future product 3D-graphics on the order increases the accuracy of the design, particularly complex 3D-objects, you can easily edit the three-dimensional model, thereby saving time for the design.

This gives the designer in the early design stages to assess massoinertsionnye characteristics, collection items, steer mechanism, the correctness of the size of chains and other information that is in 2D-design could not be obtained. The presence of a virtual product model allows for a CAE-media full range of computational experiments on modeling business processes in the product and its components, not only to evaluate their performance on all indicators, but also to achieve a significant improvement in weight and size characteristics by optimizing the key dimensions of the parts and assemblies . Essentially at design products provide its performance and quality. [3] Indeed, 3D-model is not only the most complete, accurate and descriptive information carrier on future product, but also serves as the main link in the development of simulation techniques, simulation of machining of parts on CNC machines, the conflict analysis in assemblies, etc.

Thus, the use of CAD systems, based on three-dimensional modeling, is now the standard for building design and technological documentation (does not matter on the basis of how to build a CAD training, as the basic operations in any of them are similar.) This, in turn, causes the special requirements for the training of engineers in technical colleges. In organizing training as a necessary condition are: the formation of the specified levels of competence, professional culture specialist, development of its needs in continuing professional self-improvement. These conditions are fundamental for effective work in an environment of competitive environment.

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Yadykina V.V., Trautvain A.I.

**INCREASED ACTIVITY OF MINERAL POWDER, RESULTING IN
VARIOUS GRINDING MILL**

Belgorod Shukhov state technological university, Belgorod, Kostyukova 46

In this report we describe the dependence degree of shredding of various materials from the time of grinding in different mills, the concentration of exchange centers from the specific surface materials, as well as the decrease in the exchange capacity with time after grinding. Moreover, of the studied mills identified best in terms of increasing the activity of fillers of various materials.

Key words: activity, fine mineral powder, milling equipment, asphalt.

Now, the most important task is to use local materials as mineral aggregates and fillers for the production of asphalt. However, available raw materials often do not meet regulatory requirements, which forces use a variety of processing technologies that could improve the quality of the finished product.

One way to solve this problem is to make the necessary structural instability of the material or activity [1]. This is possible through control of refining processes, for example, by thermal, mechanical or chemical activation.

As a mineral powder for asphalt is usually produced by grinding, and only a small percentage of raw materials can be used in the initial state, then of considerable

interest to study the activity of the material is modified depending on the size of its specific surface area and reactivity after saving for a time meal.

Meanwhile, in a production environment and scientific research as the sole criterion of the degree of comminution is most often take the dispersion. The role of structural changes during milling has not been adequately addressed [2].

The objects of study were dispersed: quartz sandstone, waste wet magnetic separation of ferruginous quartzite (WMS), quartz sand and crushing of granite screenings. Grain composition of starting materials is presented in table 1.

Table 1

Characteristics of the grain composition of raw materials

Mineral material	Complete the remains on the sieve,%				
	1,25	0,63	0,315	0,14	less than 0.14
Quartz sandstone	0,8	12,7	30,4	74,5	99,9
Waste WMS	0,1	3,4	21,6	65,3	99,9
Granite	0,6	12,6	28,1	71,2	99,9
Quartz sand	0,4	4,9	35,3	84,1	99,9

Active material was characterized by the presence of Bronsted acid exchange centers on their surface [3].

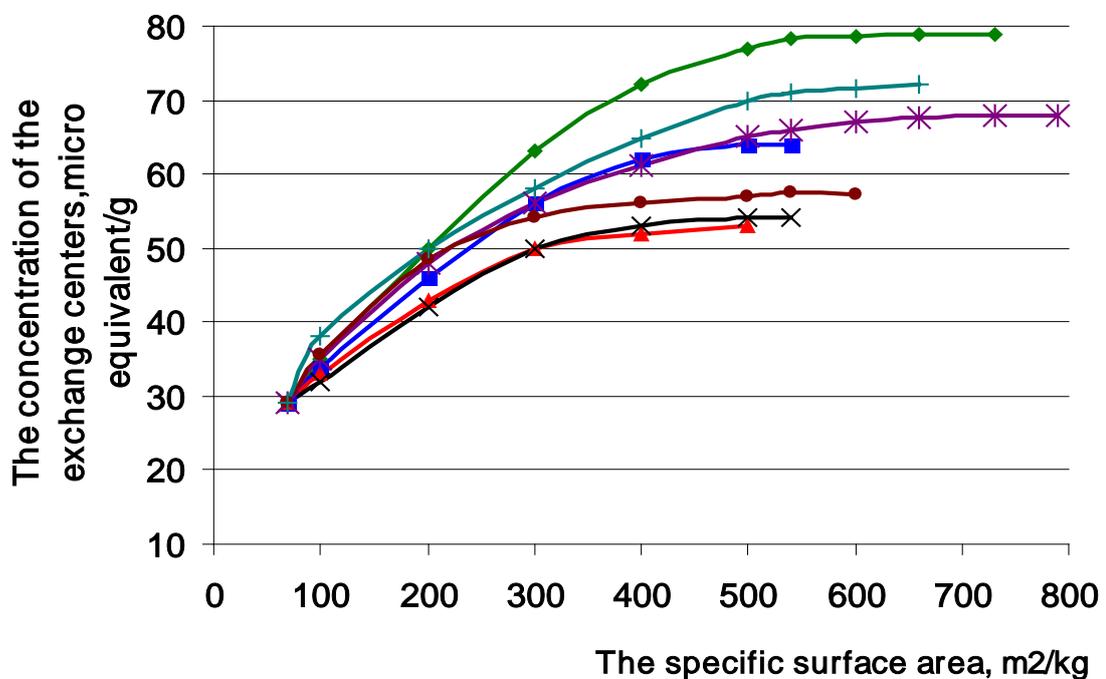
Depending on the specific surface of mineral powders on grinding time are shown in figure 1. However, grinding materials are different. Quartz sand has a very low capacity for grinding. This may explain the greater strength of sand grains. The high degree of grindability of waste WMS [4] due to the content of the waste fraction of mica and quartz, varying degrees of crystallinity. For high grindability quartz sandstone quartz content can be explained by the degree of metamorphism zalenoslantsevoy with defective structure [5].

The figure shows that the intense increase in specific surface occurs to a certain point, then grind to produce not advisable, since the growth of specific surface area is

considerably slowing down. As a result, the maximum surface area have the materials, crushed in a planetary ball mill, a minimum - in a vibratory attritor.

It was established [2] that the observed changes in physical-chemical properties of finely divided material may not be associated only with decreasing particle size. As it turned out, in many cases, the technological properties of fine powders due to dispersion is not so much how much the structure of such violations. In this connection it was of interest to identify the activity depending on the surface of the investigated materials, determined immediately after grinding on their specific surface.

a)



The figure shows that the degree of crushing significantly affect the concentration of active centers, and the dependencies for all materials in a variety of mills have their own characteristics. For example, when grinding in a planetary ball mill, an optimal surface area in terms of growth rates of the concentration of centers for quartz sandstone and waste WMS will - 600 m²/kg, granite and sand - 500 m²/kg, in a vibrating mill for quartz sandstone and waste MMC, this value is 400; sand - 300; granite - 450 m²/kg.

The presented results show that good time, meal, in terms of growth rates of the centers of concentration in terms of the optimal surface area is different.

As can be seen from the graph, most of the activating ability has ball planetary mill, the smallest - vibratory attritor. Perhaps this is due to the fact that in the planetary ball mill material fracture occurs in the field of structural defects formed during this fragmentation particles have a shape, whereas the vibration

b)

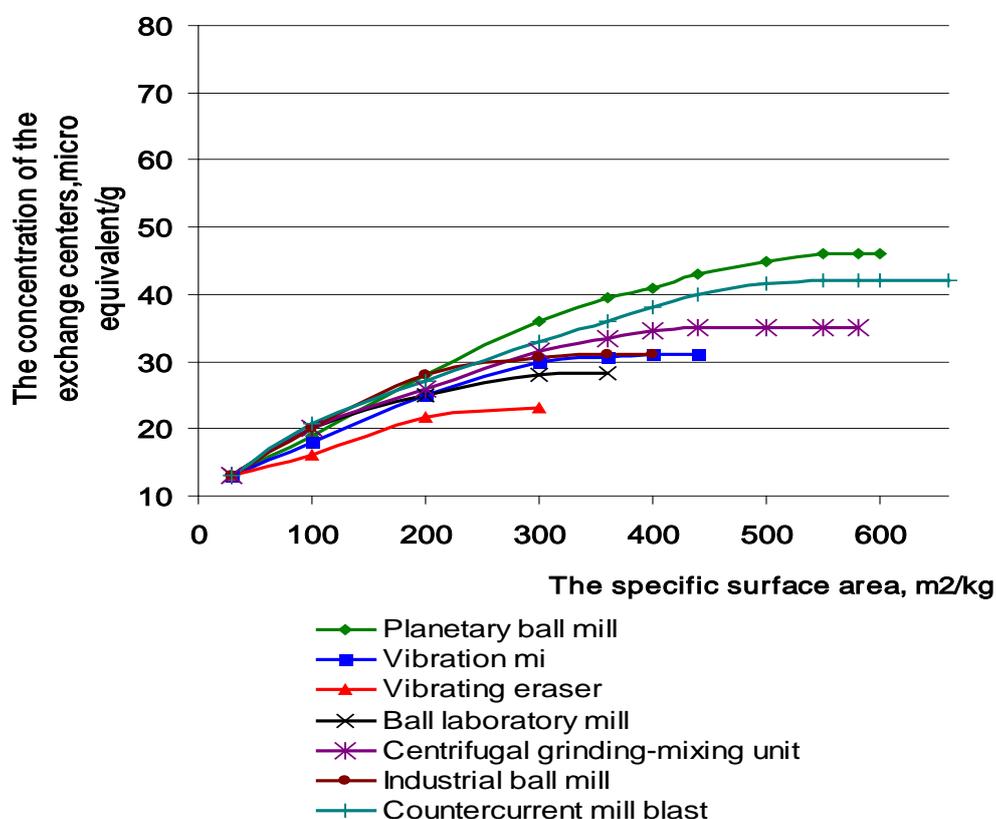
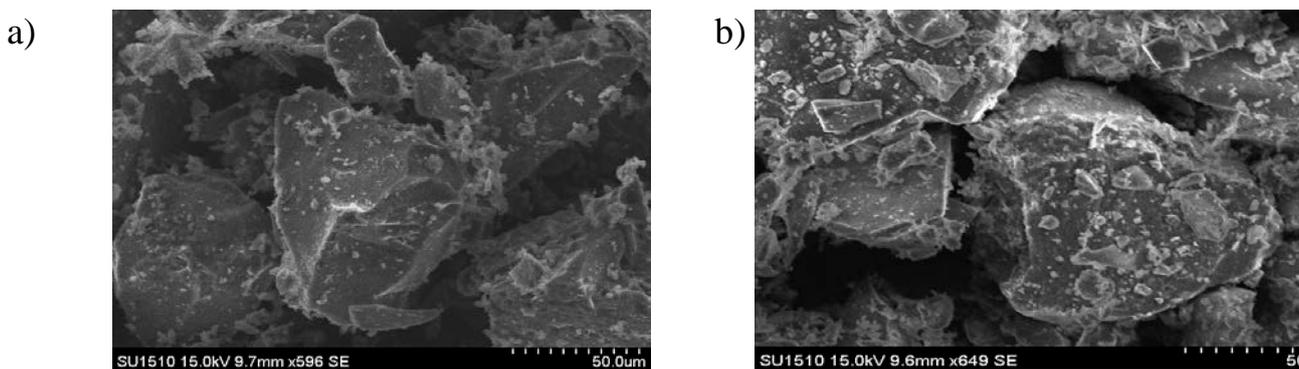


Fig. 1. Dependence of the concentration of active adsorption sites on the surface of materials, crushed in different mills, on the specific surface: a - quartz sand; b - waste WMS

Eraser material affected only the abrasion particles is only a round shape, and material in the ground vibrating mill, a small percentage of fragmentation of grains form (fig. 2).



**Fig. 2. The surface morphology of the particles, crushed in a variety of mills:
a - planetary ball mill; b - ball mill**

Herefore, when grinding the material must consider not only the nature and properties, but also the type of mill, which has the greatest effect on the activating surface of materials.

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J11307-175

Tchigirinsky Ju. L.

**ASSESSMENT OF THE RELIABILITY OF THE DESIGN PLANS OF
PROCESSING ON THE BASIS OF THE PROBABILITY TABLES
ACCURACY**

Volgograd State Technical University, Russia, Volgograd, Lenin's av., 28

This article considers the technique of evaluating the reliability of mechanical processing. Application of the proposed technique allows to jump to a statistically justified design plans of mechanical processing of surfaces of a specified quality.

Key words: technological design, plan processing, stage of mechanical processing, reliability, quality, variations factor.

Introduction. Examining the concept of «reliability» as applied to mechanical treatment, we can be argued:

– for mechanical surface treatment, performed in a separate technological transition, the following terms should be considered the totality of processing modes and physical-mechanical properties of instrumental and processed materials. In case of correct project, these conditions uniquely correspond to specific technological method;

– compliance with the treatment conditions should expect to receive the results of the processing, the relevant technological tolerances [1, 5];

– a variation of processing conditions on a separate technological transition in the permissible range shown in the tables accuracy in the intervals of non-zero width values of each of the indicators of products quality.

Let us consider separately taken the technology transition from the point of view of assessing the reliability of the projected results of processing. We believe that the process of processing can be considered reliable in that case, when the inaccuracy of the resulting value is estimated by the value, significantly lower than the resulting eigenvalue. Reliability of technology transition can be defined as the probability of

securing the required accuracy parameters [4].

Depending on the number of considered parameters, handling plan is modeled technical system with serial structure (fig. 1, a) or mixed structure (fig. 1, b).

In practice, under the oversight at minimum of two parameters of the processing quality (as a rule, the accuracy of the size and height of roughness parameters of the processed surface), serial (fig. 1, a) the structure of the plan may not be considered. For the analysis of composite structures fulfill the decomposition of the scheme and the sequence (fig. 1, b) independent blocks, as which we consider technological transitions.

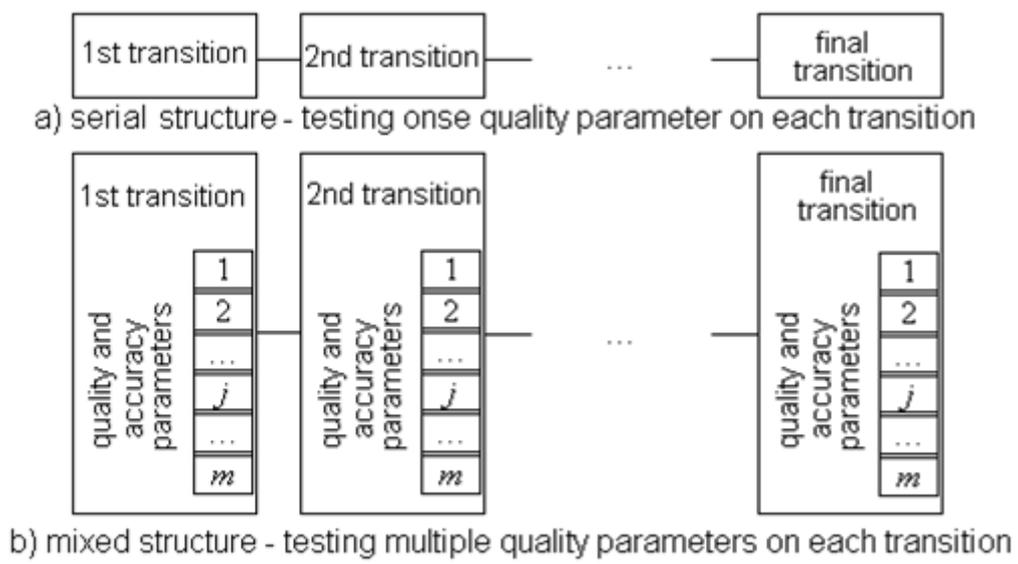


Fig. 1 The structural scheme for the calculation the reliability of processing plan

Each of the indicators of treatment quality is random value, which is characterized by its own set of parameters [1, 4]. Because of the quality indicators, relating to the different classification groups [1], have a different – this is evidenced by the majority of research in the field of the theory of cutting nature, the random variables, the relevant quality indicators should be viewed as mutually independent. The total reliability of several, joint mutually independent processes are determined by the value of the probability of the expected completion of these processes [4].

$$P_{\Sigma i} = \prod_{j=1}^m \Phi(v_{ij}), \quad (1)$$

where m – the number of tested quality parameters at each separate technological transition;

V_{ij} – variation coefficient of each (j) quality parameter at each (i) separate technological transition;

$\Phi(V)$ – cumulative probability of the expected completion of the process, which is determined for the most often considered the laws of the distribution in accordance with the math expression (2).

$$\Phi(V) = \begin{cases} \frac{1}{\sqrt{2 \cdot \pi}} \cdot \int_{-\infty}^{\frac{1}{V}} V^{-2} \cdot e^{-0,5 \cdot V^{-2}} dV, & V < 0,564 \\ 0,5 + \frac{1}{V \cdot \sqrt{6}} - \frac{1}{12 \cdot V^2}, & 0,564 \leq V < 0,697 \\ 0,5 + \frac{1}{2 \cdot V \cdot \sqrt{3}}, & V \geq 0,697 \end{cases} \quad (2)$$

Reliability is measured by the value of the variation coefficient, since the variation coefficient is a statistical criterion, not dependent [3] from the relationship of probability distribution within the technological tolerance. It can be assumed that the values of the accuracy and quality indicators of the treatment, the corresponding lower limit values intervals tables accuracy is achieved with a probability equal to 100 %. Then getting results at the upper limits of the technological tolerance is possible with a probability of less than 100 %, and the probability is less than the more distinctive the stochastic nature of the process.

Let us consider the probability distribution within the technological tolerance for each pair of adjacent in terms of processing technology transition (table 1) on the example of the quality indicator of the processed surface – the arithmetic average of the deviations profile (Ra).

Consider the technological transitions, for which the calculated value of probability is different from 100 %: once-core-drilling, executed after the rough-core-drilling (likelihood of receiving $Ra = 4$ mcm is 91 %) or after drilling (81 %) and finish-core-drilling after semi- (or once-) core-drilling (68 %). For the construction of nomographic chart probability distribution within the process of admission perform the interpolation (2) of 10 intervals. The characteristic points of the interpolation intervals calculated (3) in such a way that the Ra^{\max} corresponds to $F(V = 0) = 100$ %

and $V = 0$; $Ra^{\min} - F(V_{ij})$ and $V = V_{ij}$.

Nomograph (fig. 2) shows that for the considered methods of processing it is possible to guaranteed (with probability not less than 99 %) receipt of a surface with roughness of Ra no better than 9 mcm to semi- (or once-) core-drilling, and it is not better to 7 mcm to a fine-core-drilling.

Table 1
Changing the Ra parameter at multi-transition processing of cylindrical holes [2]

Previous transition		Ra tolerance		Improvement of the quality (ratio), times										
				Next transition										
		min	max	1	2	3	4	5	6	7	8	9	10	
1	rough-core-drilling	10	20			1,15	1,29	2,22	4,43	4,43	8,82	9,08	17,5	
2	drilling	10	20			1,15	1,29	2,22	4,43	4,43	8,82	9,08	17,5	
3	once-core-drilling	4	16	0,91	0,81			1,12	1,93	3,85	3,85	7,67	7,89	15,2
4	finish-core-drilling	4	10	1	1	0,68			1,72	3,44	3,44	6,85	7,05	13,6
5	semi-reaming	1,25	6,3	1	1	1	1			2,00	2,00	3,98	4,10	7,88
6	semi-grinding	1,25	3,20	1	1	1	1	1			1,03	1,99	2,05	3,94
7	finish-reaming	1,00	3,20	1	1	1	1	1	0,65			1,99	2,05	3,94
8	finish-grinding.	0,40	1,25	1	1	1	1	1	1	1			1,03	1,98
9	fine-reaming	0,32	1,25	1	1	1	1	1	1	1	1			1,92
10	fine-grinding	0,16	0,63	1	1	1	1	1	1	1	1	1		

$$\Phi(R_a^k) = \frac{(R_a^{\max})}{\left(\frac{R_a^{\max}}{R_a^{\min}}\right)^{\left(\frac{k}{10}\right)}}, \tag{3}$$

where k – ordinal position of an interpolation interval; $k \in [1;10]$;

Ra^k – each (k) characteristic value of technological parameter Ra within a technological tolerance.

All other combinations of processing methods, considered at table 1, are reliable enough (the probability is 100 %), or did not feasible as, for example, boring after grinding.

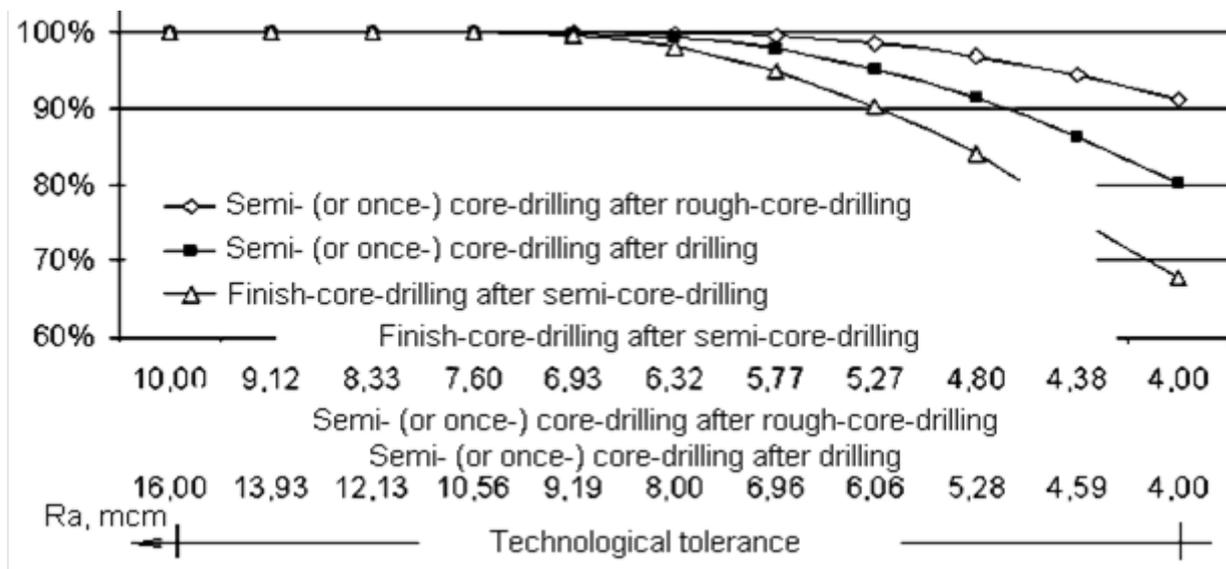


Fig. 2 The probability distribution within the technological tolerance

Conclusions. The proposed technique of calculation of the reliability of processing makes it possible to build algorithms for the design of plans of processing of surfaces with specified quality on the basis of probability tables accuracy using the methods of discrete mathematics.

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UDC 622.06; 622.013.364.2

J11307-176

Kovalsky E.R.

PILLARS EXTRACTION AT THE FLAT SEAMS

National mineral resources university

The paper is devoted to the problem of increasing the extraction ratio at the potash deposit “Starobinskoe” (Belorussia) by mining out the pillars left in ground. Technology of the pillars extraction based on the auger equipment is introduced. Some elements and parameters of the technology are described.

Key words: potash seams, extraction ratio, auger equipment, pillars.

Introduction: During coal and potash mining, some parts of seams (pillars) are not extracted to the surface. These parts are left underground and referred as “written-off resources”. The pillars hold the roof strata, keep the waterproof layers intact (it is a primary concern at potash deposits), keep the excavations in normal usable condition, etc. Leaving the pillars in ground leads to low extraction ratio – for example, at coal deposits the extraction ratio may drop down to 70-80%, and at potash seams – even to 40-60%.

On fig. 1 an example of mining method is shown. The method is implemented at potash deposit “Starobinskoe” (JSC “Belaruskaly”, Belorussia). It is seen from the figure, that two types of large pillars are used – so called “internal” (inside the current extraction panel or column) and “external” (barrier pillar between the current and the previous panel).

The purpose of the internal and external panel pillars is to keep safe the panel drifts and prevent them from collapsing under the bearing pressure. Pillar width a may vary from 20 to 100 m and length – from 1500 to 2500 m, depending on specific conditions. The situation is the same in the other mining methods implemented at

deposit “Starobinskoe”. Some researches were made at deposit to develop and implement mining technology without the pillars at all, but they were not successful.

All these aspects lead to significant loss of mineral resources, decrease of mines’ operating period, loss of potential economic benefit.

Results of studies: Some researches were carried out with intention to deal with low extraction ratio at “Belaruskaly”. The results showed that the perspective method of solving this problem is the extraction of the pillars with auger equipment [4].

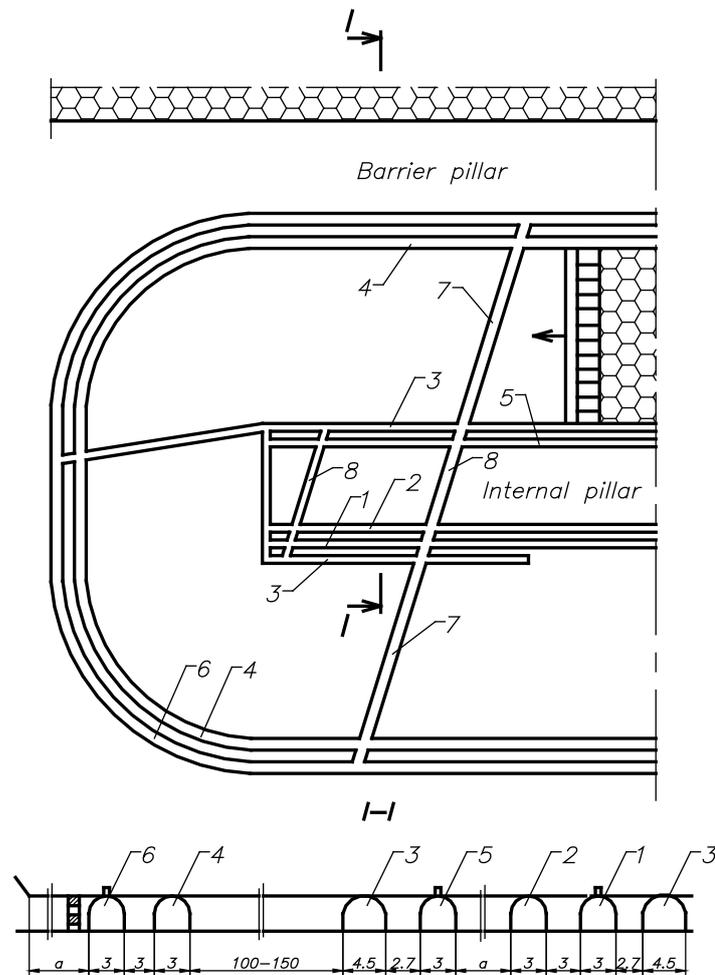
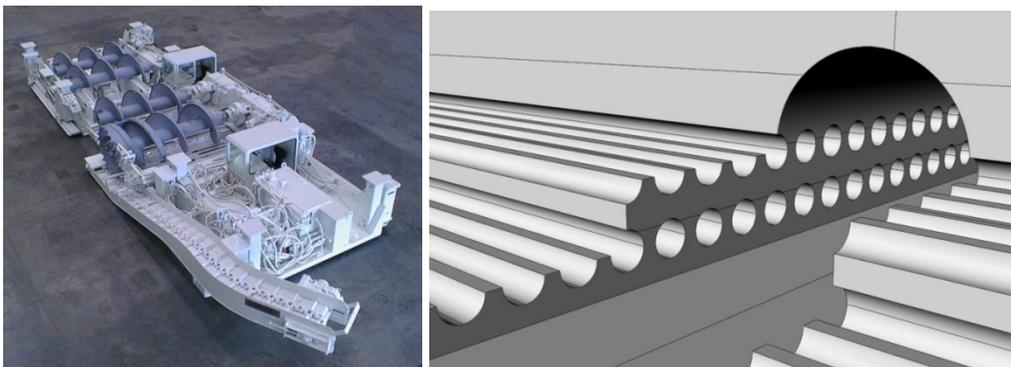


Fig. 1. Typical mining method with turning longwall face to the opposite direction at the edge of panel

1, 2 – panel conveying and transport drifts; 3, 4, 5 – conveying, ventilation and transport drifts for the longwall face; 6 - service drift; 7 – additional service excavations; 8 – cross slits; “a” – pillars width

Augering machine (AM) is placed in a “start drift” and bores large holes in productive layers (fig. 2)



Pic. 2 Augering machine BUA 600 (BryDet Development Corporation, USA) and a series of double-rowed boreholes in walls of a start drift

Modern modifications of augering machines are able to make boreholes with diameter 0.5-0.8 m, length up to 85 m, inclination up to 15° , in rocks with cuttability up to 250 kN/m. Some models can make twinned holes instead of single holes shown on fig. 2 (in this case boring bars rotate in different directions to compensate for rotary moment).

Potash seams at deposit “Starobiskoe” are characterized by complex geological structure and consist of productive layers of sylvinite and non-productive layers of carnallite. The advantage of AE in such conditions is its ability to extract the productive layers selectively thus decreasing transportation and processing costs.

On fig. 3 principal scheme of development and extraction of pillars with auger equipment is shown. On fig. 4 a variant of equipment layout is present. These are the typical schemes and may vary according to specific conditions.

In some cases panel pillars are in good conditions and ready for extraction. Only construction of the start drifts is required. Stress-and-strain state of the pillars varies depending on the time period lasted since their formation. Also it depends on position of the extraction front on the current and neighboring production horizons [3].

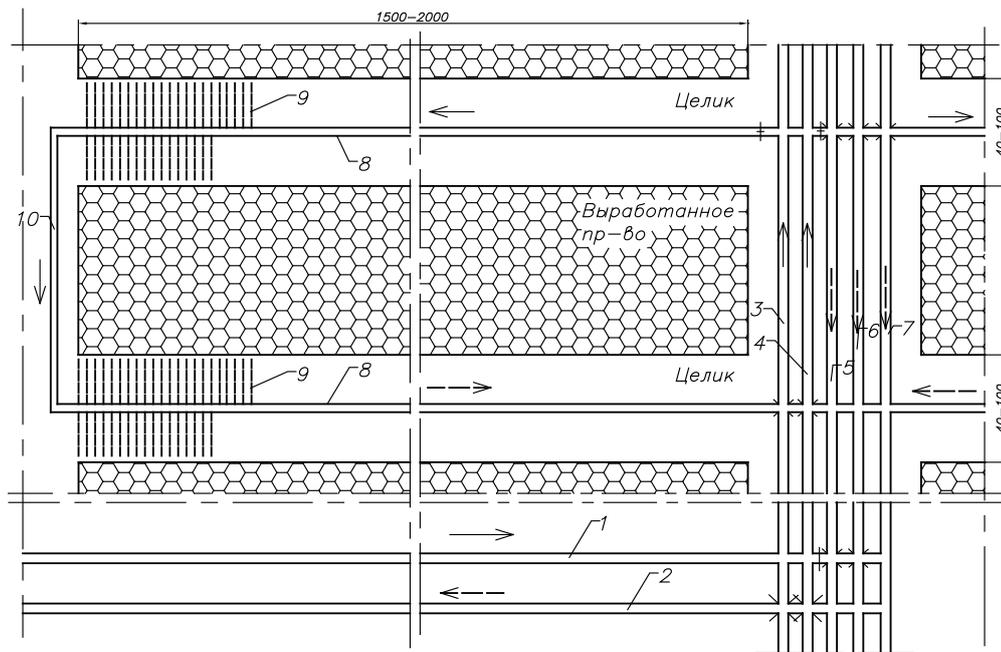


Fig. 3. Scheme of pillars' extraction

1, 2 – main conveying and transport drifts; 3-7 – panel service drifts; 8 – start drifts; 9 – boreholes; 10 – boundary ventilation excavation

After repair of the panel service drifts (if necessary) the start drifts are constructed. According to the development configuration at the deposit “Starobinskoe”, there are 5 panel drifts are shown on fig. 3 (positions 3-7). It's not necessary to use all of them for pillar extraction and only two or three may be required, depending on AE output.

Position of start drifts depends on the width of the extracted pillars. On the scheme (fig. 3 and 4) the drifts are constructed in the middle of the pillar. The drifts are connected via boundary ventilation excavation on the boundaries of the mine field to ensure the ventilation due to the mine air-pressure drop.

Extraction of potash seams inside a pillar may be done with one or two augering machines (AM) placed in s start drift. In the first case the same AM drills the boreholes in both directions; in the second case one AM drills boreholes only in one direction. The second variant is preferable because the output is 2-2.5 times higher (due to lower cycle time).

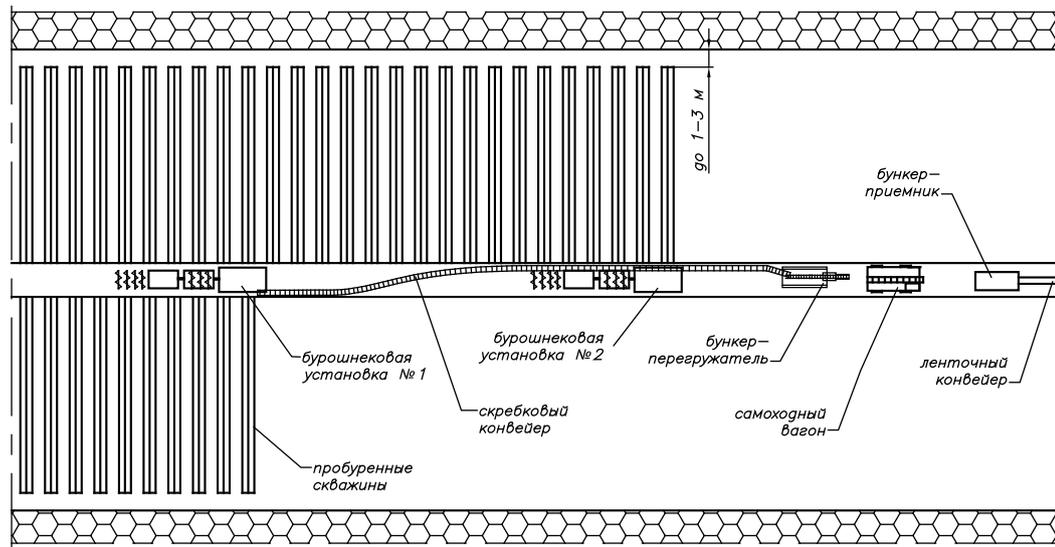


Fig. 4. An example of equipment layout

A stand-alone topic for research is the safe parameters of the pillars between the holes. The numerical modeling [1] was carried out to estimate the safe and rational pillar width. If the pillar width is about two diameters of the holes (extraction ratio is about 33%) then the pillar behave as a “rigid” construction; if the pillar width is about two and a half of diameters of the holes (extraction ratio is ~40%) then the pillar exhibits “yielding” behavior. The further increase in extraction ratio may lead to the deterioration of mechanical state of rock mass and working conditions.

Modification and implementing of the known approaches in calculation of the AM output [2] for the given conditions have shown that the drill velocity is more important than the length of the boreholes. If high production levels are to be reached, than the drill velocity must be increased in first place instead of increasing depth of boreholes.

The volume of development works for extraction of pillars is 5-7 meters per 1000 tons of extracted ore. It is 2-5 times lower than the same parameter for the “traditional” mining methods at potash deposit “Starobinskoe”. The total ore output is about 3.3 tons per 1 meter of the borehole length.

The possible economic benefit for one extraction column can be calculated from the expressions

$$E = n \cdot d \cdot l \cdot A \quad (1)$$

or

$$E = \frac{d}{d+b} \cdot L \cdot S \cdot A \quad (2)$$

where n – number of the boreholes; d – diameter of the boreholes; l – length (depth) of the boreholes; A – per-ton production cost (before processing)); b – width of the pillar between the boreholes; L and S – length and width of the extraction column.

Conclusions: The production cost is higher than in traditional mining methods if auger equipment is used to extract the pillars. However, high mining costs are compensated by low processing costs due to high quality of the potash ore ensured by selective extraction of the production layers. Aside from that, the significant advantage of the presented technology is the possibility of extraction of abandoned and written-off reserves of potash ore. The expected effects are the following: increase in extraction ratio by 10-15% (i.e. the overall extraction ratio will reach 65%); increase of mine operating period by 8-12 years; for a typical production unit the possible economic benefit may amount to 1.2 million US dollars per one extraction column.

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**Shelkunov E.B., Vinoglodov S.V., Shelkunova M.E., Pronin A.I., Samar
E.V., Savchenko R.E.**

**REKONFIGURIRUEMY THE MACHINE TOOL WITH PARALLEL
KINEMATICS WITH THE CONTROLLED ZONE OF ACCESS**

Komsomolsky-na-Amure the State Technical University,

In given clause the circuit of the metal-cutting machine tool with a controlled zone of the access based on a combination of the mechanism of parallel structure on bars of variable length with the mechanism on bars of constant length is submitted.

Key words: The machine tool with parallel kinematics, tripod, triglyd, working space, a bar, the hinge, a platform, the basis.

Now in world machine-tool construction the equipment based on mechanisms with parallel structure (tripod, geksapod, triglyd, etc.) actively develops. Use of these mechanisms in metal-cutting machine tools allows to reach high accuracy and speed of execution of movements at rather low general material-capacity the equipment and simultaneously with it, high reliability and constructive flexibility.

One of the major properties of all metal-cutting machine tools are the form and the size of their working space. The working space of machine tools with parallel kinematics represents a complex geometrical figure on which form the big influence render: the quantity of bars and their arrangement, and influence the sizes of working space: a corner of a divergence of bars, lengths of bars and a range of their change, mobility of hinges, diameters of the basis and a platform.

In the sizes the working space of machine tools based only on one parallel structure considerably concedes to working space of machine tools of the same dimension with consecutive kinematics. The given lack can be in full or in part eliminated by use of the hybrid configuration combining in elements of traditional consecutive and parallel kinematics [1], or rekonfiguriruemy the mechanism of

parallel kinematics [2, 3], i.e. an opportunity of change of parameters of the parallel mechanism during work of the machine tool.

All mechanisms of parallel structure used in metal-cutting machine tools, are divided on two groups:

- Mechanisms with bars of the controlled variable length (bipod, tripod, linapod, pentapod, geksapod);
- Mechanisms with bars of constant length (bigly, trig laid, ortoglyd, geclaglyd, rotopod, "delta", "scissors").

Rekonfiguriruemy mechanisms with bars of constant length it is carried out by change of a corner of an inclination directing, and accordingly and directions of movement carriage [2].

Rekonfiguriruemy mechanisms to bars of variable length occurs change of radius of the basis and corners of an arrangement of hinges on the basis [2, 3].

On fig. 1 the circuit rekonfiguriruemy the machine tool - geksapoda with the controlled form of working space [2] is shown. At simultaneous change of lengths of bars there is a change of position of working body in the space limited to a range of courses of bars. For moving working body outside this range it is necessary to move hinges of the basis along directing. The length of moving of each of six hinges depends on a necessary direction of increase in a working zone.

At the given configuration the working space is inside the mechanism and is limited to the hinges located on a motionless platform (basis), and an opportunity of collision of working body with drive bars. Displacement of hinges on directing changes corners of their arrangement, but does not allow to expand border of working space considerably.

On faculty « Technology of mechanical engineering » Komsomolsk – na - Amure state technical university it is developed rekonfiguriruemy the metal-cutting machine tool with a controlled zone of access which parallel mechanism unites the elements inherent in mechanisms with changeable length of bars and mechanisms with constant length of bars [4].

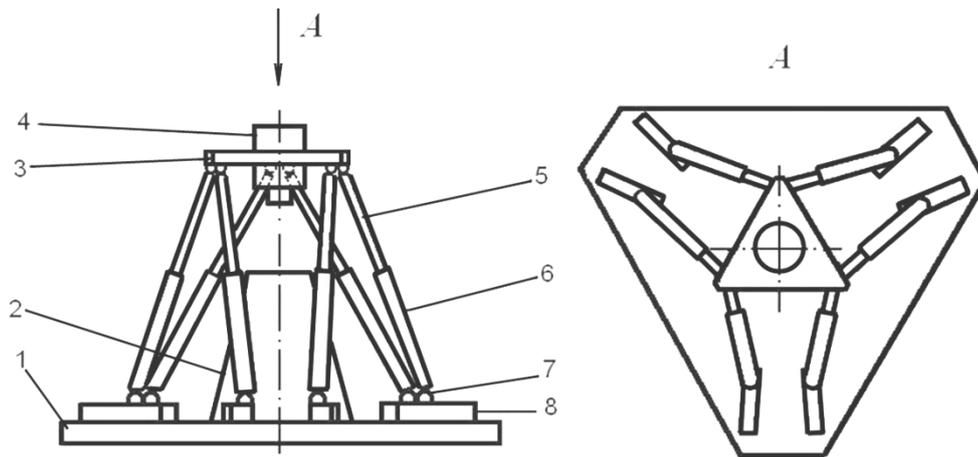


Fig. 1. The machine tool - geccapod with the controlled form of working space [2 : 1] - a motionless platform; 2 - a table; 3 - a mobile platform; 4 - working body; 5 - a rod of a bar; 6 - the case of a bar; 7 - the hinge; 8 - directing

For a basis parallel mechanisms triglyd (fig. 2, a) and tripod (fig. 2, б) are accepted. On fig. 3 the structural - kinematic circuit of the parallel mechanism of the developed machine tool with a controlled zone of access is shown.

The mechanism contains the motionless basis consisting of the central part of 1 and three running screws 2, missing from the central part beams through everyone 1200, the bottom platform 6 and three telescopic приводные the bars 4 resulted by electric motors (on the circuit are not shown).

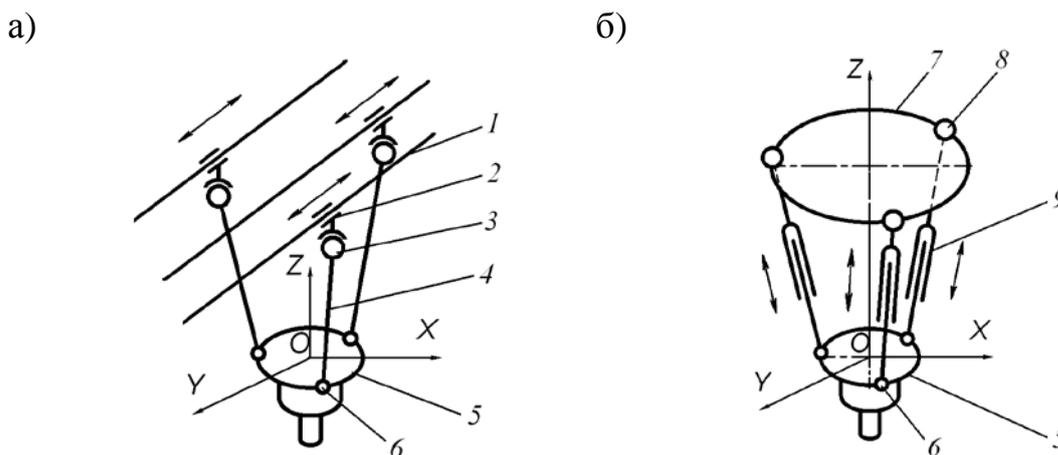


Fig. 2. Circuits triglyd (a) and tripod(б): 1 - directing; 2 - the carriage; 3 hinge of the carriage; 4 - a bar of constant length; 5 - a mobile platform; 6 - the hinge of a platform; 7 - the motionless basis; 8 - the hinge of the basis; 9 - drive a telescopic bar

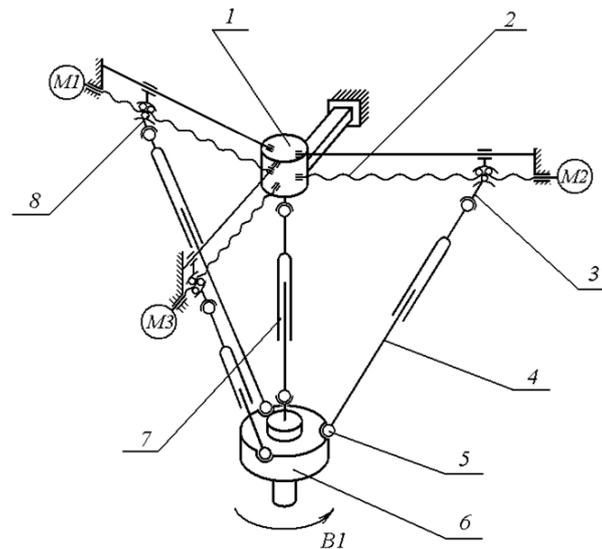


Fig. 3. The structural - kinematic circuit of the parallel mechanism: 1 - the central part of the basis; 2 - the running screw; 3 - the top hinge; 4 - drive a telescopic bar; 5 - the bottom hinge; 6 - the bottom platform with the tool head; 7 - the central bar; 8 - the carriage; M1, M2, M3 - electric motors of drives carriage

Drive bars 4 and central not drive a bar 7 connect the basis and the bottom platform with the help of hinges 3 and 5. The top hinges 5 are established on the carriages 8 resulted by electric motors M1, M2, M3.

From tripod here there are three drive telescopic bars 4 with engines and the central bar 7. From triglyd - carriages 7 on directing, located under corners 120o to each other.

In the given design of movement of a mobile platform can be realized by the next ways:

- 1) By change of lengths drive telescopic bars at the fixed set position of the top hinges;
- 2) By moving the top hinges drive telescopic bars at the constant set lengths drive telescopic bars;
- 3) By moving the top hinges drive telescopic bars along running screws with simultaneous change of lengths drive bars.

Key parameters of the parallel mechanism are resulted in table 1.

Table 1

Parameter	Numerical value, mm
Radius of the basis of the machine tool	160 - 400
Radius of a mobile platform of the machine tool	80
Height between a platform and the basis	800
Diameter of a sleeve of a bar	32
Diameter of a rod of a bar	20
Diameter of a sleeve of the central bar	50
Diameter of a rod of the central bar	40

The given mechanism allows to change radius of the basis, achieving a parity of radiuses of the basis and mobile platform $R/r = 2-5$ that directly influences the size of working space of the machine tool.

On fig. 4 sizes of the greatest areas of section (fig. 4, a) and volumes (fig. 4, б) working space are shown at the greatest and least parities of radiuses of the basis and a platform. Calculation was carried out in the original program « the Program for the decision of direct and return problems of kinematics for the equipment of platform type» [5].

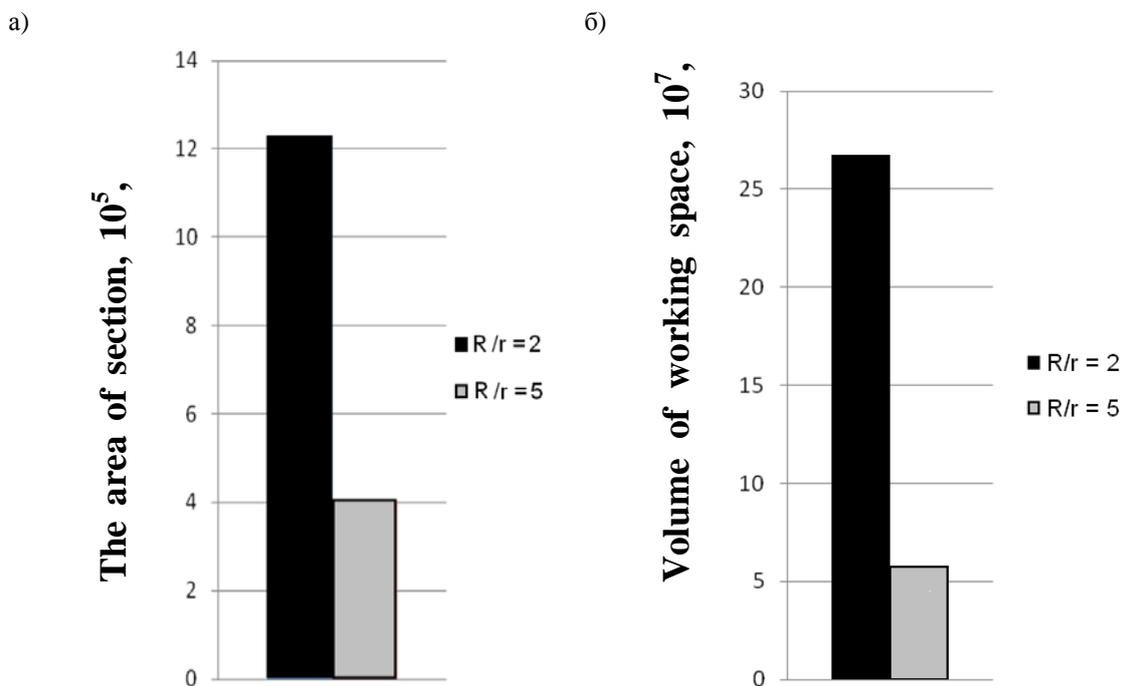


Fig. 4. The sizes of working space of the machine tool at the greatest and least radiuses of the basis: and - the greatest area of section; - volume

At parity $R/r = 4-5$ size of working space is minimal, however it should be chosen at processing preparations of the complex form demanding an inclination of a

spindle, with the purpose of prevention of collision of a platform with processable preparation. When the increase in a zone of working space is not required an inclination of a spindle probably by reduction of parity $R/r = 2-3$.

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Kizim A.V.

**ORGANIZATION OF MAINTENANCE AND REPAIR
METHODOLOGIES PROGRAMMING-INFORMATIONAL SUPPORT**

Volgograd State Technical University, ARMSoft Ltd.

Russia, Volgograd, Lenin avenue 28, 400005

In this report the tasks of application of program-informational and methodical tools of effective maintenance and repair organization (MRO) are described. The work actuality and necessity are given. The software MRO support systems classes,

modern MRO methodologies and structure of MRO methodological support are listed. The MRO methodologies support program-informational algorithm is given.

Key words: equipment, maintenance and repair (MRO), maintenance and repair organization, methodological and program-informational MRO support MRO methodologies.

Enterprise should constantly look for ways to reduce costs and improve productivity to ensure its competitiveness. Actually one of the current problems is the rational using of the enterprise assets. Scheduled production value is performed and possibility of additional production is realized during the equipment optimal functioning. In this regard, rational maintenance and repair of equipment, reducing downtime and increasing its efficiency of use has particular importance. Mechanical services company or specialized service contractor organizations performs supporting function of facilitate the smooth equipment functioning. [1]

Methodical and comprehensive software and information support is required for effective equipment maintenance and repair organization (MRO). The following software or tool (methodical, mathematical, computer, information, organization, technology and other means) can be used for more effective management of MRO processes. Specialized software and information systems can be used to automate the assets maintenance and repair. [2] It may be the system ERP system (Enterprise Resource Planning), EAM system (Enterprise Asset Management) and CMMS (Computerized Maintenance Management System) depending on the scale of the problem. Unfortunately, none of the MRO support software system has all necessary to end user features.

The service department of an enterprise been organized by the head of repair service with a set of guidelines, rules and regulations. In the Soviet Union was acted the GOST 28.001-83, describes the purpose and structure of a set of "System maintenance and repair of equipment" (STOiR) standards. In Russia there is not as such a complete system of existing standards regulating directly the MRO organization and conduct processes, activities, and procedures for maintenance and repair. There are MRO industry standards in several industries. Several large

companies have their own standardization elements, but this is an exception to the general rule. Industry institutional methodical materials used in the Soviet Union are outdated and do not apply to the full at this moment.

Supporting maintenance and repair organization tools available in our country are not enough [2]. The developing and adapting a wide range of modern supporting maintenance and repair tools, including methodical support [1, 3], software and information systems, mathematical methods and algorithms for solving problems [4] and needed.

Maintenance and repair organization efficiency performance improving is possible by the using of modern advanced MRO methodologies and their combinations. MRO process improvement approaches historically changed from equipment reactive repairs (emergency repairs) in fact its failure to preventive maintenance. Preventive maintenance can be divided into the following types: planned (or scheduled) maintenance (like detailed Soviet industry methods of MRO organization, describes in detail the maintenance and repair rules of industrial equipment types), maintenance of the equipment status (condition based maintenance) and the best preventive maintenance on the basis of forecast data. Each of these approaches has its advantages and disadvantages and should be applied according to its terms of use. The different MRO organizations approaches to different equipment groups are necessary to apply for better management of maintenance and repair (the prototype is the RCM maintenance technology [5]). To segment the equipment assets groups, you can identify a number of criteria for assessing the equipment performance characteristics in accordance with applicable maintenance and repair organization approach. That's the equipments critically (the importance of its ongoing work), cost of repairs, maintenance and repair time, etc. The risk matrix can apparatus be used for its division and selection.

That's steps of software and information supporting of MRO methodologies organization:

1. Collection and organization of information: providing views in a database of all information MRO process objects, and the storage of historical information on equipment failures, and the ongoing work.

2. Measuring the equipment and MRO organization performance. The use of a balanced quality scorecard associated with the objectives hierarchy [6] allows us not only to assess the current situation, but also to produce directional continuous improvement of MRO.

3. Application of information (software technology of data storage and the different reports formation), mathematical (analytical and other algorithms) and software (software automation features of repair services, including integrations with ERP and EAM software systems).

4. Application of artificial intelligence models: the knowledge representation model (frames, semantic networks, ontology, knowledge maps) and the corresponding inference procedures.

5. Efficient implementation of integrated complex MRO support. That's the study of the present MRO system, its reengineering (if required) and the implementation of software, informational and methodological MRO support tools combination.

Some results on the integrated methodology of maintenance and repair organization development to support MRO on the base of systematic manner achieved.

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Ivanova N.N.

**FEATURES OF LEARNING MATERIALS PROVISION FOR
REGIONAL DEPARTMENTS OF NETWORK UNIVERSITY**

Moscow state industrial university, Moscow, Avtozavodskaya st., 16

This article is devoted to automation of the accounting process of learning materials in network university. The described approach is used in Institute of distance education in MSIU.

Key words: network university, quality of education, information systems, accounting system of learning materials, learning materials provision, content, curriculums.

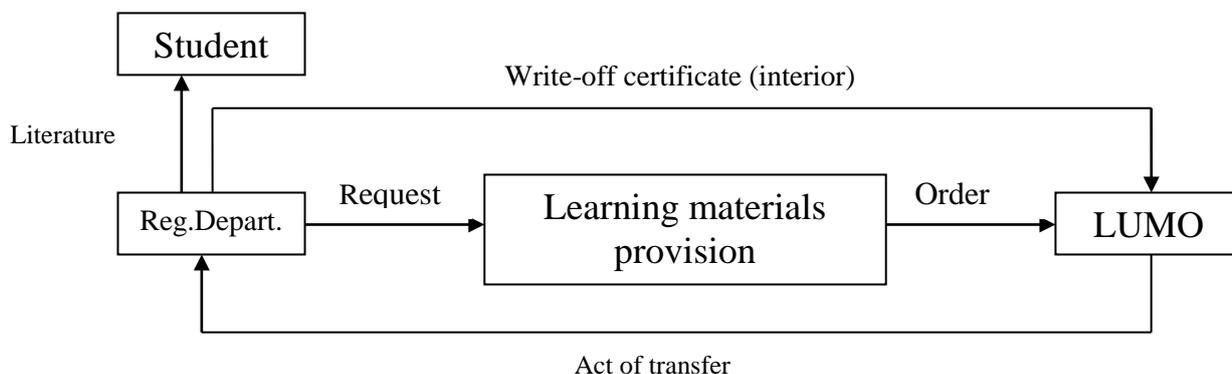
Nowadays the accounting system of learning materials of the university has very important meaning in the timely provision of students learning materials. It plays more important role in the meaning of the network university. We named some university “network university”, if it has wide net of regional departments [1]. Faced with the electronic system of distance education, the “parent” university should provide library existence in every regional department, the student to have access not only to electronic resources, but also to the default instance of textbooks. This is

primarily due to the fact that, despite the widespread Internet access in the country, there are regions where access to the network is weak or non-existent.

As for the quality of educational activity, university should provide each student with a complete set of appropriate learning materials. That is why it is necessary to control the degree of fullness of the library collection and relevance in every regional department. The accounting system of learning materials helps a lot in this process, because it covers all stages in provision of students with learning materials: from purchases accounting till writing off from the balance.

As is known, the learning process takes place in strict accordance with the curriculums. Every year educational segments are formed. Every discipline has list of literature, recommended for learning in every curriculum. It is this list which helps to regional employees to form books sets for students. To realize the volume of regional library collection at the moment, the accounting system of learning materials envisages set of dynamic reports, which helps to control literature ordering process from the “parent” university and to control process of students books provision [2].

The scheme of the process provision of students with learning materials in regional departments can be represented as depicted below (pict. 1).



Pict.1. The provision of students with learning materials in regional departments

To order the delivery of literature, the employees in regional department have to generate a request, which is regarded by the laboratory of training and methodological support (LUMO) in the “parent” university. This request is generated in the accounting system of learning materials based on information about students quantity in this educational segment, who study relevant literature, and information about the volume of regional library collection at the moment.

The learning materials provision in regional department consists of difference between books quantity in regional department library, sent with acts of transfer from “parent” university, and written-off with internal acts.

This resulting difference is the amount of literature available, which can be passed to students. On the distance faculty the ratio between book and student is 1:1. That is why calculating the number of literature for students sufficiently transparent, and through a system of accounting UMM takes about a second.

After order for delivery of literature formed, the employees in LUMO should check the request and approve it “as-is” or should correct the request in depending on availability the quantity of books in the main warehouse or in terms of procurement, the mark of what is put in the system. The parcels and acts of transfer are formed in the main warehouse, after that it goes to the regional department.

The main goal of the accounting system of learning materials is to give to employees and to the head of the university tools for analysis of the current state of local library collections and procurement and forecasting literature in subsequent periods.

A set of dynamic reports, based on actual information, helps to take different decisions to improve library collections and, as a result, improve the quality of education and ensure student learning materials.

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Viazovik V., Lisenko V., Stolyarenko G.

THE ALTERNATIVE BURNING OF HARD FUEL

Cherkassy State Technological University, Ukraine

The development of civilization makes more new challenges to science, even in such traditional sphere as fuel combustion. Gas, oil and coal are the raw material for energy, metallurgy, chemical industry and other industries. Therefore are ongoing searches for methods of rational use of fuel. One of these methods is electrocatalytic fuel combustion, which is in the handling the fuel on the catalyst, which is in the area of electrical discharge.

Theoretical bases. The fundamental scientific problem, which was put, is: to learn and develop the apparatus and technology of electro-catalysis as the method for declining the energy of activating on a catalyst due to bringing of him in the area of quiet electric discharge. In the processes of electro-catalysis of overcoming of energy of activating is carried out for the account of following acts: synthesis and extinguishing of oxygencontained radicals; reception of energoactive and reactionable atoms and molecules due to the stream of lone electrons; wave influence of discharge on the system in an area to the catalyst; ultraviolet irradiation; thermal influencing of quiet discharge.

Conduction of chemical reaction on a catalyst in the area of quiet discharge intensification of process is going in after a few directions:

- oxidizing power of the system changes because as an oxidant not only oxygen but also molecules of ozone (at low humidity) are used, and also (with the growth the water pressure part) oxygencontained radicals HO^\bullet , HO_2^\bullet , RO^\bullet , RO_2^\bullet ;

- molecules of reagent under action of high tension, stream of surplus electrons, ultraviolet irradiation, e.t.c., grow into the energetically-excited atoms, ions or ion-radicals;

- oxidation of such reagents by oxygen, ozone and radicals flow spontaneously or at the minimum of the energy charges;

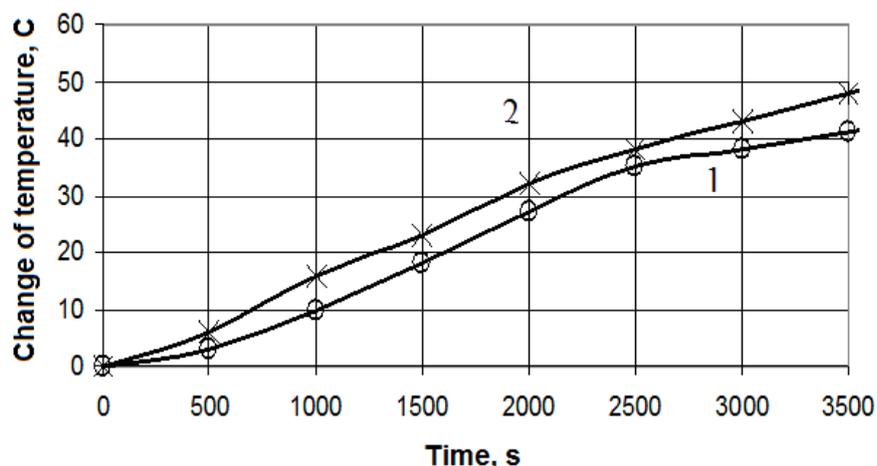
- compensation of energetic thermal charges is possible due to the rise of temperature of the system in the area of discharge; it means using without bulky heat-exchange vehicles and caldrons;

- influencing of frequency of discharge, optimization of strimmers working, influence of temperature on a chemical reaction yield will be determined for every system experimentally.

Results of researches. The experiments on optimization of hard fuel burning (anthracite coal) were conducted on setting which consists: from a combustion chamber with the arc device; thermostat; source of energy and compressor. The arc device is the complete set of the reticulated electrodes with an inflicted on them catalyst. Electrodes are placed in the ceramic tube of combustion chamber. A combustion chamber is placed in an electro-thermostat which a coal inflames by. Air which before contiguity with a coal passed through electrodes was given from below in a combustion chamber.

As you can see from these dependences, at incineration of coal with a discharge there is the speed-up heating of water, that testifies to the selection of greater quantity of heat, than at single experience. On the resulted curves three regions are visible: region of establishment of even process of burning (beginning of curves from 0 to 2 minutes), region of the even burning of coal (rectilinearly area in sredine of curve from 2 to 16 minutes) and region of fading of process of burning (after a 16 minute). For computation the power of coal combustion and efficiency in the described plant it was taken the area of the even burning.

Researches were conducted with a coal the particles which had a size about 0,25-2 to mm. In a combustion chamber loaded a 1 kg of coal which ignited by an electro-thermostat. After the self-ignition the igniter was disconnected. The output of heat was determined on heating of permanent quantity of water. Measuring of temperature of water produced in every 2 minutes, time of ending of coal burning was determined on $\Delta t=0$.



*Fig 1 – Dependence of temperature from time, by burning coal
1 - without processing, 2 - with processing.*

At by the use as a fuel the electrocatalysis of process burning of coal was the considerable economy of fuel 10-15%.

The degree of coal burning down during conducting of both experiments is definite. For this purpose was definite ashity of coal and degree of burning down of coal at burning without arc and with arc. The degree of coal burning down at single experience makes approximately 72 % (that approximately corresponds to the caldrons having of heating with a whole grate); the degree of coal burning down at the using arc arrives at 89 %. The degree of increase of burning down made on the average 17,45 %.

Similar results were obtained by burning wood and pellets.

In Fig. 2-3 show the some results of the electrocatalytic wood incineration.

So by using the electrocatalysis for incineration of wood, namely pine and birch, maximum temperature difference between the simple incineration and incineration with processing is achieved:

- For birch at a voltage of 3,5 - 5 kV can be up to 2,5-3 ° C (that represents an increase of heating value at 71-75%), at lowest voltages, the difference of temperatures is much smaller, and there is 1.5 ° C (increase of heating value at 27%). For voltages over 5 kV there is a gradual decrease of the difference of the temperature and it does not exceed 1-1.5 ° C (increase of heating value at 15-20%);

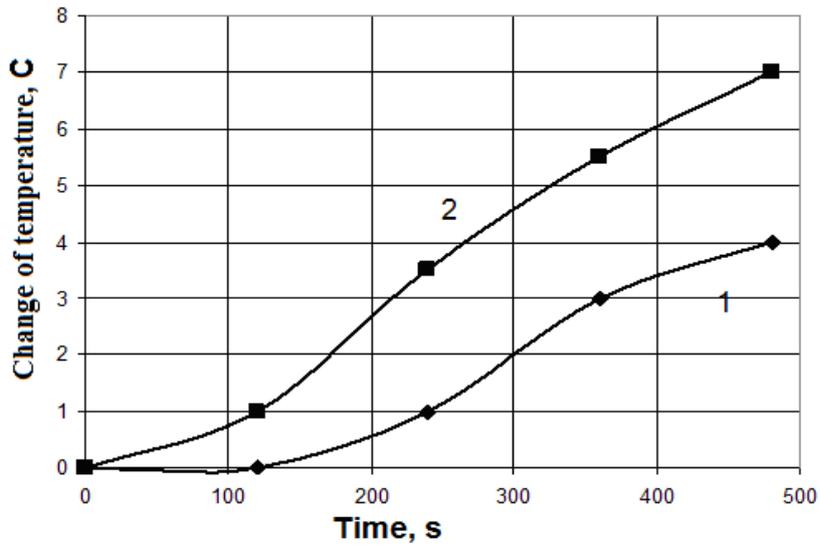


Fig. 2 - Dependence of temperature from time, by burning birch
1 - without processing, 2 - with processing

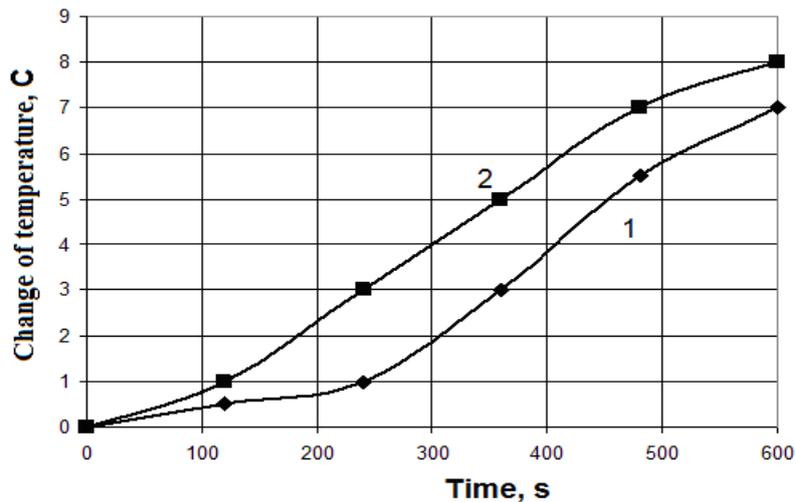


Fig. 3 - Dependence of temperature from time, by burning pine
1 - without processing, 2 - with processing

For pine at a voltage of 3.1 – 3.5 kV can be up to 1-1.5 ° C (that represents an increase of heating value at 14-21%). For voltages over 3.5 kV there is a gradual decrease of the difference of the temperature and it does not exceed 0.5 ° C (increase of heating value at 7%).

The greatest energy effect is achieved at a voltage of 3 to 5 kV for both types of wood. When the voltage is higher, the energy effect is lower.

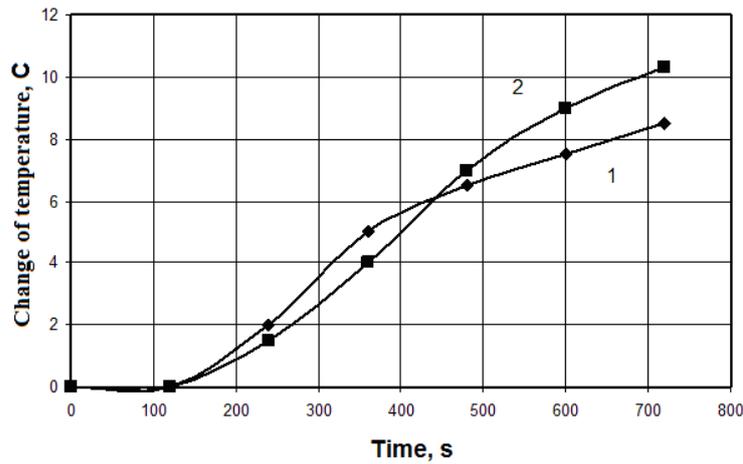


Fig. 4 - Dependence of temperature from time, (with the voltage 4 kV) by burning pellets 1 - without processing, 2 - with processing

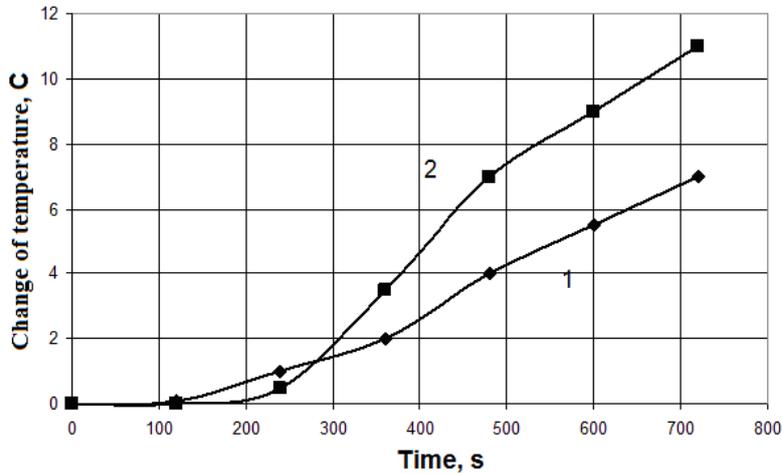


Fig. 5 - Dependence of temperature from time, (with the voltage 5 kV) by burning pellets 1 - without processing, 2 - with processing

Analyzing the percentage of energy used, for electrocatalysis, from the amount of energy that can be produced, by the combustion of 1 ton of wood, with the voltages, 3-3.5 kV, percentage is the lowest, and it does not exceed the 2-2.3%. At higher voltages, the percentage is growing, and at voltages 7.8 kV it exceeds 4%. But with all different voltages, despite the decrease of the energy effect, this percentage does not exceed the amount of excess energy, which stood out, with using electrocatalysis.

The combustion of pellets, achieved the following results (see Fig. 4-5).

The maximum, of temperature difference between the simple incineration and incineration with processing, is achieved at a voltage 5 kV, and reaches up to 4 ° C. At lower voltages (3-4 kV), this difference is less. At a voltage 4 kV, the difference is 2 ° C. For voltages over 5 kV, energy effect is reduced to 2 ° C, and it keeps at this level.

The highest energy effect just like for wood is achieved at a voltage of 3 to 5 kV. For these voltages, percentage of energy, used on the process electrocatalysis is not exceeding 1.5%. When the voltage is higher, the energy effect is lower.

In this case, we greatly reduce emissions into the atmosphere. Thus, from coal combustion is achieved emission reductions NO_x up to 80%, CO up to 52%. When wood combustion is achieved emission reductions NO_x up to 49%, CO up to 33%.

Conclusion. At by the use as a fuel the electrocatalysis of process burning of hard fuel was the considerable economy of fuel: from coal combustion 10-15%, wood combustion – 71-75 %. In this case, we greatly reduce emissions into the atmosphere.

UDC 004.2

J11307-181

Limantseva O.V., Eremenko I.A.

CALCULATION OF THE REDUNDANT STRUCTURES ON THE COMPUTER

Southern Federal University

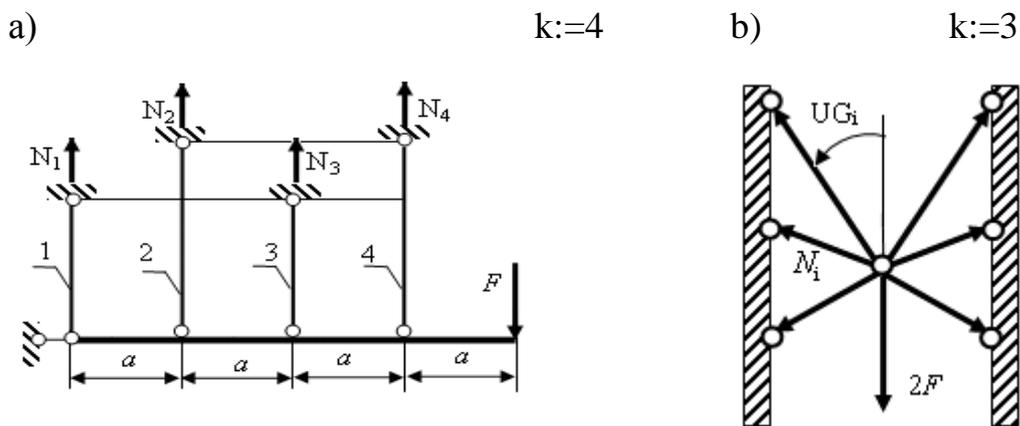
Key words: minimising method, potential energy deformation, redundant structure, extension-restriction, in-plane bending, MathCAD.

Redundancy eliminatory of the beam and plug structures is one of the main and difficult calculations. Rather often classical methods are used. An equilibrium formula is completed with an equation of strain compatibility [1] or canonical equation of the force method is compiled [2,3]. While using these methods in the mathematical system framework in all round engineering assigning there is saved a huge amount of hand-preparing calculations. However, the restraining force in the

redundant structure has to be matched by the potential energy deformation. Calculation complexes (we use MathCAD) provide built-in functions, which can pick out values to the unknown parameters, minimizing the objective functions, using the method of successive approximations (hidden from the user). This very method is used in the examples below.

Extension-restriction. Pick out condition in a plug (pic. 1a,b).

Data input: number values for the parameters, shown on the pictures, vectors with the length L_i and cross-sectional stiffness EA_i of the all plugs.



Pic. 1. Redundant plug structures

Conditions of the Objective function:		Equilibrium equation
(a)	$\sum_{i=1}^k N_i \cdot s_i - F \cdot 4a = 0$	$\sum_{i=1}^k N_i - F = 0$
(b)		$\sum_{i=1}^k N_i \cdot \cos(UG_i) - F = 0$ (symmetry is used)

Mathematical model of the objective (pic. 1a,b).

$$PED(N) := \sum_{i=1}^k \frac{N_i^2 \cdot L_i}{2 \cdot EA_i} \quad (1)$$

$N_i = 1$ GIVEN

Уравнения равновесия (a) или (б)

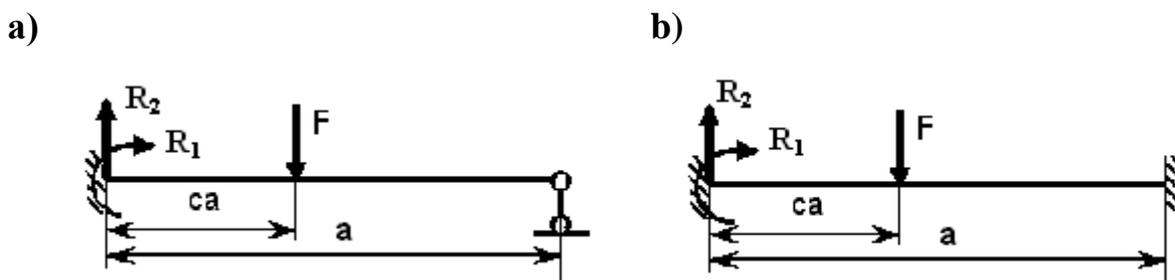
$N = minimize(PED, N)$ N=? (2)

The model consists of: Objective function is an expression of the potential energy deformation PED in the function of the desired bar stress (1); random starting value, according to these conditions and formulas (a and b), fulfilling a role of the constrains for the objective function. We give the ability to the built-in function to pick out conditions, in case of the potential energy will obtain minimal value (3). The problem is solved.

In-plane bending. Redundancy eliminatory of the in-plane bending is a bit more difficult.

It is needed to check out the resistance of the beam, picture 2a,b. It is interesting to see changes of the moment diagram, if the both ends of the beam are fixed. We will only look through the stage of the heave-moments formula generation and the redundancy eliminatory of the in-plane bending. To build a diagram in MathCAD is to type a correct formula, in which the variable will be only a coordinate of the following beam section, and to use the “master of diagram building”. Before the calculation we will find out supporting reactions R_i .(i:=1,2).

Data input: F, a, c, bending stiffness EI_x . Type a formula for the heave-moments (c) and potential energy deformation (4). Give a task to MathCAD to figure out a reaction-vector on the left-end of the beam with boundary conditions on its right side $s=L=a$ (d,e).



Pic. 2. Redundant beams

Formula for the heave-moments

$$M(s, R) := \begin{cases} U \leftarrow R_1 \cdot s + R_2 \\ U \leftarrow U - F \cdot (s - c \cdot a) \quad \text{if } s > c \cdot a \end{cases} \quad Q(s, R) := \frac{d}{ds} M(s, R) \quad (c)$$

Restriction of the objective function to the boundary conditions on the right side of the beam

$M(a, R) = 0$ (d)	$M(a, R) \neq 0$ (e)
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Mathematical computer model of the objective:

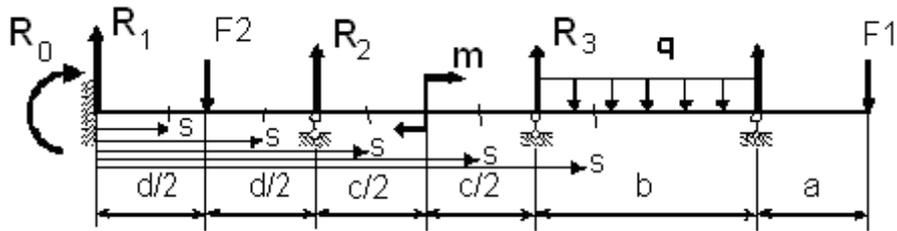
formula for the heave-moments (c)

$$PED(R) := \int_0^L \frac{M(s, R)^2}{2 \cdot EI_x} ds \quad (3)$$

$R_i := 2$ GIVEN

boundary_conditions_on_the_right_side(d or e)

$$R := minimize(PED, R) \quad R=? \quad (4)$$



Pic. 3

This model we will use for the support reaction definition of the continuous beam (Pic. 3). Paste the heave-moments formula (4), the cross sections formula (5) and the formula of the condition on the right size of the beam (6).

$$\begin{aligned}
 M(s, R) := & \begin{cases}
 U \leftarrow R_0 + R_1 \cdot s \\
 U \leftarrow U - F_2 \cdot (s - \frac{d}{2}) \text{ if } s > \frac{d}{2} \\
 U \leftarrow U + R_2 \cdot (s - d) \text{ if } s > d \\
 U \leftarrow U + m \text{ if } s > d + \frac{c}{2} \\
 U \leftarrow U + R_3 \cdot (s - d - c) - \frac{q \cdot (s - d - c)^2}{2} \text{ if } s > d + c \\
 U \leftarrow U + R_4 \cdot (s - d - c - b) + \frac{q \cdot (s - d - c - b)^2}{2} \text{ if } s > d + c + b
 \end{cases} \quad (4)
 \end{aligned}$$

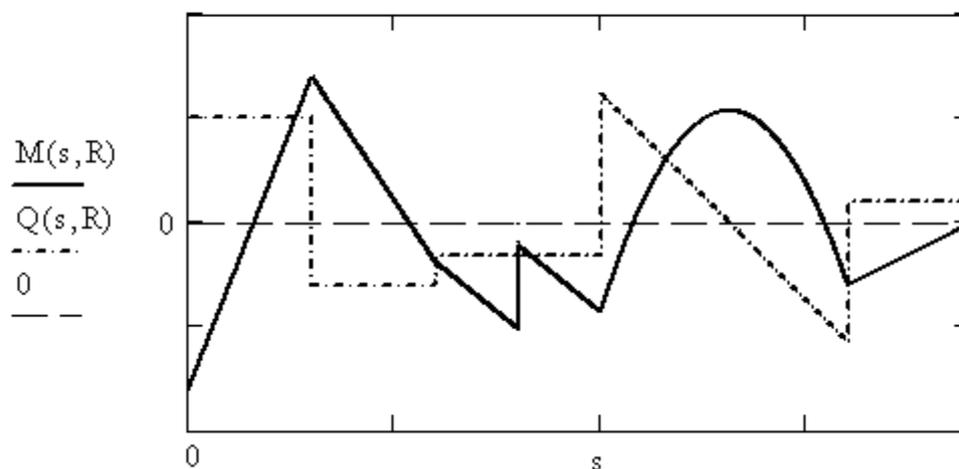
$$Q(s, R) := \frac{d}{ds} M(s, R) \quad (5)$$

$$M(d+c+b+a,R)=0 \quad Q(d+c+b+a,R)=F1 \quad (6)$$

In output we get a vector of 5 desired reactions. “Master of diagrams” could draw the diagram of heave-moments and cross loads in the continuous beam:

It is possible to draw a graphic, which shows, how the strain and moments of the loads’ resistance are divided along the length of the beam (according to the possible strain). But diagrams M and Q are wanted, because they allow finding out mistakes in the formula (4) [1].

$$s := 0, 0.01 .. d + c + d + a$$



Offering the built-in optimizing program in the calculations of the beam-framed structure, author hope that described models will take students’ and engineers’ fancy.

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Radionov A.A., Radionova L.V., Malakhov O.S.

**A COMBINED ROLLING-DRAWING MILL MECHATRONIC SYSTEM
CONTROL**

South Ural State University; Magnitogorsk State Technical University

This article describes the electric drive and automation of a new rolling mill with a nondrive stand. It shows the analysis of the operating modes which correspond to the technical requirements. It also proposes a new method of building of the automatic electric drive and its control system which realizes the regulation of the deformation centers critical angles.

Keywords: automation; electric drive; control; rolling mill

A new method of steel wire production was developed and an original construction of a combined rolling-drawing mill was proposed in Magnitogorsk State Technical University. The mill combines two processes in a single production line. These processes are the initial rolling of the workpiece and the following dragging it through a monolithic die. That is why the mill possesses the advantages of these processes, such as low cost deformation during the rolling and high accuracy of wire geometry during the drawing. Fig. 1 shows the scheme of the mechatronic systems of the combined rolling-drawing mill. The mill consists of the unwinder, the rolling section and the drawing section. The rolling section includes two stands with electric drive and one nondrive stand situated in the middle of the section. The energy required for the deformation of the metal in the nondrive stand is supplied only through the material being worked by pushing it with the first stand and pulling it with the third stand. This structural feature can significantly increase the energy efficiency of the rolling process due to the use of the reserve forces of friction in the deformation centers of the drive stands [1], but it also leads to some changes in the technological requirements for the systems of automated electric drive. The drawing section is a direct-flow wire-drawing machine with adjustable back-pull. The machine is also equipped with the two-reel winding device that implements a

radically new scheme of the continuous removal of the finished wire and its automatic transfer from one reel to the other.

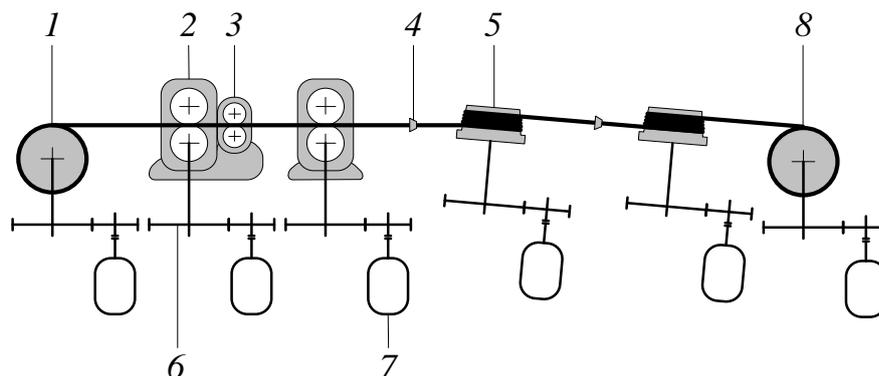


Fig. 1. The mechatronic systems of the combined rolling-drawing mill:

1 – unwinder; 2 – drive rolling stand; 3 – nondrive rolling stand; 4 – die; 5 – the drawing section drum; 6 – reducer; 7 – electric motor; 8 – two-reel winding device

Obviously, the creation of a new complex machine is impossible without a serious consideration of the development of each mechatronic system separately, including automated electric drives which ensure the safe operation of the machine and take into account the set of innovative design features. The analysis of the technological process of the rollingdrawing machine showed that the basic requirements to its mechatronic systems are the following:

1) The general requirements to all parts:

- ensuring load and jog modes;
- ensuring a constant acceleration with start and braking;
- joint and separate control of the electric drives;
- ensuring service, special and emergency braking modes with recovery of the energy in the power supply.

2) Requirements to mechatronic systems of the rolling mills:

- ensuring a control of the speed, both in static and in dynamic modes with an error not exceeding $\pm 2\%$;
- the range of the speed regulation within 1:50;
- ensuring a regulation of a neutral angle at the centre of the deformation at a given level of the technology, both in static and dynamic modes with an error not

exceeding $\pm 5\%$.

3) Requirements to mechatronic systems of drawing drums:

- ensuring a control of the back-pull value with an error not exceeding $\pm 15\%$;
- the range of back-pull regulation within 1:10;
- the range of speed regulation within 1:50.

4) Requirements to mechatronic systems of the two-reel winding device:

• ensuring a control of the winding tension according to given law (during winding the tension should be reduced as the reel is being loaded according to the

- hyperbolic law in the function of the winding radius,
- which eliminates interturn jamming of the wire and deformation of the reels)

with an accuracy of better than $\pm 15\%$;

- the range of tension regulation within 1:10;
- linear speed of the reel neck should be equal to the speed of the wire while transferring the wire from the full reel to the empty reel;
- the range of speed regulation within 1:100;
- the table pivoting drive should provide the speed of 0.5 ... 0.7 rad/s;
- location of the rotary table in predetermined positions with an error less than \pm

0.174 rad;

- ensuring a reverse mode.

The requirements analysis allows to propose to implementation the electric drive built on the system “frequency converter – squirrel-cage induction motor with the automatic control system implemented on the basis of the coordinates subordinate regulation principle”. The proposed electric drive works as automated electric actuators. Fig. 2 shows the functional diagram of the developed system of the automated electric drive of the stands, the drawing blocks and the two-reel winding device of the combined rolling-drawing mill. Conventional signs: *ASRS* – automatic speed regulation system; *ATRS* – automatic tension regulation system; *ABRS* – automatic back-pull regulation system; *SS* – speed sensor; *TS* – tension sensor; *BS* – back-pull sensor; *CS* – current sensor; *EM1..EM6* – electric motors; *Usf1...Usf7* – speed feedback signals; *Ucf1..Ucf6* – current feedback signals; *Utf1, Utf2* – tension

feedback signal; U_{bf1} , U_{bf2} – back-pull feedback signals; FC – frequency converter; IE – inverting element.

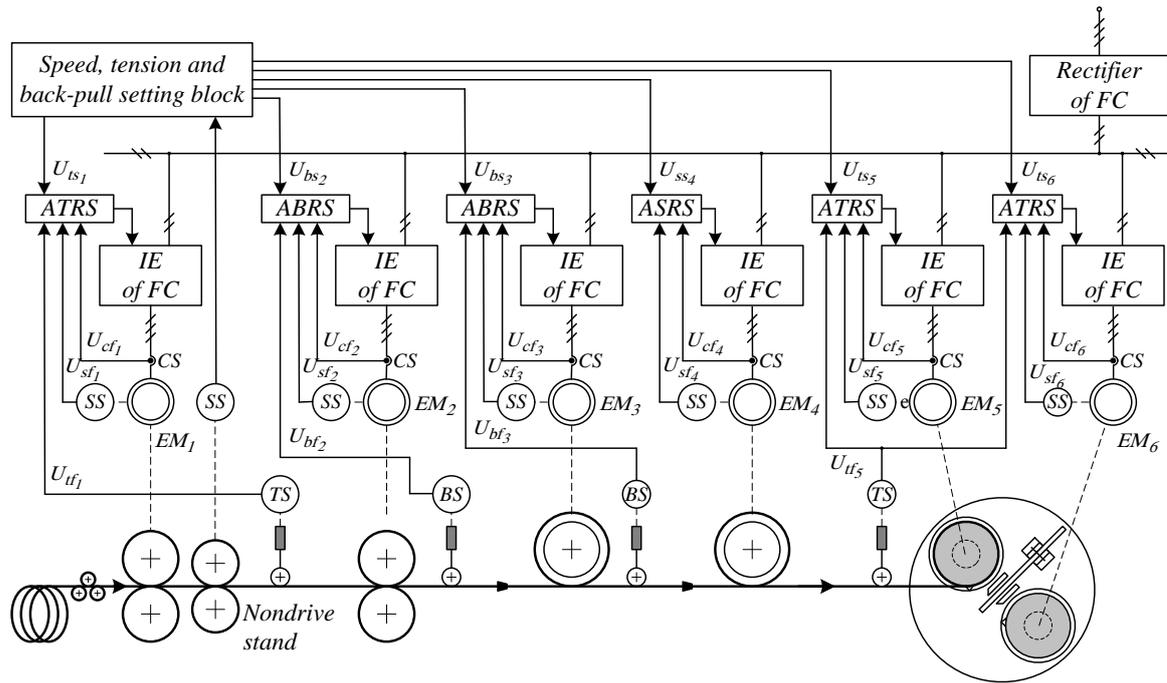


Fig. 2. The functional diagram of combined rolling-drawing mill automated electric drive

The implementation of the conflicting demands on simultaneous regulation of the rolling (drawing) speed, the values of the tensions between mills, the back-pull force and the value of a neutral angle in the deformation centers of the driving stands is done by the distribution of tasks between the electric drives – their division into one master drive and the rest – slave drives. In this case, the master drive has a system of automatic speed control and provides the machine operation at a given speed. The slave drive provides the interstand tension regulation, controls the neutral angles in the centers of deformation and regulates the value of back-pull in the drawing section.

The values of tension in the winding section, back-pull in the drawing section and tension in the second interstand interval are set consistently with the speed, back-pull and tension setting blocks in accordance with the drawing (rolling) route but the speed rate is zero. The signal to acceleration of the mill appears after the back-pull and the interstand tension are set in all interstand intervals. Then the mill accelerates to operating speed. If, for example, the back-pull increases in the interval between the

second and the third drums, the signal from the back-pull sensor reduces thereby increasing the difference between the signals at the input of the back-pull regulator. The signal at the output of the back-pull regulator increases and therefore the speed setting (the input signal of the speed regulator), the current (the input signal of the current regulator) and the signal at the input of the frequency converter increase consistently. This will increase the motor torque that causes a brief increase the speed. As the deformation power does not change it will decrease the back-pull value. Thus, the back-pull in the second interval between drums will get its original value.

Theoretical studies of the back-pull process show the impossibility of indirect estimation of the back-pull value separately in each interval between drums. That is why it is necessary to install force sensors before each die holder. The system of the back-pull control was developed. It's a three-circuit slave control system with internal current circuits, speed circuits and an external back-pull circuit. The analysis of the influence of technological parameters on the work of electric drives of the stands proves that two variants of electric drive control system are possible. In both versions the electric drive control system of the third stand provides regulation of the back-pull in the interval before the die and sets the speed of the rolling. The electric drive control system of the first stand stabilizes the rotation speed of the rollers in the first version and the wire tension in the second. An additional control circuit of the neutral angle provides its control in the centre of deformation of the first stand and doesn't allow its reduction below the specified minimum value, or ensures the alignment of the neutral angles in the centers of deformation of the electric drive stands.

A combined electric drive control system of the two-reel winding machine was developed. It provides two operation modes in accordance with the technological requirements. The first mode provides winding the wire with the tension regulation. The second mode provides transferring the wire from the full reel to the empty one and deceleration of the full reel with the regulation of its drive speed.

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Mikhailenko V.S., Kharchenko R.Y.

AUTOMATION OF THE CALCULATION PROGRAMS

Odessa National Academy of Food Technologies, 112, Canatnaya str., Odessa,

Odessa National Maritime Academy, 8, Didrikhson str., Odessa

In this report analyzes the traditional assessment methods set up a model of complex objects and considers the application to use the modified version of ACS temperature superheated steam boiler power station. Study the effectiveness of the proposed model with the PI controller settings by computer simulation.

Keywords: complex frequency response (CFC), harmonic oscillator (GSK), PI and PID controllers.

INTRODUCTION

Stage adaptive adjustment of automatic control systems (ACS) is a complex and important task in the start - up and adjustment - secure production work. A number of scientific studies estimate set up a model of control object, to calculate optimal settings PI and PID - regulators made staging computer experiment on the transient response of the object [1]. Other researchers [2, 3] propose to perform this operation by traditional methods of analysis of complex - frequency response (CFC) system, selecting the structure of the transfer function model, consisting, for example, from several parts of the inertial delay [2]:

$$W_{i\ddot{a}}(s) = \frac{k_{i\ddot{a}} \exp(-\tau_{i\ddot{a}}s)}{(T_{i\ddot{a}}s + 1)^n} \quad (1)$$

In order to determine the four unknown parameters of the object (A , T , τ , n), is proposed to use the harmonic oscillator (GSK), which estimates the CFC object at two different frequencies, which belong to a substantial range. Given the real equations for the modules and phases:

$$\left. \begin{aligned} A_1 &= \frac{k_{i\ddot{a}}}{(\beta^2 \tau_{i\ddot{a}}^2 \omega_1^2 + 1)^{0.5n}} ; \\ A_2 &= \frac{k_{i\ddot{a}}}{(\beta^2 \tau_{i\ddot{a}}^2 \omega_2^2 + 1)^{0.5n}} ; \\ \phi_1 &= -\arctg(\beta \tau_{i\ddot{a}} \omega_1) - \tau_{i\ddot{a}} \omega_1 ; \\ \phi_2 &= -\arctg(\beta \tau_{i\ddot{a}} \omega_2) - \tau_{i\ddot{a}} \omega_2 \end{aligned} \right\} \quad (2)$$

a decision which, under certain amplitude, frequency and phase shifts: $A_1, A_2, \omega_1, \omega_2, \phi_1, \phi_2$ can find the values of parameters of the transfer function model of the object. At the same time constant $T = \beta\tau$ We introduce the notation: $\Omega = \omega_1 \tau_{mod}$. Accordingly, the system of dimensionless equations takes the following form:

$$\left. \begin{aligned} A_1 &= \frac{k_{i\ddot{a}}}{(\beta^2 \Omega^2 + 1)^{0.5n}} ; \\ A_2 &= \frac{k_{i\ddot{a}}}{(\beta^2 \tau_{i\ddot{a}}^2 \omega_2^2 + 1)^{0.5n}} ; \\ \phi_1 &= -n \arctg(\beta \Omega) - \Omega ; \\ \phi_2 &= -n \arctg(\beta \Omega) - b \Omega \end{aligned} \right\} \quad (3)$$

where $b = \omega_2/\omega_1$

The system of equations can be done as follows.

Dividing the first equation to the third, then the coefficient n can be written the following expression:

$$n = \frac{2 \ln \frac{A_1}{A_2}}{\ln \left(\frac{(\beta b \Omega)^2 + 1}{(\beta \Omega)^2 + 1} \right)} \quad (4)$$

Subtracting the second equation of the fourth, after multiplying the latter by b we obtain the relation for n :

$$n = \frac{\phi_2 - \phi_1}{b \arctg(\beta \Omega) - \arctg(\beta b \Omega)} \quad (5)$$

Typing $x = \beta \Omega$ and completing a number of permutations of the following values:

$$n = \frac{\phi_2 - b \phi_1}{b \arctg(x) - \arctg(bx)}$$

From equation (3) the dimensionless frequency and time delay

$$\Omega = -\varphi_1 - n \arctg(x); \tau_{i \ddot{a}} = \Omega / \omega_1 \quad (6)$$

transfer coefficient of the object model

$$k_{i \ddot{a}} = A_1 (x + 1)^{0.5n} \quad (7)$$

Analyze the method described by the example of adaptation and tuning the search object model for ACS temperature superheated steam boiler thermal power plant species:

$$W(s) = \frac{0,55}{(1,5s + 1)^3} e^{-0,52s} \quad (8)$$

Assessment of the frequency of the signal identifying GCK can be inferred of the vibrational mode for sufficiently large constant controller integral $T = 10$ min by increasing its transmission rates. Stability limit has been reached, but with acquired characteristic oscillatory with sufficiently weak damping, allowing the period of these oscillations ($T = 10.36$ min) are considered to belong to a substantial range. With GCK was assessed CFC vector object with the outcome parameters of controller settings for the oscillation period equal to 10 min (frequency $\omega_0 = 0,628$). As Fig. 1 and 2, with the result we obtained the following values of the modulus and the argument object CFC: $A_\mu(0,628) = 0,421$; $\varphi_\mu(0,628) = 1,55$. In order to get the CFC-tuning model with four factors necessary to evaluate CFC vector object by another one that is different from the first one and a half \rightarrow double frequency. We choose it half as $\omega_0 = 0,314$ (a period of 20 min.) Using the simulation and calculation we get the following results:

$$A_\mu(0,314) = 0,21; \varphi_\mu(0,314) = -2,61.$$

As a result of the following values of the model: $k_{mod} = 0,61$; $\beta = 2,12$; $n = 2,25$; $\tau_{mod} = 0.94$, from the expression $\beta = T_{mod} / \tau_{mod}$ follows $T_{mod} = 1.9$ They not coincide with the true values of the coefficients of the transfer function of the object (8). However, the relevant CFC superimposed on each other (Fig. 2) that is controller parameters are the same. Subsequent calls to the procedure of adaptation can be limited to a single point estimate of CFC system for fixing the pre still two factor model $\beta = T_{mod} / \tau_{mod}$, n and running calculation optimal settings typical regulator. Also exponent model in this case is not necessarily an integer. In the

absence of random perturbations of a two-point adjustment can be efficiently implemented and to configure the method of oscillations. It's enough to make experiments at two different time constants phase shifter filter to get the vector of the system and the object at the two hour frequencies. To study the effectiveness of tuning model, the authors conduct a search of the PI controller settings and permutations of the computer model with ACS-known object. Transients shown in Fig. 3.

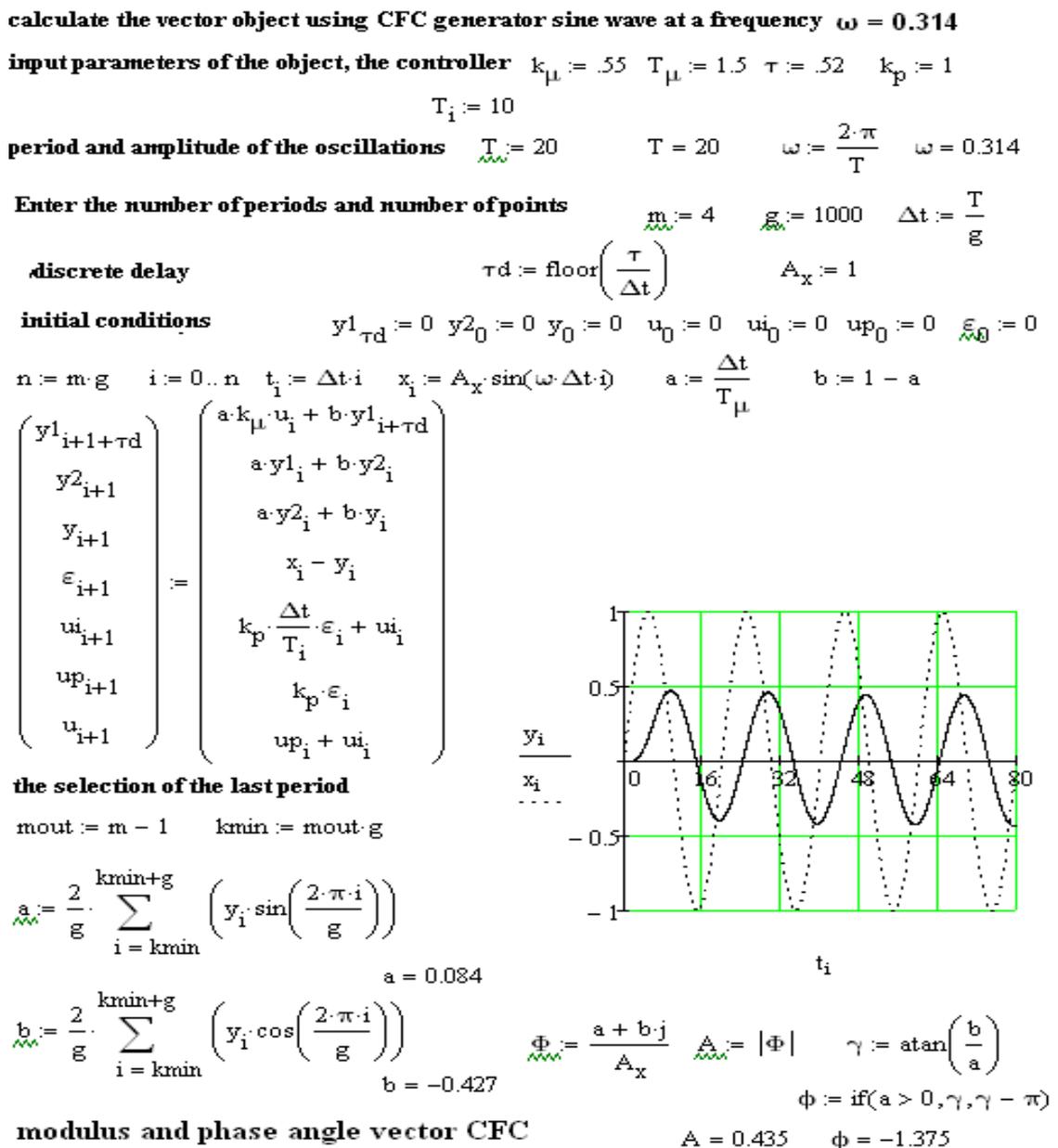


Fig. 1. CFC program evaluation system at the initial frequency

CFC score vector object using harmonic oscillator

**input module and the CFC phase system,
the controller parameters, frequency**

$$A_{\mu} := .44 \quad \phi := -1.375 \quad k_p := 1 \quad T_i := 12 \quad \omega := .314$$

calculate the vector object CFC $\Phi_{\mu} := A_{\mu} \cdot e^{\phi \cdot j}$ $W_r := k_p \cdot \left(1 + \frac{1}{T_i \cdot \omega \cdot j}\right)$

$$W_{\mu} := \frac{\Phi}{1 - \Phi} \cdot \frac{1}{W_r} \quad p := \text{Re}(W_{\mu}) \quad q := \text{Im}(W_{\mu}) \quad A_{\mu} := |W_{\mu}| \quad A_{\mu} = 0.421$$

$$\gamma_{\mu} := \text{atan}\left(\frac{q}{p}\right) \quad \phi_{\mu} := \text{if}(p \geq 0, \gamma_{\mu}, \gamma_{\mu} - \pi) \quad \phi_{\mu} = -1.557$$

Obtaining tuning object model with four free parameters

input of initial data vectors CFC object

$$\omega_1 := .314 \quad \omega_2 := .628 \quad A_1 := .421 \quad A_2 := .211 \quad \phi_1 := -1.557 \quad \phi_2 := -2.614$$

definition coefficients of the model

$$b := \frac{\omega_2}{\omega_1} \quad C(x) := \frac{b \cdot \text{atan}(x) - \text{atan}(b \cdot x)}{\ln\left(\frac{b^2 \cdot x^2 + 1}{x^2 + 1}\right)}$$

$$D(x) := \frac{\phi_2 - \phi_1 \cdot b}{2 \cdot \ln\left(\frac{A_1}{A_2}\right)} \quad F(x) := C(x) - D(x) \quad x = 0, .001..2$$

$$x := .6 \quad X := \text{root}(F(x), x) \quad X = 0.625$$

$$n_{\text{mod}} := \frac{2 \cdot \ln\left(\frac{A_1}{A_2}\right)}{\ln\left(\frac{b^2 \cdot X^2 + 1}{X^2 + 1}\right)} \quad \Omega := -\phi_1 - n_{\text{mod}} \cdot \text{atan}(X) \quad \frac{F(x)}{2}$$

$$\tau_{\text{mod}} := \frac{\Omega}{\omega_1} \quad \beta := \frac{X}{\Omega} \quad k_{\text{mod}} := A_1 \cdot (X^2 + 1)$$

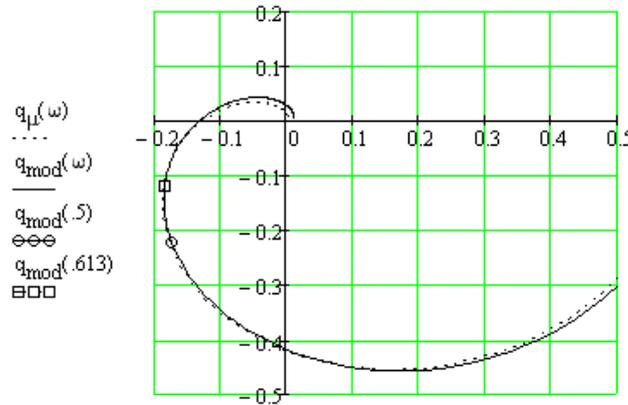
$$n_{\text{mod}} = 2.259 \quad \beta = 2.123 \quad \tau_{\text{mod}} = 0.938 \quad k_{\text{mod}} = 0.611$$

Ввод параметров объекта: $k_{\mu} := .6 \quad T_{\mu} := 1.99 \quad \tau := .52$

$$W_{\text{mod}}(\omega) := \frac{k_{\text{mod}} \cdot e^{-\tau_{\text{mod}} \cdot \omega \cdot j}}{(\beta \cdot \tau_{\text{mod}} \cdot \omega \cdot j + 1)^{n_{\text{mod}}}} \quad W_{\mu}(\omega) := \frac{k_{\mu} \cdot e^{-\tau \cdot \omega \cdot j}}{(T_{\mu} \cdot \omega \cdot j + 1)^3}$$

$$\omega_{\text{end}} := 3 \quad n := 300 \quad \Delta\omega := \frac{\omega_{\text{end}}}{n} \quad \omega = 0, \Delta\omega.. \omega_{\text{end}} \quad q_{\mu}(\omega) := \text{Im}(W_{\mu}(\omega))$$

$$p_{\text{mod}}(\omega) := \text{Re}(W_{\text{mod}}(\omega)) \quad q_{\text{mod}}(\omega) := \text{Im}(W_{\text{mod}}(\omega)) \quad p_{\mu}(\omega) := \text{Re}(W_{\mu}(\omega))$$



$$p_{\mu}(\omega), p_{\text{mod}}(\omega), p_{\text{mod}}(.5), p_{\text{mod}}(.613)$$

Fig. 2. Program for calculating the tuning parameters (reference) model

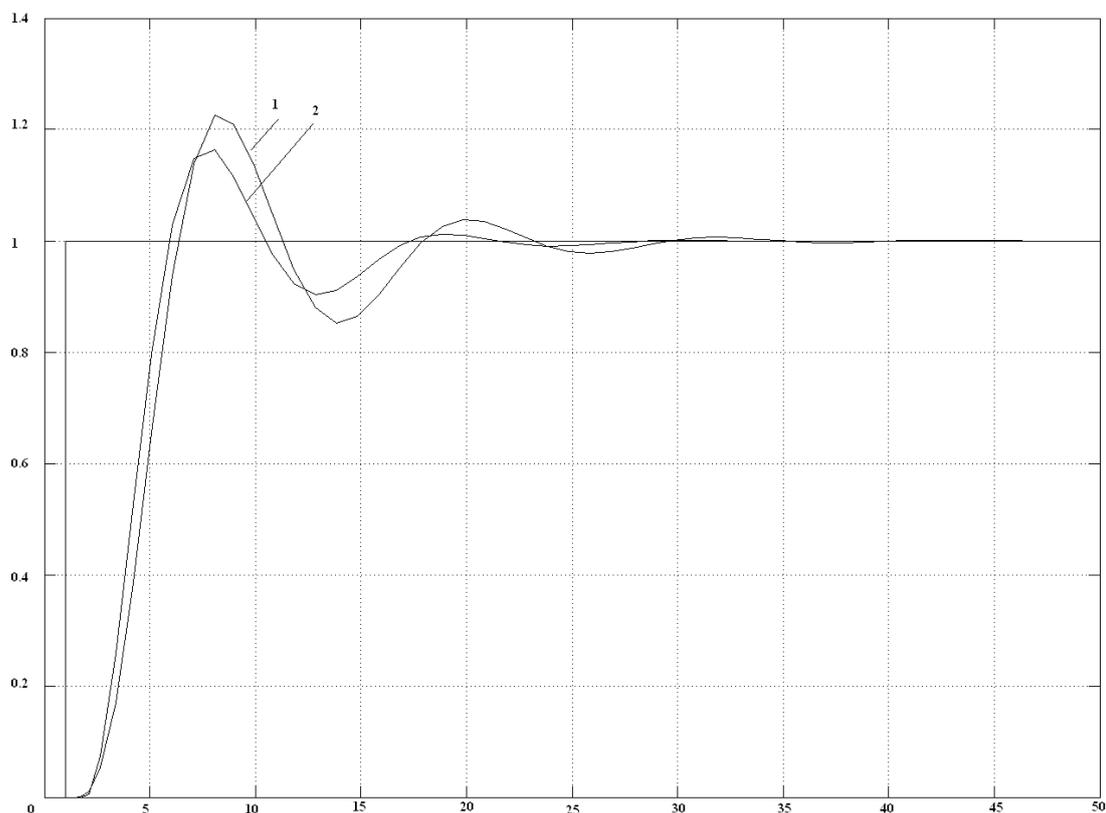


Fig. 3. Transients adaptive ACS via the job search method acting to set up a model: 1 - process at the output of the facility; 2 - process at the output of the custom model

CONCLUSION

Analysis of the quality of transients (Fig. 3) demonstrates their eligibility process heat and power, but it should be noted that the management at the output of the object (1) is characterized by large values of time the regulation and deregulation ($T_p = 30$ s, $G = 25\%$), on compared with the model (2) ($T_p = 20$ s, $G = 19\%$), ie is not optimal.

You can specify that the coincidence of these characteristics can be considered acceptable. A close relative position of the object and the actual characteristics of the model in a significant frequency range allows the use of this method of adaptation for PI and PID controllers.

The disadvantage of the method, according to the authors, include the provision of special equipment identification (GSK), and the duration of the search process of identifying and calculating the optimal settings. Also, if the system during an active experiment will have a profound disturbance, noise and interference, the evaluation

of mathematical models can be made with considerable errors. Thus, GSK may require the additional costly hardware with adaptive filter settings. Note that the scientific problem of the design and implementation of adaptive filters, and search for the best methods of adaptation ACS still remains open.

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J11307-184

Chetverikov B.S., Pogonin A.A.

**LASER DEVICE FOR DEFINITION ERROR IN THE FORM OF LARGE
MACHINE PARTS**

*Belgorod Shukhov State Technological University, Russia, Belgorod, Kostyukova
str., 46*

Device for definition error in the form of large machine parts is well-known at present time for automatic control of dimension and geometry of rotating mechanical equipment which has cylindrical form [1]. Demerits of this device are low integrity of definition error in the form, time-consuming in scaling for preselected algorithm of the definition error in the form of the face objects, because the keyline (obtainable in consequence of projection laser beam through holographic array) is a lop-sided and “smudgy”, which reduces the quality and the evaluation precision of a form error in conditions of the operation monitoring.

Therefore, laser device for definition error in the form of large machine parts was developed (fig. 1).

Developed device have next distinctive features such as:

- unit of the laser emitters (fig. 2) fixedly connected with the optoelectronic receiver (OER). At that, unit of the laser emitters is in the form of two pivotally interconnected plates, the two lasers are placed on each one, and two additional lasers mounted on conjugation line of plates, and camera of the optoelectronic receiver is found between the additional lasers;

- rigid coupling unit of laser emitters with optoelectronic receiver ejects superinducement of error in the process of projection beam of laser emitters and read-out optoelectronic receiver form of the obtainable figure, leading to increase a precision of the positioning block of laser emitters;

- unit of the laser emitters is in the form of two pivotally interconnected plates, that makes capacity adjust the opening angle and provides definition error in the form surface of the various standard sizes without repositioning of the device;

- mounting the camera of the optoelectronic receiver on conjugation line of plates provides a cutting time for tuning and carrying out of the measurements, because it excludes readjustment the device in the process of the “work” with objects of the various standard sizes.

Laser device for definition error in the form set up and works in the following way:

originally measuring head 9 is exposed with one of the known methods, so that the axis of the additional lasers 8, which determine the direction of projecting laser beams, were arranged perpendicular the normal line to surface of an object 16. Through the user interface 15 to microprocessor 14 we define an object 16, in particular diameter, for example, banding of a cement kiln.

The opening angle of hingedly fixed plates 4 of unit 3 of laser emitters is adjusted depending on the size of the controlled surface of the object 16 and the distance to it.

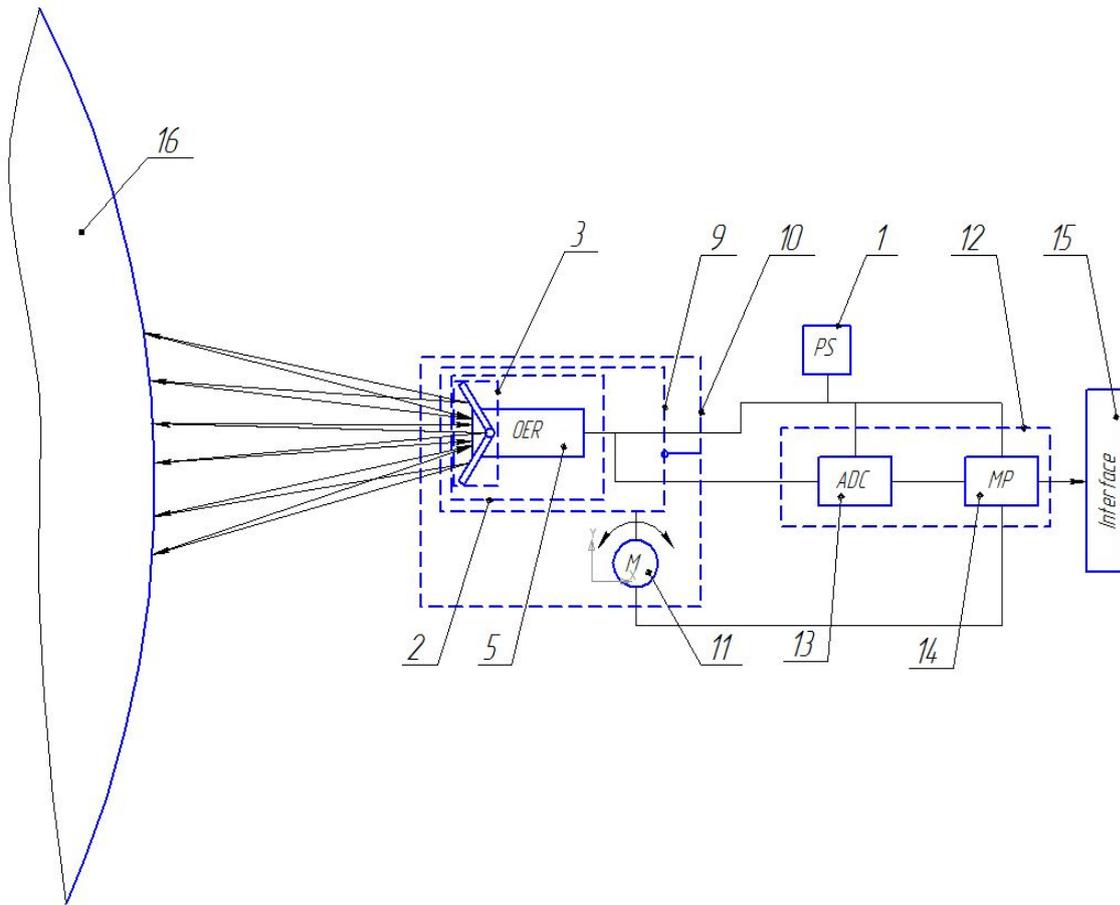


Fig.1. Scheme of the device

Unit 3 of laser emitters is projecting beams on the controlled surface of the object 16 as six points and this indicates the contour of the projection figure. And besides the position of these points is determined preliminarily, depending on the size of the object 16 and the installation distance from the controlled surface to the measuring head 9, which is hingedly fixed in the structure 10.

The location of points, which are the projections of laser beams 7 and the additional lasers 8, as an image of certain figure, is fixed by the chamber 6 of the optical electronic receiver 5 frame by frame during the control of the object 16. Then information about the parameters of the optical image are transmitted through the optical electronic receiver 5 in the electronic signal generator 12. In the electronic signal former 12 converter 13 transshapes the received analog signal of the image and relies it in digital form to the microprocessor 14, where is analyzed the data by

comparing the distances between points in the initial position (this position is set preliminarily), which we got in result of the dimension.

Based on the analysis of distances between the points of projection of laser beams is produced the finding of angles' size of deviation of the axis lasers from normal lines and the availability of forms' errors, such as the radius of curvature of the surface and the position of the center point's curvature, and identify of deviations from cylindricity.

After elaboration of information the microprocessor 14 generates a control signal to drive the rotation of 11, which provides turn of the measuring head 9 to install it through the normal line to the controlled surface of the object 16.

Power supply 1 provides power to all the elements within the device.

In the process of technological rotation of the object 12 the projections' location of laser beams of unit 3 laser emitters will vary in accordance to the position of the object 16 and the shape of its surface.

When the position of the object 16 is changed during the rotation happens deviation of units' axis 3 of laser emitters from the normal lines to the controlled surface, which changes the angles of projection. In consequence of this changes the position of lasers' projection.

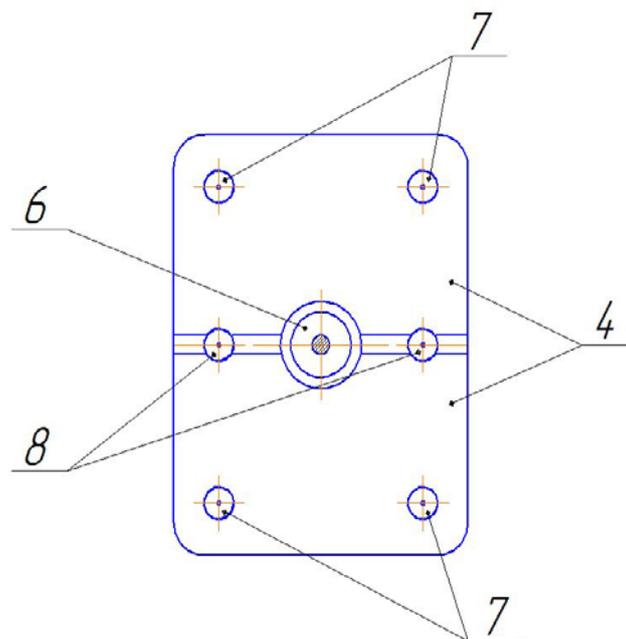


Fig.2. Scheme of the unit with laser emitters

In this way it can be concluded that offered device renders possible to increase an evaluation precision of a form error and to cut time at the expense of the technical effect, which stated in supply of equability light striking of the projected keyline and following significant display it.

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UDC 621.9-113.1

J11307-185

Pogonin D.A.

**MACHINING MODULE FOR
LARGE-SIZE BODIES OF REVOLUTION RESTORING**

*Belgorod State Technological University after V.G. Shukhov, Russia, Belgorod,
Kostyukova 46, 308012*

In this paper according to the analysis of existing flaws of equipment and methods of large-size bodies of revolution surfaces obtaining we offer a new solution of large-size parts machining problem – machining with special machining modules using adaptive technologies of technological systems control. Author of the report got a patent for developed machining module.

Key words: restoring, surfaces, large-size bodies of revolution, machining module.

Multipurpose embedded machining module is used for the restoring of surfaces of large-size parts of machines and units (tires and rollers in cement kilns, grinding machines, desiccators and etc.). Machining module is based on parts of the pillars or substructure of the repaired equipment that enables the machining of surfaces without stopping production.

Special machining module for large-size bodies of revolution restoring developed by author has no flaws inherent in such equipment [1].

Solid model was analyzed in ANSYS Workbench v11 [2]. Assembly solid models of machining module that is used and machining module that is developed were created with the help of NX 7.5 software and next they were downloaded into ANSYS software (fig. 1, a – machining module that is used; b – machining module that is developed).

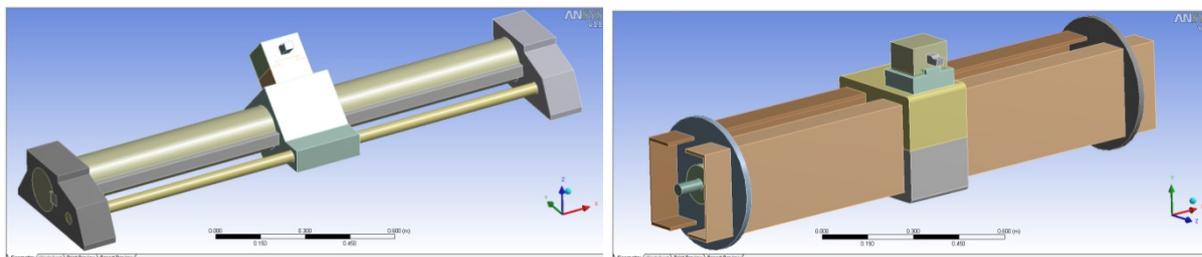


Fig. 1. Solid model of: a) – machining module that is used; b) – machining module that is developed

Firstly a FEM mesh was created (fig. 2). The size of mesh has been selected automatically and the smaller size has been selected manually for most responsible parts of structural elements.

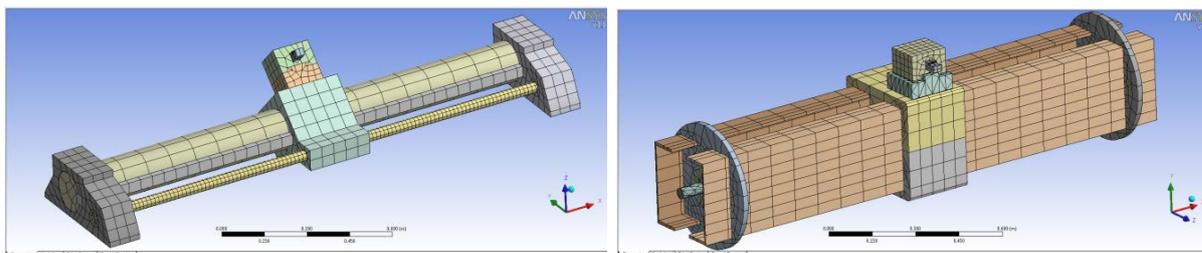


Fig. 2. FEM mesh

According to problem conditions boundary conditions were applied and loads corresponded to maximum stresses of Pz cutting force were applied (fig. 3).

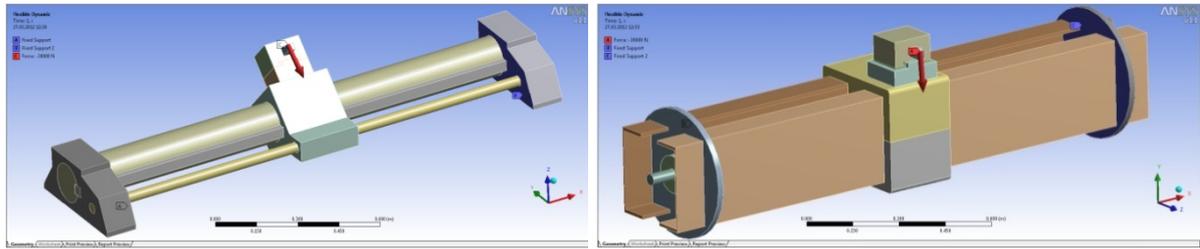


Fig. 3. Boundary conditions and loads

As a result maximum flexures of cutting tool and feed-screw in machining module that is used and machining module that is developed were obtained (fig. 4).

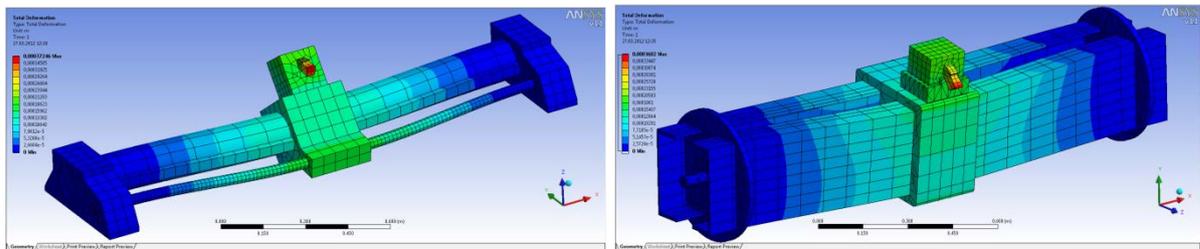


Fig. 4. Analysis results

According to analysis results the maximum flexure of cutting tool is: 0.37246 mm in machining module that is used and 0.3602 mm in machining module that is offered. Feed-screw flexures are 0.21283 mm and 0.077185 mm.

In this way it can be concluded that the offered design of machining module provides the same stiffness as the design used currently, having improved mass-dimensional characteristics at the same time. Considering the minor flexure of the feed-screw, the higher accuracy of surfaces is provided. The demountable design of the lengthwise slide allows disassembling it without the prior disassembly of the nodes connected with it. The turnable mechanism provides an opportunity to orient the front surface of the cutting tools at the right angle to the surface that is machined.

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UDC: 004.942

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Dyachenko A.A.

Actual problems of creation and development of automated systems of customs control on maritime transport

State Customs Service of Ukraine, Evpatoria, sq. Sailors 1-a, 97400

Ukrainian Academy of Customs, Dnepropetrovsk, Rogalova 8, 49000

This article describes the problems of development and implementation of an automated system of customs control in maritime transport. It was analyzed the characteristics of complex, multi-level systems, which can be included to customs control. According to the research the author propose to create an automated, modular, adaptive control system based on advanced and efficient information technology.

Key words: automated system of customs control (ASCC), optimization of management processes and making decisions, cluster analysis, multi-module system.

Introduction

Nowadays, considering that Ukraine is a transit country by sea and through which passes a significant amount of external loads and vehicles, there is an urgent need to study issues of customs control in maritime transport.

An important role for Ukraine customs in modernization plays the adoption of the new Customs Code, the introduction a number of necessary laws and normative

legal acts, the update of old standards and the development of new. All it takes customs legislation to the current level of international requirements and standards.

In our times, the great importance played by the introduction of advanced information technology, automation techniques and artificial intelligence. This allows us to upgrade any company, reduce operating costs, increase efficiency and avoid errors associated with the "human factor", to optimize management processes and decision-making. A large number of organizations, enterprises, institutions and other areas started to implement new information technologies, the developments and convinced of their benefits. Customs Service of Ukraine on this issue is not an exception: the current system ASARM (automated system of analysis and risk management) showed very good results in efficiency, reducing the time and quantity of customs control without reducing their quality in general.

Problem statement

So customs control in maritime transport can be represented as a complex multilevel system, which characterized by the following properties:

- Uniqueness. Each object in the system has a specific and unique structure. The control system must operate with due regard to all its qualities and parameters.
- Lack of formalized objective existence. Not all objects can articulate the purpose of their existence.
- Lack of optimality. Formulation of classical optimization problem is impossible. Thus, the majority of management criteria in such a system will take objectivity if the decision made by the person (DMP).
- Dynamics. Over time, the structure and functioning of objects are changing.
- Incomplete description. There is the initial lack of all necessary information about the objects to make adequate management solutions.
- A significant number of subjects. There are a lot of different factors and agents, not all of them will have an impact on the operation of the facility management.
- Large dimension. Complex systems characterized by high dimensionality, which prevents its simulation in the short term.

- Non-formalized information. Frequently for a decision is necessary to consider concepts that are poorly formalized.

In our time, in the global information society the use of information technology in customs authorities is almost only one solution to improve the efficiency of customs control, improve its quality and the reduction of customs legislation of Ukraine to international standards.

Now, the Customs of our country have the primary task of promoting foreign trade by simplifying customs procedures, using selectivity in customs control, increasing care and efficiency in the international movement of goods, vehicles and people.

How to solve this problem? Using the latest information technology and modernization of the customs control system in the direction of simplification and optimization are one of few ways to solve this problem.

Given the above, it is proposed to interpret customs control in maritime transport in general, information and multilevel system for which to develop a single, unified program-informational complex. This will improve the productivity and efficiency of customs procedures on maritime transport.

Results of the study

The basis of development an automated system of customs control on sea transport is a combination of effective scientific instruments, namely the methods of cluster analysis and pattern recognition, network and situational management of complex systems.

So, it is proposed to develop ASCC (automated system of customs control) on maritime transport, which is based on a modular system capable of self-learning and flexible modification. This hierarchy can increase the number of modules if necessary and make timely any changes to them.

At this stage we can select 4 main modules: the problem of cluster analysis, the task of pattern recognition, methods of network management and methods of situational control.

So, the first module of the system takes any amount of information about the object (the subject), which obtained from different sources (Fig. 1). Its main task - to develop a typology and classification, research useful conceptual schemes of grouping objects, the generation of hypotheses based on the research data, test hypotheses or research to determine whether the types (groups), marked one way or another, present in existing data. The result of this module will organize all the chaotic information and partitioning the sample into groups of similar objects, simplify further data processing and decisions making, the applicability of each cluster of his method of analysis (for example, the strategy "divide and conquer") [1].

At the end of the module the each cluster of data will have its own set of personal characteristics and attributes (numeric and non-numeric). When excessively large volume of incoming data are coming into the system, it can be used data compression by leaving one or more of the most typical representatives of each cluster. At each subsequent cycle module is possible to identify "novelty", i.e. an allocation of atypical objects which cannot connect to any of the existing clusters.

The use of clustering methods will simplify the input information in second module of the automated control system named "Pattern Recognition". As you know, it is much easier to handle ordered, divided into specific groups of data than the vast arrays of chaotic information.

According to this structure and the use of different functionalist of quality as well as methods of making decisions, we can provide the most accurate assessment of the results.

Like any other method, cluster analysis has certain drawbacks and limitations. In particular, the composition and number of clusters depends on the chosen criteria search. For the reduction of the original data set to a more compact form there are may be some distortion, and it can lose individual identities of individual objects by replacing their characteristics summarized values for the cluster. In classification of objects very often ignored the possibility of absence given set any values clusters [1].

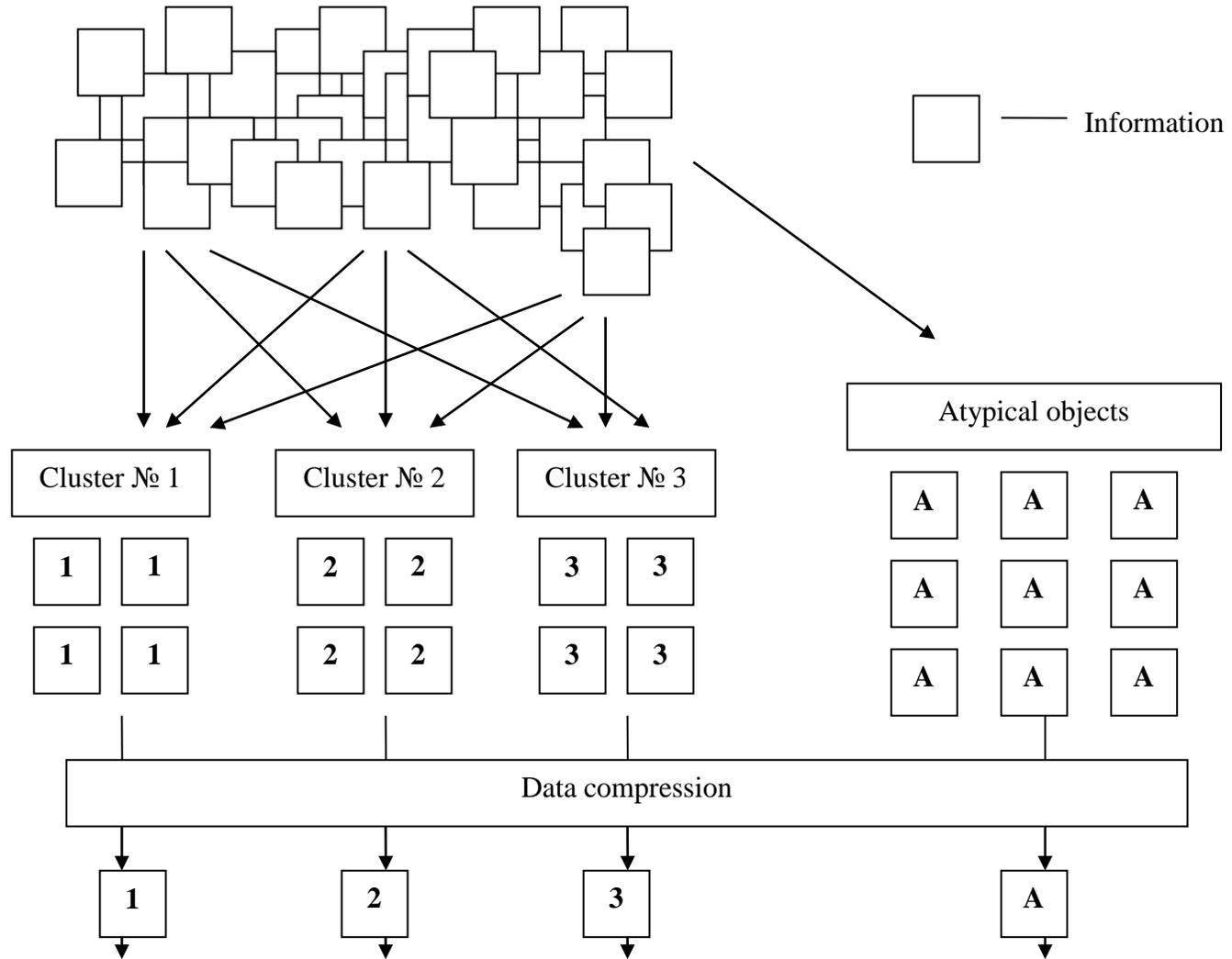


Fig.1. Graphical principle of module "Cluster Analysis"

The second module receives from the first general and orderly system of data, divided into clusters (Fig. 2). Also, this unit has atypical objects. The main objective of the module "pattern recognition" is a classification task output to a class using the selection of essential features that characterize these data, the total mass of significant and insignificant data [2]. Another important task - identification, which used to point out some specific object among the like (for example, identify inaccurate data at the customs control and registration, search of the necessary information to carry out customs procedures for maritime transport, etc.).

One of the principles of the second module is the automatic retrieval of data according to goals and objectives. For example, before the customs control and clearance begins in maritime transport, we can define the following search criteria information that inspectors need to fulfill customs procedures and formalities: date, time of arrival, the departure of the ship, type of ship, and any signs of cargo (character , composition, name, price, quantity, weight, quality and other characteristics of goods); crew and passengers (nationality, citizenship, age, personal items and luggage, the availability of currency), information on previous, last and next ports of call, the existence of protocols VCR (violation of customs regulations) and expressions of smuggling on this board in the past, the presence of orientations by the police and other countries, information from the ship-owner, the country of registration of the vessel and the port, frequency of call of the vessel in port, check all the necessary documents and their reliability and compliance to certain requirements , and other criteria.

Using these criteria we would find all the relevant data required under specified parameters. This insignificant data is removed from the system. So, as a result of the module we get the required number of useful information that will simplify, speed up and eliminate unnecessary customs procedures for maritime transport.

Methods of pattern recognition help to find the necessary information, divided into classes with certain attributes and characteristics for future use in the following modules of the system - namely, the method of network management.

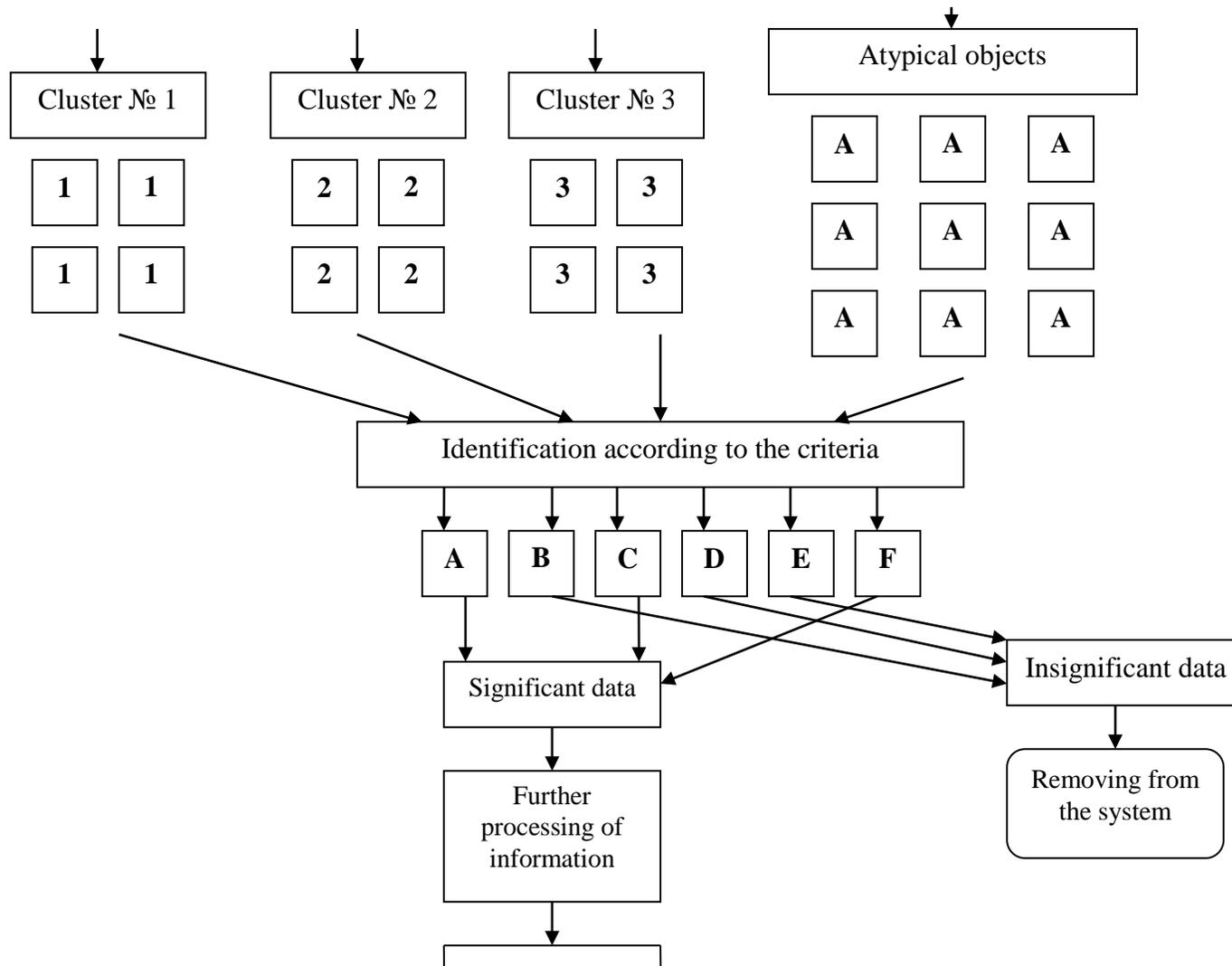


Fig.2. Graphical principle of module "Pattern Recognition"

The third module of the automated system builds a network graph, which corresponds to the procedures and actions that are performed on the test object (Fig. 3). This operation uses data provided by the first two units of the system. After the previous two stages, the information was processed by certain "filters" and gained considerable simplification, grouping and selection.

Network planning is a form of graphical display of the content work and duration of long-term strategic plans and systems of design, planning, organizational and other types of enterprises or institutions. Along with line graphs and tabular calculations network planning methods are widely used in developing long-term plans and models to create complex manufacturing systems and other facilities for long-term use [3]. To these objects custom control system might be included for maritime transport.

The built of network model of customs control allows to do a detailed analysis of all control operations and to make improvements in the technological structure at the stage of designing.

Thus, the application of network planning helps to develop the optimal variant of the strategic plan of the institution, which is the basis for the operational management of complex operations in the course of its implementation. The main planning document in the system is a network diagram, or simple network that presents information and dynamic model that reflects all of the logical relationships and the results of work required to achieve the ultimate goal of strategic planning [3]. In the network graph represented with the necessary degree of detail what work, in what sequence and at what time to be done to ensure the completion of all activities within a specified or planned period.

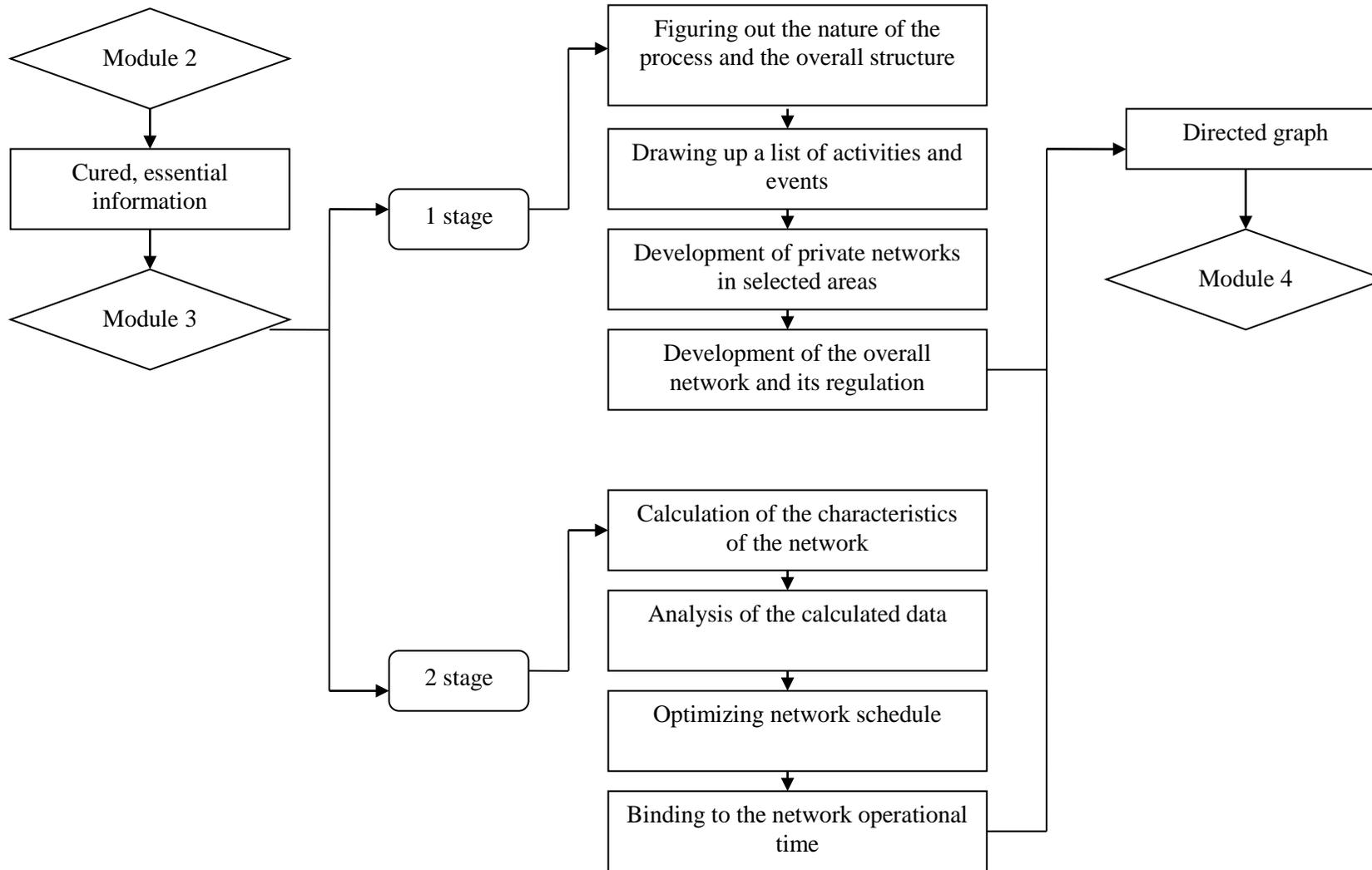


Fig.3. The general scheme of the third module of the system

Already at the interface between the first three modules and information that was processed and sorted, the main model is the fourth module - methods of situational control (Fig. 4). At this stage, the data will be enough to find out conflict and non-conflict situations. Then there is a comparative analysis of the actual parameters of the object with necessary calculation options for solving the problem of management, decision making, and therefore performance goals ASCC in general.

The general scheme of operation situational models of the object can be represented as follows. The input control model receives various messages that carry information about the state of the object, the current situation on various changes or other changes. The prevailing situation is reportedly recognized as conflict or non-conflict. In case of non-conflict situations, i.e. situations that do not require management models or humans actions, information received by the system is stored and made adjustments to the information model object. In case of conflict situations it continues the recognition as long as it isn't classified as a class conflict. Next to the resulting class conflict searched its constituent elementary class conflict situations, and the search begins corresponding set of elementary commands. The conclusion made by analyzing, evaluating situations on subjects that affect the choice of management teams in the class conflict. [4]

As a result, the shared assessment on all related classes of situations for study and excreted management team that specifies the name of the operation to be done to resolve the conflict in this situation. In the third stage of the model a certain operation is provided with all necessary resources and a set of additional operations outside the flow sheet desired operation. Thus ends the cycle of this complex model.

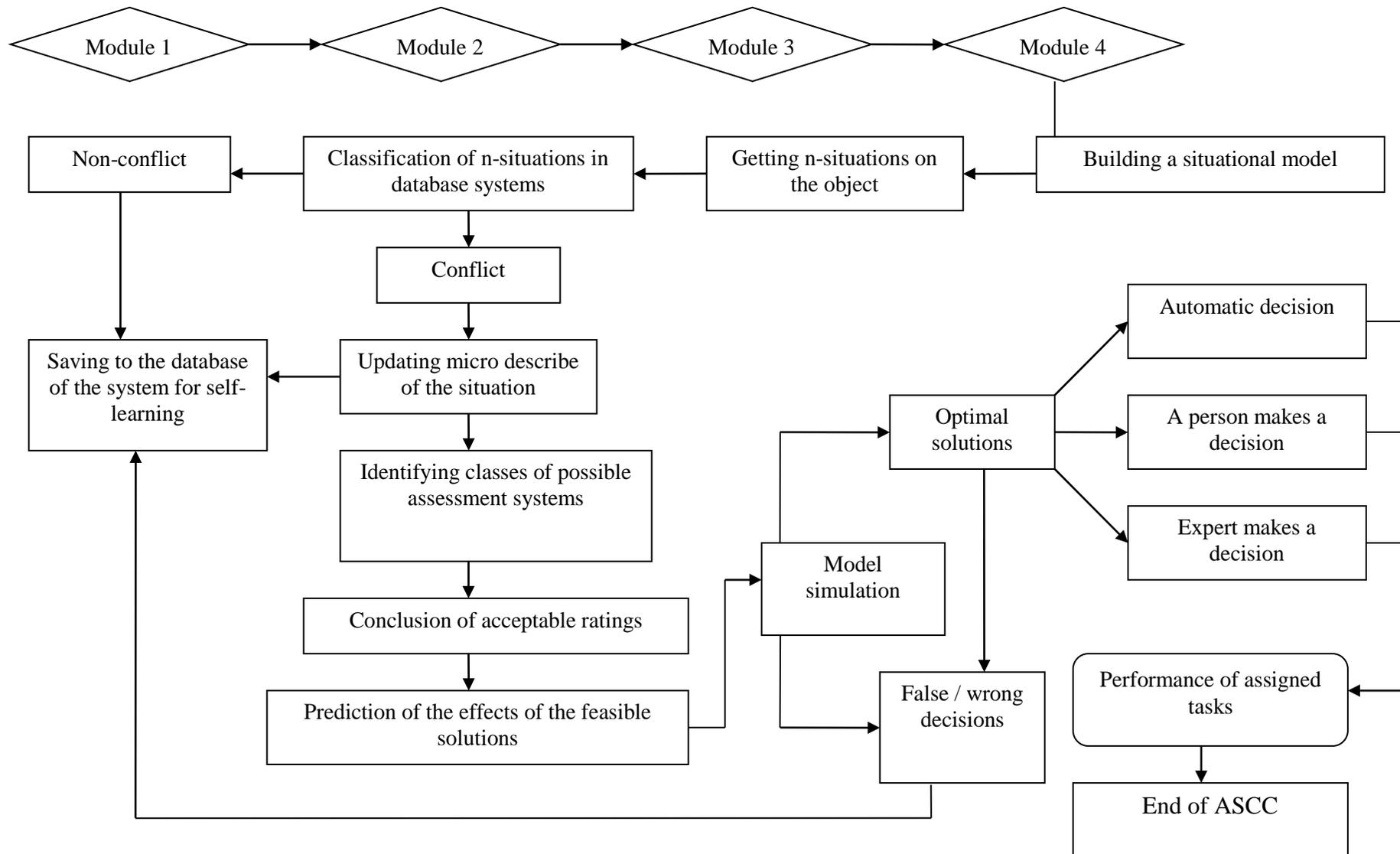


Fig.4. The main stages of evaluation system based on situational models

Conclusions

Based on this model, we can say that this approach to create an automated system of customs control on sea transport will help to achieve significant advantages in this area, namely: improving the quality and effectiveness of customs control, reduction of customs procedures, minimization of time and costs necessary for their implementation, expanding the capacity of marine ports, prevention and anticipation of cases of illegal movement of goods and vehicles across the customs border of Ukraine.

So the idea of creating an automated system of customs control on sea transport is relevant and perspective, considering that SCSU introducing the reform “electronic customs”.

Required prerequisites for the successful integration of automated customs control system in maritime transport are the further improvement of customs legislation; the upgrade of computer technology in customs and expand channels of communication; introduction of new customs control tools; development of systems for exchange of information between Ukraine and other countries of the world, different government agencies and private enterprises; modernization of records and documents; the creation of special databases in all areas of customs authorities for their implementation in automated system of customs control and clearance.

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Chernysheva I.V., Kalenik T.K., Chernysheva V. V.

**TECHNIQUE OF THE CHOICE OF QUANTITY OF THE ENRICHING
ADDITIVE ON THE BASIS OF PROGRAM CALCULATIONS AND
RESEARCH OF ORGANOLEPTIC INDICATORS**

Far East federal university

Introduction

In this report the technique of selection of optimum quantity of an enriching additive «Fukolam-R», containing fukoidan, for the raw smoked sausage prepared on the recipe for Granular sausage is considered. The technique is based on realization of priorities of safety and executed with use of program calculations and quantity corrections on the basis of research of organoleptic properties. The electronic database «Assessment of Safety and Quality of Foodstuff» was developed for optimization of calculations for an assessment of quality and safety of a ready-made product. This base allows on the basis of laboratory researches on the actual content of the toxic substances which are a part of meat raw materials and in structure of the applied food additive, to define possibility of introduction of a food additive and to calculate the greatest possible quantity which can be entered into a product without excess of standard requirements to the maintenance of kontaminant in the final enriched product.

The principle was put in a basis of a technique of selection of quantity of an entered food additive not excess of kontaminantny structure. This principle got out proceeding from some features of rationing of toxic substances in meat raw materials and a ready-made product, and as of features of preparation of raw smoked sausages. Drying leads to weight loss at the expense of decrease in amount of moisture, and, in the end result, – to increase in the content of toxic substances at a unit of weight of a ready-made product.

For production of the enriched raw smoked sausage the food additive of «Fukolam-R» possessing a unique chemical composition and a series of tire-tread properties actual now was chosen. «Fukolam-R» (raw materials), let out by experimental plant of the Pacific institute of bioorganic chemistry, are in the market since 2006. It is intended for industrial application in the food industry by production of meat, confectionery, bakery products, drinks and biologically active supplements. Its main structure - polysaccharide fukoidan (not less than 60%), allocated from seaweed into which structure enter monosugar: galactose, фукоза, monose, glucose, ксилоза. Except fukoidana «Fukolam-R» contains a mannitol, oligosaccharides, polyphenolic connections, mineral and nitrogenous substances, high concentration of ions of iron, cobalt, manganese, nickel, a chlorophyll and phenolic connections [10, 14].

Properties of an additive are defined by TU 9284-067-026981-2006 requirements. According to the passport of a series used by us (040310 of 29.04.10), it represents uniform or melkovoloknisty powder of color from light-beige to brown without foreign smells and taste with a mass fraction of water no more than 15%, with pH 1% of solution 5,95 and a mass fraction of ashes no more than 30%.

The last decade introduction of an additive of «Fukolam-R» in composition of foodstuff is caused as its chemical composition (as the enriching agent on micro and to macrocells), and as a tire-tread additive, thanks to entering into his structure fukoidany. Fukoidan has the expressed antiviral effect (destroys viruses of herpes of type 1, F) ; slows down development of allergic reactions and destruction of fabrics; stops the excess growth of gladkomyshechny cages in walls of vessels; activates the enzymes participating in a beta oxidation of fatty acids, reducing level of cholesterol in blood; slows down glucose absorption from intestines in blood; normalizes level of sugar in blood. Reception fukoidana considerably raises a post-ischemic kidney blood-groove and can be used as a prophylactic at diseases of kidneys, showing also antimicrobial activity [3,15,16]; protects walls of a gastrointestinal path from damage by various agents, including bacteria; it well heals fabrics and restores elasticity of skin; possesses onkoprotekorny, immunomodelling, gepatoprotekorny properties;

slows down aging process. Admissible daily dose of consumption fukoidana - 60 mg (100 mg fukolam) [5,8].

«Fukolam-R» is actively used in the food industry as additives to grain products, meat and dairy products, including ice cream [1,2,7,9] with good research results. So, according to authors [13], at the use by mice of ice cream with additives fukoidana, the increase in the content of the general cholesterol in serum of blood makes only 3,5%, whereas at the use of traditional ice cream - 10,7%. Addition «Fukolam-R» in foodstuff positively influences and their quality. For example, at production of bakery products [7] the specific volume of a long loaf increases by 8,1-11,5%; for 11,8-17,1% - height of products improves the formoustoychivost (on 22,5-30,0 %) and porosity of a crumb improves. Samples of podovy bread with addition of 0,05-0,15% of an additive of «Fukolam-R» correspond to category of quality «excellent» against control «good».

Process of design of safety of a ready-made product was begun with drawing up a compounding of the raw smoked sausage enriched with an additive of «Fukolam-R». For a basis of a compounding of sausage (on the main unsalted raw materials and spices) it was taken ingredienny structure of raw smoked Granular sausage according to GOST 16131-86 requirements in which it was planned to enter a food additive of «Fukolam-R» without prejudice to safety of a ready-made product. At this stage possibilities of the database (D) «An assessment of safety and quality of foodstuff» [11] which allows not only to develop a compounding of future products were used, to estimate their nutrition and power value, compliance to standard requirements and physiological needs of the person, but to calculate safe concentration of an entered additive on the basis of criteria of safety.

As for criteria of safety, that, according to passport data, the list of the toxic elements normalized for «Fukolam-R» - lead, mercury, arsenic, cadmium (tab. 1), coincides with the list of toxic substances normalized for meat raw materials for production of raw smoked sausages. The same kontaminant are normalized and for ready raw smoked sausages. Therefore at the subsequent researches the special

attention [4,6] was paid to these kontaminant. The list and standard values of toxic substances are provided in tab. 1 for a food additive of «Fukolam-R».

Table 1

Indicators of toxic substances for «Fukolam – R»

№ o/o	Toxic elements, mkg/kg	Size (according to the passport)	Admissible level
1	lead	0,2 ±0,086	5,0
2	cadmium	0,75±0,19	1,0
3	Arsenic	Менее 0,03	3,0
4	Mercury	0,0074±0,0012	1,0

For an assessment of importance of criteria of safety for the main raw materials (unsalted raw materials), the raw smoked sausages [11,12] applied in production passable a stage of drying, calculations on which conditions were imposed previously were carried out that the maintenance of kontaminant in meat raw materials (beef and salted pork fat) chislenno are equal to standard (maximum concentration limits) to values (tab. 2).

Table 2

The content of toxic substances in finished goods at the maintenance of kontaminant in raw materials at the level of maximum concentration limit

Kontaminant	Maintenance of kontaminant, mg/kg			
	Raw materials		Admissible level of the content of toxic substances for raw smoked sausages	Settlement data (sausage without fucolam)
	Beef	Salted pork fat		
Lead	0,5	0,5	0,5	0,52
Arsenic	0,01	0,1	0,1	0,105
Mercury	0,03	0,03	0,03	0,006
Cadmium	0,05	0,05	0,05	0,012

As a result of calculations (tab. 2), it became obvious, what even without introduction fukolam the content of lead and arsenic in sausage, though is insignificant, but will exceed admissible state standard specifications levels. It means that requirements to kontaminantny structure of meat raw materials for preparation of

raw smoked sausages have to be or more rigid, or their actual contents in unsalted raw materials has to be less maximum concentration limit that is especially actual in case of enrichment by the food additives, containing the same kontaminant. From this calculation the conclusion also was drawn that the quantity of an entered additive needs to be carried out on a database of laboratory researches of the actual kontaminantny structure of applied meat raw materials and a food additive.

Further, on the basis of actual data on kontaminantny structure of raw materials and an entered additive the greatest possible quantity of a food additive which can be entered into sausage structure without risk was calculated to exceed normalized levels of toxic substances it is possible to add 430 grams of an additive of «Fukolam-R» on 25 kg of unsalted raw materials that there correspond 1,72 g of an additive on 100 g of unsalted raw materials.

However introduction fukolam in foodstuff in large numbers influences their taste and a smell. Therefore additional researches on meat models for studying of organoleptic properties of a product with additives fukolam selection of quantity of entered concentration at which organoleptic properties of a ready-made product don't change was which purpose were conducted.

For these purposes preliminary experiment on meat models - mincemeat with the maintenance of beef – 45% and chic spine – 55% that corresponds to the maintenance of unsalted raw materials for production of sausage of the raw smoked, raw smoked Granular sausage prepared on the recipe with introduction of 1 g was made; 0,4 g; 0,1 g of «Fukolam-R» on 100 g of unsalted raw materials. At production of meat models mincemeat without spices that allowed to minimize presence of strangers of substance at a product was used. Models were investigated on organoleptic indicators, first of all - on flavoring qualities.

Research showed that products from the first two series (1 g; 0,4 g; fukolam on 100 g of raw materials) had a pleasant smell and taste, but 1-2 minutes later after the use there was an aftertaste - obvious feeling of bitterness in this connection they were recognized as the unsuitable. Samples of the third series on taste were softer, pleasant, with easy granularity, didn't leave after itself any aftertaste, looked more

juicy. On the basis of results of organoleptic researches concentration of an additive of «Fukolam-R» in future sausage was finally chosen. It made 0,1 g fukolam on 100 g of unsalted raw materials.

Upon termination of experiment expected calculations of indicators of criteria of safety for a ready-made product of raw smoked Seaside sausage which were compared to results of laboratory researches of finished goods were executed.

Table 3

Summary table of results of experiment

Kontaminant	Maintenance of kontaminant, mg/kg					
	Raw materials *			Ready foodstuff (sausage) *		Data of calculations
	Beef	Salted pork fat	«Fukolam-R»	Sausage without fukolam	Sausage with fukolam	Sausage with fukolam / maximum concentration limit
Pb	0,032± ±0,017	0,015± ±0,008	0,51	0,082± ±0,032	0,096± ±0,041	0,1649/0,5
Ar	0,02± ±0,06	0,021± ±0,009	0,91	0,028± ±0,013	0,028± ±0,013	0,05/0,1
Hg	0	0	0,065	MeHee 0,004	MeHee 0,004	0,0063/0,03
Cd	0,0027± ±0,007	0,0026± ±0,0009	0,49	0,003± ±0,0013	0,007± ±0,0036	0,011/0,05

At calculations quantity of kontaminant in spices was accepted to equal standard values.

Conclusions

Thus, the choice of quantity of an enriching additive on the basis of expected calculations and research of organoleptic indicators includes the following stages:

- laboratory researches of raw materials and the enriching additive, entering into a product compounding on the actual maintenance of kontaminant;

- calculation of the greatest possible quantity of an entered additive on the basis of a compounding of a finished product and taking into account the actual quantity entering into ingredients (raw materials and an additive) identical kontaminant;

- production of food models with the greatest possible quantity of entered enriching additives;
- research of organoleptic properties of the enriched product on food models and correction of results of a choice of quantity of entered enriching additives;
- expected calculation of the maintenance of kontaminant in the finished enriched foodstuff on the basis of the modified quantity of an entered additive;
- production of the enriched foodstuff;
- laboratory researches of the finished enriched product on existence of kontaminant;
- comparison of the received results and results of research; conclusions.

The fundamental thesis at final definition of the content of quantity of an entered food additive is not excess of kontaminantny structure and not influence of an additive on organoleptic indicators of a ready-made product.

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Musatkina B.V.

**HYGIENIC ASPECTS OF USE OF DEVICES OF NEUTRALIZATION
AND COMPENSATION ELECTROMAGNETIC FIELDS**

Omsk State Transport University Omsk, Marx av., 35, 644046

In this work the analysis of the Russian standards of electromagnetic safety is carried out. Results of pilot studies of influence of devices of neutralization of electromagnetic fields on levels of radiation of technogenic sources are presented.

Keywords: devices of neutralization of electromagnetic radiations, tool control of electromagnetic fields.

Introduction.

Since the second half of the XX century as a result of technical progress the new significant factor of environmental pollution – an electromagnetic field (EMF) of anthropogenous (technogenic) sources was created. The term "global electromagnetic pollution" which has been officially entered by World Health Organization in 1995,

rather precisely characterizes current situation. At the same time with increase in scales of electromagnetic pollution and development of scientific researches EMF in public consciousness inconsistent tendencies are shown: on the one hand, knowledge of workers, administrative personnel and the population as a whole about possible risks for health grows; on the other hand, not always and not everywhere means and ways of protection against EMF are consciously and effectively applied.

Materials of researches.

In recent years on sale there were different "field converters", "jacks of electromagnetic radiation" which within this article we will agree to call "neutralized devices" (ND). Developers (producers) ND offer them as means of protection from EMF of all types, both production, and household sources; structurally most often such ND represent plates (sticker) of a small format.

In maintenance instructions ND carrying plates in a pocket of clothes or their sticker on the display, the cell phone, household appliances, etc. is offered. The principle of action ND, according to statements of producers, is protected by copyright certificates or patents. In some advertizing materials references to the biopower information mechanism of protective action ND are had. Available hygienic certificates on ND as on any consumer production, contain data on lack of adverse effects of this product (or materials of which products) on a human body are made. They don't bear information on degree of efficiency of protective properties.

There is a question of objective confirmation of efficiency ND. The author doesn't consider from positions of the theory of an electromagnetic field and electrical equipment possibility of shielding, absorption and compensation of EMF of external sources with the help ND the individual using, structurally executed in the form of a plate (sticker) of a pocket format with a dielectric covering.

We will be limited to consideration of two aspects of the matter: objective tool control of the EMF levels before application ND and hygienic rationing.

The author carried out measurements of the EMF levels of displays, density of a stream of the energy radiated by Microwave ovens and cell phones with application ND of different types (names and producers). Methods and measuring instruments

and estimates conformed to requirements of existing normative documents [3 – 13]. The measuring devices included in the State register of measuring instruments of the Russian Federation (the measuring complex «Cyclone-5M» for control of EMF of displays in the range of frequencies from 5 Hz to 400 kHz, the measuring instrument of the field «IPM-101» and the measuring instrument of density of a stream of energy «PZ-33M» for measurement of electromagnetic radiations of radio-frequency range from 0,3 MHz to 300 GHz) were used. Various options of a relative spatial positioning of sources of EMF, ND and users were investigated.

Results showed lack of statistically reliable influence ND, fixed by objective gages, on the EMF levels created by displays, microwave ovens and cell phones.

As for hygienic rationing, that, without pressing in discussion of the biopower information technologies declared by producers ND, it is obviously important to consider the approach accepted in the Russian Federation to establishment of the maximum permissible levels (MPL) of influence of factors of the environment on a human body. The main summarizing requirement to establishment of MLP EMF is absence at the person even temporary violation of a homeostasis, and also violation of protective and adaptation and compensatory mechanisms neither in the next, nor in the remote period of time.

The maintenance of promotional and informational materials of a row ND allows to assume that the protective effect declared by the producer is created at continuous and long application ND in the form of stimulation and formation in an organism of the user of the increased adaptation potential, that is loading of adaptation reserves.

Conclusion.

Now level of a technogenic electromagnetic background exceeds a natural background by 1000 - 100 000 times and continues to grow, and it is a question not of conditions of professional influence on production, and of conditions of usual activity of the population and natural ecosystems. Live organisms (including the person) in the course of evolution adapted to the EMF certain level (a geoelectromagnetic background).

Sharp change of an electromagnetic background happened for historically small period that can't but cause tension of adaptation opportunities of an organism, long-term action of this factor can lead to their exhaustion and irreversible consequences at system level. Artificial stimulation of compensatory reserves of a human body as some kind of "the inoculation against electromagnetic fields", assumed by some developers of devices of compensation and neutralization of electromagnetic radiations, demands additional medicobiological researches of potential risks for health of users and is represented insufficiently studied method of protection. Results of tool control showed lack of statistically reliable influence ND on the EMF levels created by displays, microwave ovens and cell phones.

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J11307-190

Vanin V.V., Gryaznova G.P.

**SOME ASPECTS OF GEOMETRIC MODELING OF SPARE PARTS
MADE OF COMPOSITES WINDING PRODUCTION TECHNOLOGY**

National Technical University of Ukraine ("KPI"), 37 Prospect Peremogy, Kyiv

This article is dedicated to the geometric research of the process of manufacturing parts made of composites by winding, and gives determination of the conditions of equilibrium filaments on the surface of revolution.

Key words: reinforced products, winding technology, composites, geometric modeling.

Introduction. The development of machine-building production involves the use of advanced technologies and, above all, composite materials (CM). An example of this trend is the increased use of polymeric materials in equipment of aerospace, industrial, commercial sports, recreational areas and other industries [1, 2].

Main part. One of the known ways of making parts from CM is a continuous winding technology. The essence of the method is in the fact that the tape of several polymeric filaments saturated by epoxy prepreg and applied to the surface of the mandrel. The tape is moving in a predetermined direction to provide the desired shape of the product with defined characteristics.

Technological modes of formation of the product by winding are formed with a number of parameters, including strength thread tension and contact pressure. The kind of technological process is determined by the characteristics of the production process, the shape parameters of the future product, chemical composition of prepreg and CM [3]. Thus there are continuous filament winding, mostly implemented for surfaces of revolution, and the fiber placement, primarily used for mandrels of complex geometrical shapes.

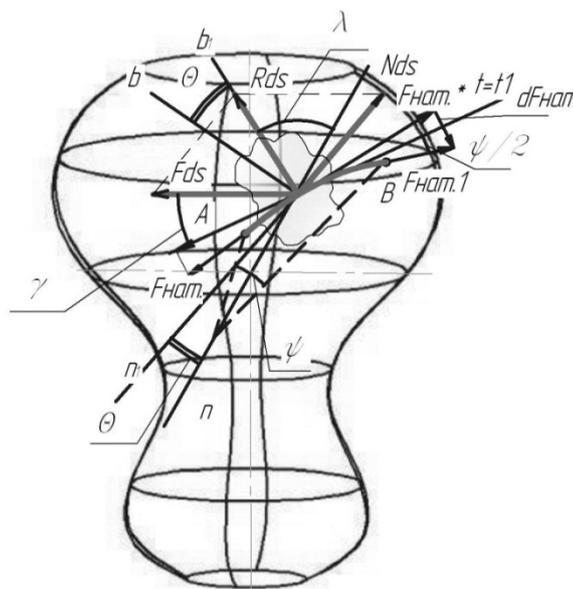


Fig.1 The thread on the surface of revolution.

Consider the surface of revolution and equilibrium conditions of thread on it (Fig.1). From a geometric point of view, AB part of the filament is the curve of an arc with the length ds . In further calculations let us agree to assume the thickness of the

thread is the same while is much lower order than its length, and therefore will not be taken into account in the calculations.

We will agree that the physical and mechanical properties of the filaments in the yarn equally and uniformly distributed. Elementary part of the thread ds corresponds to rotation angle of the radius vector of the curvature of the arc $AB - d\psi$.

Let's orient the axis of two natural trihedral for points A and B along the arc and join their centers. Directions of tangents t and t_1 match, and the normal n_1 and binormal b_1 are respectively deviated from n and b on the angle of the geodesic deviation θ . An element of the arc are under the influence of such forces: the force of tension - $F_{Ham.}$, applied to one end of the thread, and $F_{Ham.1}$ - to the other end, the surface reaction Rds [4], which is given by:

$$Rds = Nds + Fds, \quad (1)$$

where Nds - the normal reaction of the surface, Fds – friction force.

The dependence of the tensile forces on the ends of the thread from the angle of the geodesic curvature, the coefficient of friction and the angle of the surface of the girth of the form is the following:

$$\frac{dF_{Ham.1}}{F_{Ham.}} = e^{\int_0^\psi \cos \theta \sqrt{f^2 - tg^2 \theta} d\psi}. \quad (2)$$

Exploring the mandrel surface in the form of a surface of revolution, we define the angle of the geodesic deviation θ . For this we express $tg \theta$ using angle β - between the tangent to the spiral and the corresponding geodesic parallel:

$$tg \theta = \frac{\frac{dr}{dz} \cos \beta - r \sin \beta \frac{d\beta}{dz}}{\cos^2 \beta - \frac{r \frac{d^2 r}{dz^2}}{1 + \left(\frac{dr}{dz}\right)^2}}. \quad (3)$$

where r – the value of the function, which defines the image of the surface (in this case - the radius of the base), z - current coordinate along the axis of rotation. By

Clairaut Theorem [5], we obtain formulas for the terms of the angle $tg \theta$ via the angle ω , complementary to β .

$$r \sin \omega = c = const.$$

$$tg \theta = \frac{c' r^2}{c^2 - \frac{r r''}{1 + r'^2} (r^2 - c^2)} \leq f, \quad (4)$$

where r' , r'' , c' - the first and the second derivatives of the corresponding parameters.

The final equilibrium conditions of filament wound on a cylindrical mandrel are expressed in this way [1, 4]:

$$e^{-f\psi} \leq \frac{F_{Ham.1}}{F_{Ham.}} \leq e^{f\psi}. \quad (5)$$

Conclusions. The issues of geometric modeling of spare parts made of composites winding production technology were considered in the article. The geometric research of the thread placement on the surfaces of revolution was conducted. A variety of forms of parts requires further study of the process of winding using mandrels of more complex shapes.

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Nyrkov A.P., Sokolov S.S., Ezhgurov V.N., Malcev V.A.

EFFECTIVE INFORMATION MODELS OF TRANSPORT'S PROCESS

Federal budget institution of higher professional education “Saint-Petersburg state university for water communications”,

Russian Federation, Saint-Petersburg, Dvinskaya 5/7, 198035

In this report we describe the process of construction software for improvement of the efficiency of transport's process.

Key words: transport's process, multimodal transportation, software, genetic algorithm, ant colony optimization, Karman's system.

Introduction

The concept of efficiency can be given in different ways, depending on the subject area. However the efficiency can be defined as achievement of any specific results (increasing of any indications) at the lowest possible cost. Thus, efficiency is a multi-faceted concept.

For transport processes this concept can be set through the most significant (if it is possible to neglect detailed accuracy) categories. Examples of the categories, discussed in this article, are the following: picking of transport's objects, rational allocation of cargo as hub component transport, management of multimodal traffic.

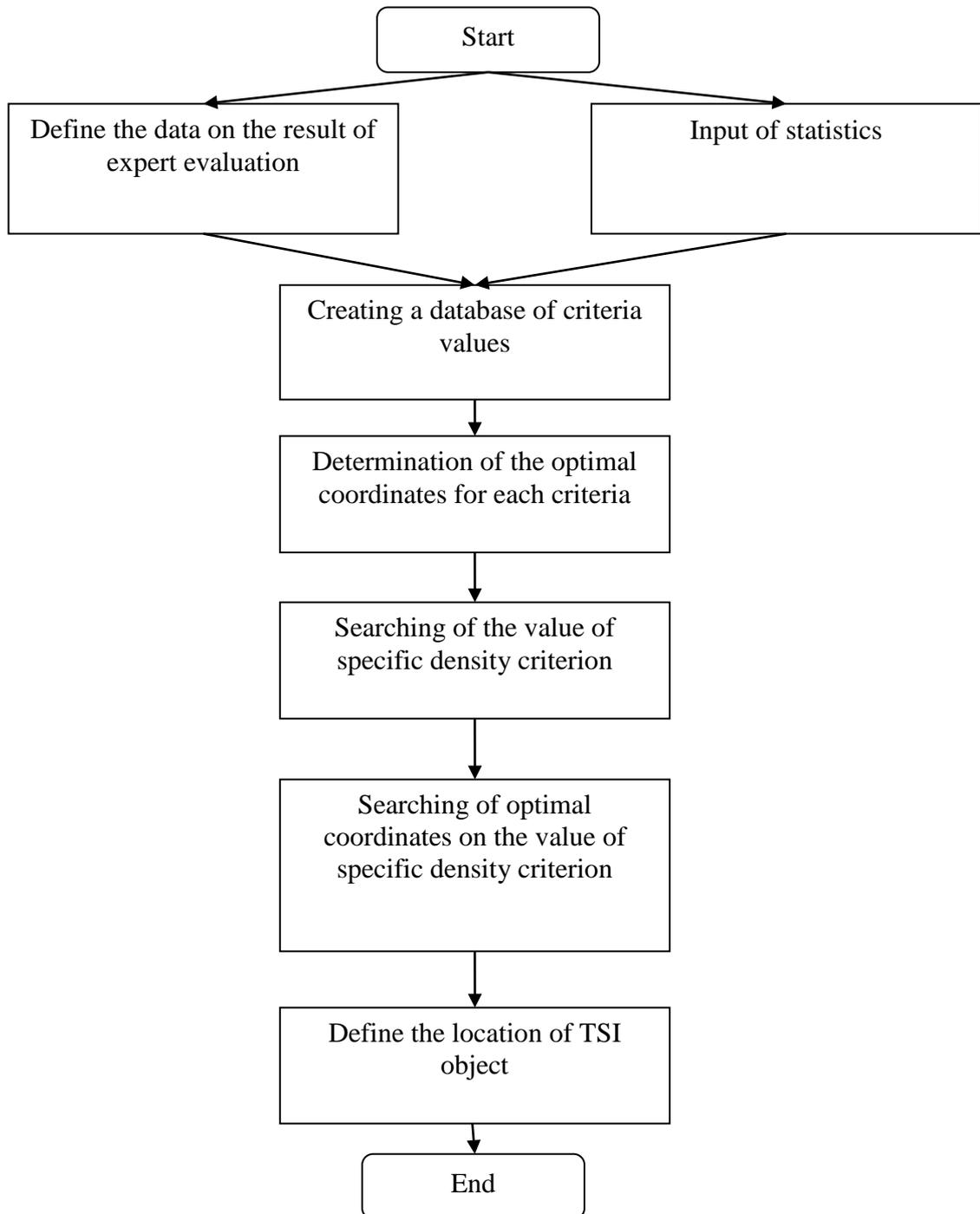
1. Picking of transport's objects

Let's consider in more details the construction of software for managing the process of picking of transport's objects, according to their rational allocation, according to priori specific criteria space, and as well as minimizing the cost of cargo

transport operation.

Correct determination the location of allocation objects is necessary to carry out a number of operations, that needed to be algorithmic and formalized.

Algorithmic process will start with the construction of a generalized algorithm of searching locations of transport's objects (pic. 1).



Pic.1. A generalized algorithm for searching locations of transport's objects

At the beginning of the expert evaluation is necessary to determinate the experts competence. For this we use the hypothesis that value of competence of single expert

is determined by the measure of consistency its evaluation with the group evaluation of criteria.

Adjustment of the competence is assumed as follows: at each step, after computing the weight group evaluation of each alternative (criterion), computing the deviations of individual evaluations of the experts from the group and coefficients of experts competence, evaluation that were close to the group, increase, and the evaluation of experts competence, that were far, reduced.

For proximity determination of expert to the group evaluation rule, describing the distance between the evaluations. Depending on rule generates the corresponding version of the algorithm.

As a mathematical model to make “Searching of optimal coordinates on the value of specific density criterion” is used the model presented in [1].

2. Rational allocation of cargo

The degree of rational allocation of cargo is density of allocation of cargo, ensuring of the requirements for stability (in water transport) and minimum strain on the shell of the transport unit.

The generalized metaevrastic algorithm, including genetic algorithm and ant colony optimization, with the decoder “low-left improved” is planned to apply for rational density allocation of cargo.

To comply the stability is planned to use the theory of ship static and operate the metacentric height when cargo is allocating. More details with described ways and resulted information structures can be found in [2].

Question about deformation of transport unit shell is planned to decide based on allocation of the containers on containers ships.

Consider a plate, simulating the process of bending the upper deck of a container ship, which is undergo outer load. Since the allocation relatively lightweight containers in holds not allow to use full ship’s tonnage, containers are also allocated on the upper deck (usually no more than four stories). Total width of allocation of the containers in holds are limited by hatches width. There is no such a limit on the upper deck. That allow to allocate half of the containers on the upper deck. Load of containers on the

deck constructions, bottom and bulwarks (fencing along the edges of the outer deck of the ship, vessel or other craft is a solid wall without openings or with special openings for water runoff, mooring (hawse) and other) can be estimated in advance, as weight of each loaded container always known.

Such a plate as a part of ship's shell may be exposed of the effort, causing plane stress, or bending deformation, and sometimes both at once.

The main objective is to determine of deflection of the plate and construction of the stress field, appeared in the plate under the action of the upper loads. In solving this problem is expected to consider deflection of the middle surface of the plate.

To solve the problem is proposed to consider system of nonlinear equations related to deform state of the plate, as it was proposed by T.F. Karman in 1907.

The direct solution of two Karman's nonlinear equations is not simple, but there are number of indirect methods now, as series solutions or energy methods. In the consider research is used nonlinear cases finite deflection of the plate with the use of numerical methods.

3. Management of multimodal traffic

Delivery of goods more than one of transport mode is cargo multimodal transport. Also, different modes of transport can be combined in any combination. To date, multimodal transport is the most convenient and popular form of delivery of significant loads at medium and long distances. The main advantage of this method of delivery goods is the maximum using of advantages of various means of transport, thanks to their competent combining. Thanks to using multimodal transport, there are appeared the opportunity to realize the principle of delivery "from door to door".

There is no hard fixation to the same model of transport in multimodal transport. The main role is gain to several factors in multimodal transport, such as: time of delivery, safety and cost.

Costs are not always the main factor, as they often overlooked in favor of time of delivery and safety. Transport safety if minimal risk in transport cargo. Delivery time is the time, during which cargo will be delivered from point of origin to the destination.

To solve problems of automating the multimodal transport is planned to use

software solution, relating to class of decision support system (DSS) – automated system of helping people in making decision in complex condition. DSS are the result of development information systems and systems of database management.

For the analysis and making proposals in DSS are used different methods: search, intelligent, searching for knowledge in database, reasoning based on the basics of precedent, simulation modeling, evolution and genetic algorithm. Neural networks, situational analysis, cognitive modeling, etc. Some of these methods have been developed through research and development of artificial intelligence. If the basis of the decision support system based on artificial intelligence, it is said about intellectual DSS, or IDSS.

With the development of information system, complication of algorithms for processing of incoming information, as well as the increasing specialization of the automate system is its evolution into an expert system, that is able partially to replace expert specialist in the area of specialization of the program.

Conclusion

In summary it should be noted that the described work doesn't apply for objectivity of an assessment of transport processes parameters however, gives effective examples of use of information support for increase of efficiency of processes.

Integrity of research and logical completeness at this stage isn't reached as development of program implementation of the described decisions isn't complete.

Also in the long term developments of work there is a solution of a question of an assessment quality system development of functioning by developed information system which would be based on a basic criteria matrix of efficiency.

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Titova O.V., Kravets A.G.

**METHOD OF STUDENTS COMPETENCES LEVEL AUTOMATED
MANAGEMENT**

Volgograd State Technical University, Volgograd, Lenin Ave 28, 400005

An insufficient level of schools graduates in physics is identified as the modern problem of the education. It is proposed to prepare students to the Unified state examination by means of tasks solution competences formation. The method of competences level automated management is developed for students competences formation.

Key words: training, the solution of tasks, competences, competence level, automated management.

Introduction. The Russian government has adopted the program of the socially oriented development of the country. According to this program one of the main objectives is the development of science and technology sectors. For the solution of

the posed problem in education the priority is given to technical and natural science disciplines.

The implemented Unified State Exam (the USE) has its goal to select capable school and university graduates. According to the results of the USE 2012 in Physics it has been found out that 26,6% of all the school graduates got average and high grades and the rest of the school graduates (73,4%) got minimal and low grades. There has been observed a tendency of increasing number of school graduates who have not passed the minimum threshold. The number of such school graduates has increased from 0,4 % in 2011 to 12,1% in 2012. The situation is no better with those who got 100 grades. The number of them decreased from 0,11% in 2011 to 0,02% in 2012. As a result the universities specializing in engineering technology missed out on competitive applicants in 2012.

In accordance with the requirements of the Federal State Education Standard all school graduates must be able to apply their knowledge and skills in familiar, changed and new situations. The formation of the ability to apply knowledge and skills in a familiar situation can be achieved by doing similar tasks. Application of knowledge and skills in changed and new situations requires some extra abilities. Pure knowledge of the theoretical material is not enough for completing the tasks in part C in the USE in Physics. Teachers of Physics tend to prepare students for the examination by giving them a great number of challenge tasks. Doing such tasks students acquire knowledge, the very knowledge that they apply at the examination. This preparation method is considered ineffective because one needs much time for fulfilling the tasks and nobody can guarantee that students will be able to cope with the task at the exam.

That is the reason why they suggest students being prepared through the formation of task-doing competences. Due to the development of new technologies and new PC hardware in educational institutions the preparatory work should be done through automatization of a teaching process.

Accordingly, the development of the method of automatised controlling the level of students' competences is viewed to be a vital target.

Description of the developed method. Aiming at defining the task-doing competences in Physics there has been carried out an analysis of the task-doing process. As a result of the analysis there has been developed a structural and functional model of the task-doing process in the form of diagrams and notation IDEF0 [1]. The model of a task-doing process is viewed as a combination of functions. For each of these functions there are form controlling, controlling mechanisms and also in- and outcoming data [2]. The obtained functions are now task-doing competences, which are to be formed in students. Control elements of the function are the theoretical material of the Physics course. The theoretical material required by solving the function is included into the ontology of a physical task [3].

Aiming at the automatization of competence level control process there have been set the tasks to control the system of practically oriented teaching in the field of natural science, within the framework of which there has been offered an idea of mathematical controlling the level of students' competences. As a result of solving the problem of the competence level control there has been obtained an optimal teaching mode. It is characterised by gradual increase in the competence level during the study process [4].

For automatized control of the competence level it is suggested that they perform a model of a student as a set of many competences.

With the help of the worked out method of presenting a range of competences there have been defined certain connections between the competences. For controlling the level of the competences there has been worked out a method of evaluating the level of the competence and developing an individual teaching strategy.

The level of competences of a student is evaluated with the help of automatized system devised in Asp.net MVC 3 RTM. It serves to evaluate the level of competences and to build up an individual strategy of the education process.

The designed automatized system of the intellectual search of the optimal way of doing physical tasks is aimed at the formation of teaching competences in students

in fulfilling the tasks. The program system code is written in Java language in the development environment of Eclipse Classic 3.7.2 Indigo.

Conclusion. The designed method of the automatized students' competence level control differs from the known methods in:

- The ontological model of a physical task has been the first to be developed. Ontology of a physical task is a field of knowledge, which includes both basic data of the task and the desired quantity. Solution to any task is included into this field of knowledge.
- There has been offered a new method of formalization of the task-doing process. It differs from the known ones due to the carried out detalization of the task-doing process and the defined logical conclusion for completing the task from the basic data using ontology and descriptive logic.
- There has been developed a method of performing a variety of competences in doing physical tasks which is unique due to the fact that the task-doing competences in Physics are formed from the solving process model.
- There have been set the the tasks to control the system of practically oriented teaching in the field of natural science, within the framework of which there has been offered an idea of mathematical managing the level of students' competences.

As a result of adopting the worked out method in the education process on practical physical lessons the quality of education has risen up to 14.2% and the time period has been reduced to 15%.

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A.V. Demianenko, M.V. Orda-Zhigulina

**SIMULATION OF AN ACTIVE ANTENNA AMPLIFIER
FOR GLONASS/GPS SYSTEM**

ABSTRACT In this article we provide a brief outline of the basic requirements to antenna amplifiers of GLONASS/GPS system. We propose a block diagram of an amplifier with separation of operating frequency bands. And we also present the simulation results of antenna amplifier built on the basis of proposed block diagram and with application of newest hardware components.

INTRODUCTION At present time, active R&D work is continued by different laboratories and engineers with view to create new generation of navigation satellites "GLONASS-K" with improved performance and extended operational lifespan, which will lead to a significant improvement of overall accuracy characteristics in near future, and thereby it will increase the competitiveness of the entire global navigation satellite system (GLONASS). And from this perspective, development and creation of new products and solutions based on GLONASS system seem to become of topical interest. These products undoubtedly include active professional grade antennas for receiving GLONASS/GPS/NAVSTAR signals, which should be developed for industrial, agricultural, and special applications.

SIMULATION Apart from the general technical requirements for this type of amplifier (operating frequency range, gain factor, saturation power, noise figure, admissible value of intermodulation distortion, operating temperature range, weight and size characteristics) it is incumbent to consider effect of radio interference of various external radio equipment operating at close frequencies on the performance of antenna amplifier. As we know, the frequency of Iridium satellite telephone

systems lies between 1616 and 1626.5 MHz, ground-based terminals of INMARSAT system transmit signals at frequencies of 1525 and 1646.5 MHz, cellular phone systems use frequencies of 850/900 MHz and 1800/1900 MHz, and moreover, within the radio frequency range considered herein, there are also radio-amateurs working on 1296 MHz frequency.

At present, most mass-produced amplifiers for active antennas are designed to operate only at one frequency range of GLONASS system (L1). These amplifiers are low-cost and inexpensive. But in cases when high accuracy positioning (within range of few centimeters) is required, it is essential to be able to receive signal in several frequency bands of GLONASS system.

To effectively minimize the impact of the aforesaid radio interferences on data signals of GLONASS/GPS, it is necessary to develop a new amplifier for GLONASS/GPS active antenna, and where amplitude-frequency response characteristics (AFC) of such amplifier would have a frequency-selective character. Currently, the navigation signals are transmitted in two frequency bands L1 and L2. Therefore, the amplitude-frequency response characteristics (AFC) of amplifier must have two frequency peaks in midfrequency of these bands. The bandwidth of each frequency band is 50 MHz.

Let us define requirements for gain factor level. As we know the main purpose of amplifier is to enhance weak signals received from navigation satellites. Situations with weak signal reception may be explained by a spatial orientation of an antenna, its specific geographical location, as well as poor current weather conditions. Additionally, an antenna usually has a lead-in cable, and cable loss must be also compensated.

All currently used radio-frequency coaxial cables with resistance of 50 ohms, depending on their design and quality of dielectric, have an attenuation per unit length ranging from 0.07 to 0.3 dB/m in superhigh-frequency band. And total attenuation of signal in a cable from 6 to 16 meters long can reach 3 dB. For reliable reception of navigation signals in various locations we will consider gain factor of 20

dB. Then, after taking into account the cable loss, we get the minimum gain factor value of 23 dB.

An important parameter for antenna amplifier is the value of input signal power, whereby saturation of the amplifier occurs. This parameter is determined by the hardware components used for building the amplifier.

Each amplifier has its own inherent noise which is amplified together with actual data signal, and such noise degrades the signal-to-noise ratio (SNR). Therefore noise figure (NF) should be considered as one of the most important parameters of antenna amplifier. The noise factor is mainly determined by Noise Figure (NF) of the first amplifier stage and by the quality factors of impedance matching. For the most accessible and inexpensive amplifiers operating in microwave band, noise figure (NF) ranges from 0.8 to 1.6 dB.

On the ground of the said requirements for an antenna amplifier we created a block diagram of amplifier, see Figure 1.

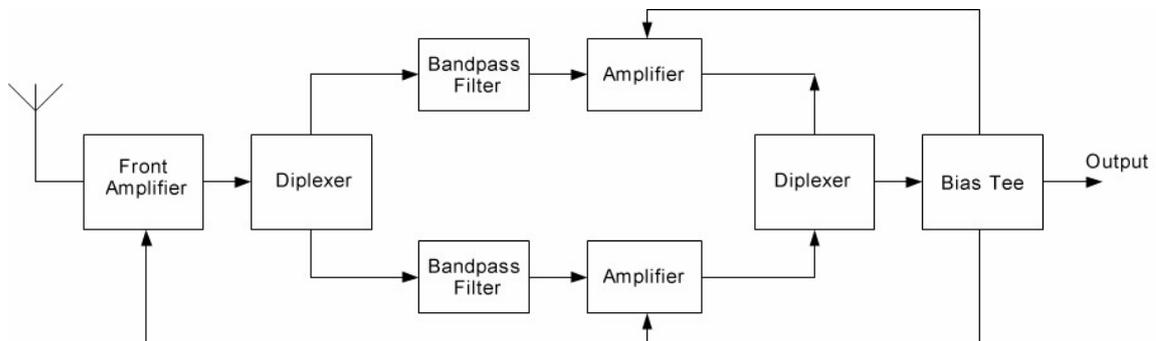


Fig. 1. The block diagram of antenna amplifier.

The signal received by antenna is fed into the input amplifier. Next, the received signal is divided via diplexers into two channels, where each channel corresponds to one of the two frequency bands. Further, the signal is filtered and subsequently amplified in each channel. Frequency selectivity is initiated and formed within this component part of the amplifier. After that, both channels are merged back together into one output signal by means of diplexer.

Power supply is fed into amplifier through a lead-in (drop) cable. High-frequency signal is separated from direct current (DC) with the aid of Bias-Tee diplexer. In order to reduce instability of antenna amplifier performance caused by destabilizing factors in the supply circuit we used parametric frequency stabilization which was achieved by adding a constant-voltage regulator to the DC circuit.

Each amplifier stage was implemented on a SPF5122Z microchip, the main characteristics of which, while operating at frequency of 1.5 GHz with supply voltage of 3 V, are shown in Table 1.

Table 1. Main parameters of SPF5122Z microchip.

Parameter	Unit	Value
Small Signal Gain	dB	14,5
Noise Figure	dB	0.65
Third-order intermodulation distortion (IMD3) (Output IP3)?	dBm	36.0
Power output w/compression 1 dB (P1dB)	dBm	19.4
Input Return Loss	dB	-16.5
Output Return Loss	dB	-18
Reverse Isolation	dB	-19

The entire simulation of the amplifier was done in MicroWave Office program. The simulation results of main characteristics of a single amplifier stage are shown in Figures 2-4.

Figure 2 shows the frequency dependence of S-parameters of one amplifier stage (Δ - S21, \square - S11, \diamond - S22, \circ - S12). From the diagram in Figure 2 we can see that at the central frequency of L1 band it is possible to achieve the small-signal gain of 14.17 dB with input return loss of -13.5 dB, and for the central frequency of L2 band -- the small-signal gain of -16.05 dB with return loss of -13 dB.

The reverse isolation of amplifier stage throughout the entire frequency range, where the simulation was carried out, is less than -24 dB and which, together with the gain factor, demonstrates the stability of the amplifier stage. The frequency

dependence of the stability factor is shown in Figure 3, which shows that the amplifier stage is stable throughout the entire frequency range.

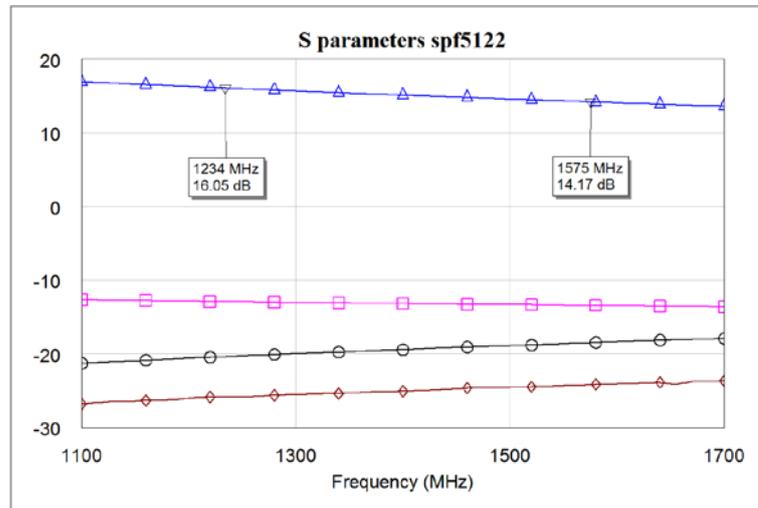


Fig. 2 - Frequency dependence of S-parameters of one amplifier stage

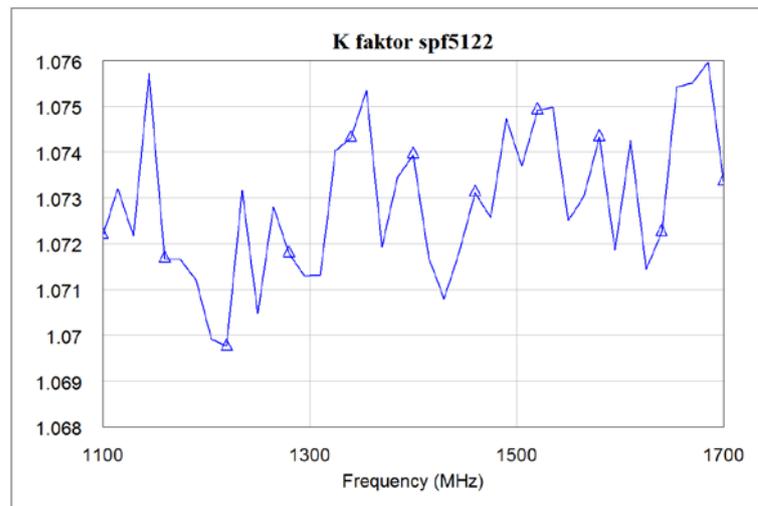


Fig 3. - Stability factor of single cascade

Figure 4 shows input and output Voltage Standing-Wave Ratio (VSWR) dependence on frequency (Δ - input, \square - output).

As it can be seen from Figure 4, input VSWR value is less than 1.58, and output VSWR value is less than 1.13, which are regarded as satisfactory values from engineering point of view.

The results of the present simulation proved that the amplifier cascade based on SPF5122Z microchips satisfies the requirements imposed on antenna amplifiers.

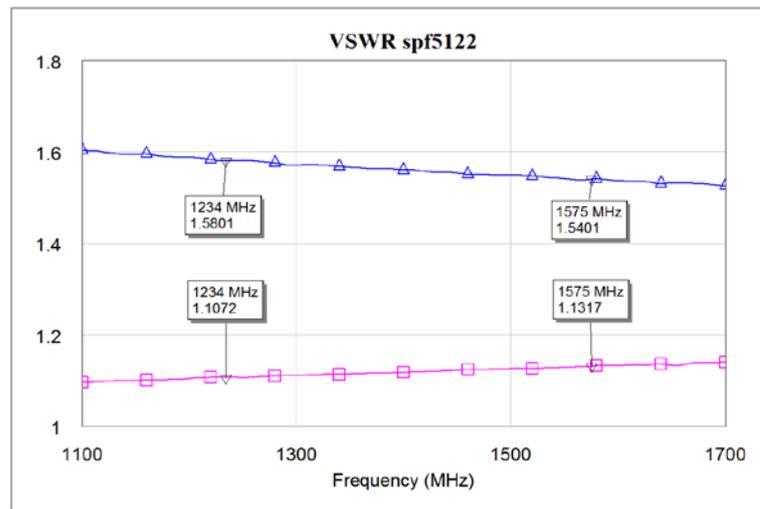


Fig 4. - Frequency dependence of VSWR

The simulation results for diplexers are given on Figure 5 and 6. The diplexers of simulated amplifier were built on LPF/HPF scheme of 10-th order with Chebyshev characteristic. The central frequency of diplexer is 1400 MHz. The frequency dependence of S-parameters of diplexer are shown on Figure 5 (Δ - S11, \square - S21, \diamond - S31, where 1 is input, 2 & 3 are output).

As Figure 5 shows, the attenuation between channels is not less than 24 dB, and where the return loss value of diplexer within operating frequency band is not less than -25 dB.

Figure 6 displays the simulation results for input and output VSWR of diplexers, which shows that the input VSWR value within operating frequency does not exceed 1.12.

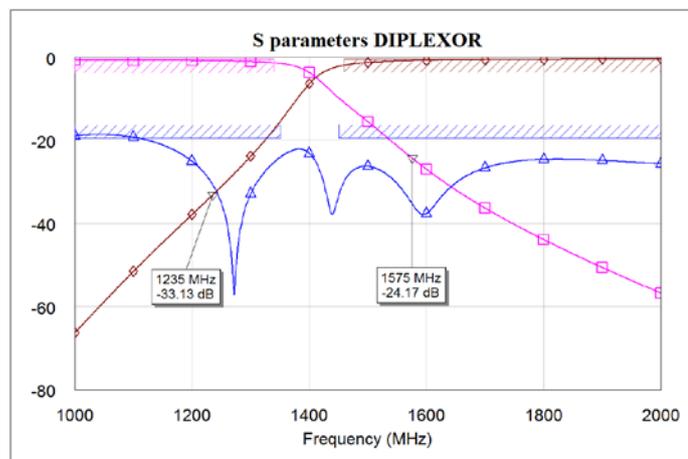


Fig. 5 - Frequency dependence of S-parameters of diplexer.

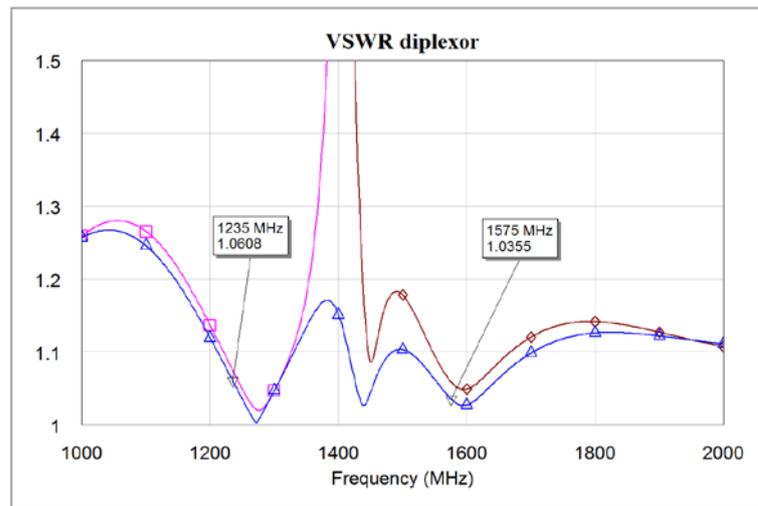


Fig. 6 - Frequency dependence of input and output VSWR of duplexers

The simulation results of the amplifier built on the block diagram (as shown on Figure 1) are given on Figures 7 and 8. The simulation of amplifier showed that the gain in the medium range bands L1 and L2 is 25.08 dB and 28.36 dB respectively. Bandpass flatness of AFC in amplification band was not more than 2 dB. The input return loss of the amplifier came to -13.85 dB and -12.51 dB at medium frequencies of L1 and L2 bands respectively. The output return loss was less than -20 dB.

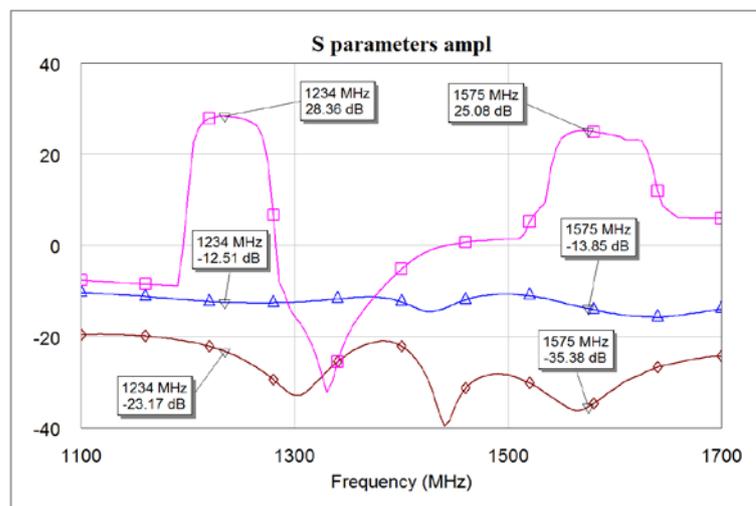


Fig. 7 - Frequency dependence of S-parameters of amplifier

□ - S21, △ - S11, ◇ - S22

Figure 8 displays the input and output VSWR values of the simulated amplifier. From the simulation results it can be observed that the amplifier is well-matched, where output VSWR values do not exceed 1.19 throughout entire operating

frequency range of the amplifier. Input VSWR values do not exceed 1.66, which can be considered to be a quite good result from a technical point of view.

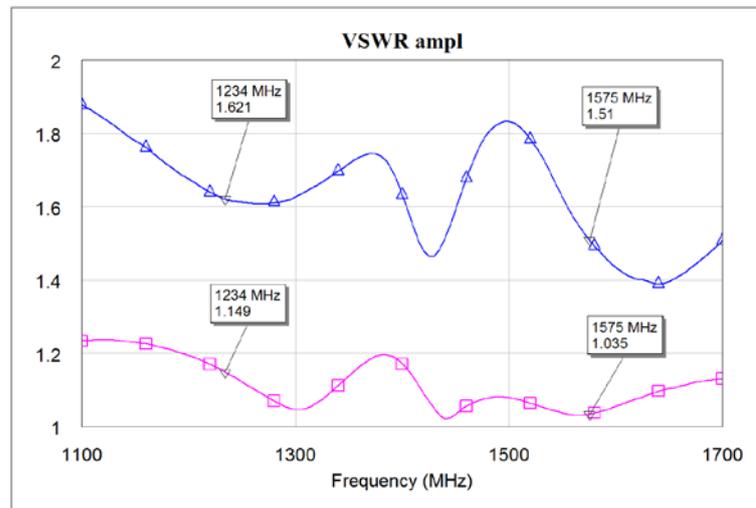


Fig. 8 - Frequency dependence of VSWR amplifier

CONCLUSION

Based upon the requirements set forth for an active antenna amplifier, we drew out the amplifier block diagram and selected its hardware components. Simulation of the main units of amplifier as well as the entire amplifier in MicroWave Office program demonstrated that the proposed scheme allows to achieve amplifier performance characteristics as good as performance of commercially available amplifiers at present.

The main advantage of the proposed amplifier block diagram is its high selectivity for each frequency channel.

The capacity to amplify signal in L1 and L2 frequency bands, while suppressing other signals transmitted at close frequencies, is provided through channel separation by diplexers. The proposed solution can significantly improve interference protection feature of antenna amplifier. Based on the results of this simulation we can recommend the present block diagram for development of GLONASS/GSM antenna amplifiers in cases when it will be necessary to ensure the highest possible accuracy of positioning.

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Sadovnikova N.P., Parygin D.S., Manunina E.V.

**QUALITY MANAGEMENT OF URBAN ENVIRONMENT USING THE
SYSTEM DYNAMICS METHOD**

Volgograd State Technical University

Introduction

The formulation of strategies based on studying laws of urban development. Strategies allow purposely change life priorities and create new ways of organizing urban space. It provides effective interaction and balanced development of all spheres of life and city.

The only possible tool for studying these laws is modeling. Modeling does not guarantee complete protection against possible errors in decision making. But

modeling allows identify the various problems and analyze the consequences decision-making.

To solve the problem of quality management of urban environment is necessary to identify the optimal set of control actions, which provide the required state parameters. In this case model experiments allow to estimate efficiency decision-making and trace dynamics of situations when implementing the different scenarios.

Modeling is one of the most appropriate methods by "price-quality" to study urban development laws. The need to consider many factors that reflect complex processes in economy, society, politics, and the level of technical innovation and management practices, for half a century facilitated the perpetration of modeling techniques. System Dynamics approach has been shown to be effective in solving problems in the semistructured spheres.

Methodology

To obtain practically meaningful results in constructing models of urban development should consider the following points:

- described system is difficult to formalize;
- variety of factors (social, economic, environmental, etc.) create an environment where the action is very different laws, the integrated effect of which is difficult to predict;
- many relationships between elements of the system are difficult to quantify description;
- the initial information is heterogeneous and is usually contradictory;
- high level of uncertainty concepts, rules of behavior and properties that characterize the system;
- possibility of changing the structure and appearance of new systemic linkages;
- significant impact of human factors on all processes in the system.

Approaches to the use simulation modeling in solving problems management of social-economic systems, including city offered by J. Forrester, P. Davidson, D. Sterman, V. N. Sidorenko, N. N. Lychkina, V. A. Putilov, A. V. Gorokhov, D. YU. Katalevsky [1-6], etc. In various countries, particularly in Russia, there are national

branch of the Society of system dynamics, annual international conference and journal "The System Dynamics Review" [7, 8]. There are many specialized systems designed for computer simulation modeling. They have a developed means for constructing models, conducting scenario calculations and analysis of simulation results.

Model Development

The purpose of the functioning of urban ecosystem – to achieve a given quality of life while maintaining natural resource potential of development. Like any anthropogenic system, the urban ecosystem is not able to repair itself, but there is the possibility purposeful influence, which would allow forming the desired development trajectories.

Formal representation of the functioning of urban system can be set using the operator Φ that determines dependence:

$$Q = \Phi(X(u, v), t), \quad (1)$$

with $Q = (q_1, q_2, \dots, q_s)$ – quality indicator system functioning (specially designated parameters of state, which determine the degree of goal achieving);

$u(t) = (u_1(t), u_2(t), \dots, u_k(t))$ – the input parameters (impacts that generated by control system);

$v(t) = (v_1(t), v_2(t), \dots, v_l(t))$ – the input parameters (uncontrolled impacts, random perturbations);

$x(t) = (x_1(t), x_2(t), \dots, x_n(t))$ – the current state of the urban environment;

$y(t) = (y_1(t), y_2(t), \dots, y_m(t))$ – output parameters describing the outcome executed actions.

The degree of stability is a common criterion for the efficiency of urban system, as well as the performance criteria of individual subsystems. Reaction the system to controlling influences depends on random factors, and the choice of control actions. Parameters of system state $x(t)$ are related to input parameters by some operator F :

$$x(t) = F(x_0, t, u[t_0, t], v[t_0, t]), \quad (2)$$

with $x_0 = x(t_0)$ – initial system state.

Method of forming control actions determines management strategy (way to allocate resources and management mechanisms). Specifying selection criteria of strategy, we obtain the problem of optimization of management. Given the complexity of the processes under study is difficult to identify a formal mathematical expression for this task. As a rule, the operator F can be represented as a set of interrelated actions. The criterion for selection strategy is to identify a set of indicators characterizing the achievement of objectives. So in this case is more applicable phrase "better management".

The problem of selecting operating influences is solved by decision maker with the assistance of expert consultants in various subject areas. The main function of a decision support system is related to the formation rules of selection decisions. Their application will allow to bring the system to commanded state. Unit operational management includes ongoing project management processes and procedures for monitoring the execution of decisions. At the strategic level decision-making processes can be structured in specific sequence of actions (fig.1). Thus, at the strategic level, decisions are made in the process of establishing management principles, and at the operational – in the selection process ways of using territory, distribution of funds, changing the conditions of economic management.

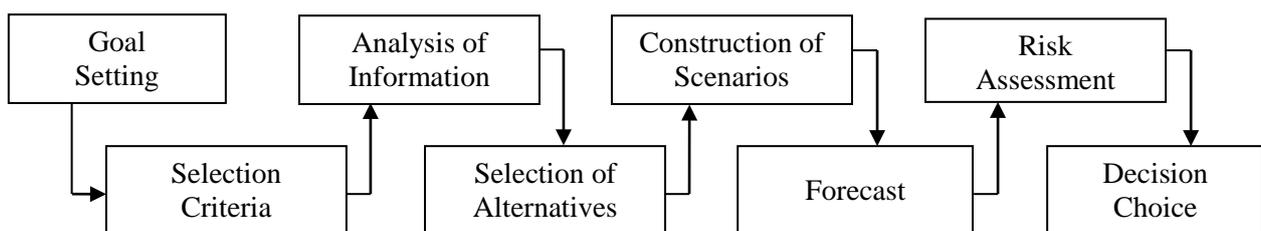


fig.1 Strategic level of decision making

In the strategic management of any level actively use the System Dynamics modeling. This approach allows us not only simulate processes occurring in the studied system, but also give specific recommendations for improvement, both the structure and management practices. System Dynamics methodology is particularly

effective in solving semistructured problems occurring in large systems with a significant number of feedbacks, material, financial and information flows.

Model Implementation

The first step is to develop a conceptual model of the situation under study. Formed meaningful description studied system specifying the purpose of modeling and aspects of functioning the studied object that need to be studied with using simulation experiment. In this case, the purpose of modeling is to predict the anthropogenic load in the long term.

The model can be used for:

- approximate analysis of the existing dynamics and predict of anthropogenic load on the city territory;
- modeling consequences of different solutions;
- calculation environmental indicators.

Static description of the modeled system is performed during the structural analysis of the object. On the basis of statistical, analytical and expert information identifies the cause-effect relationships between factors. Also to structure the expert knowledge is constructed streaming charts.

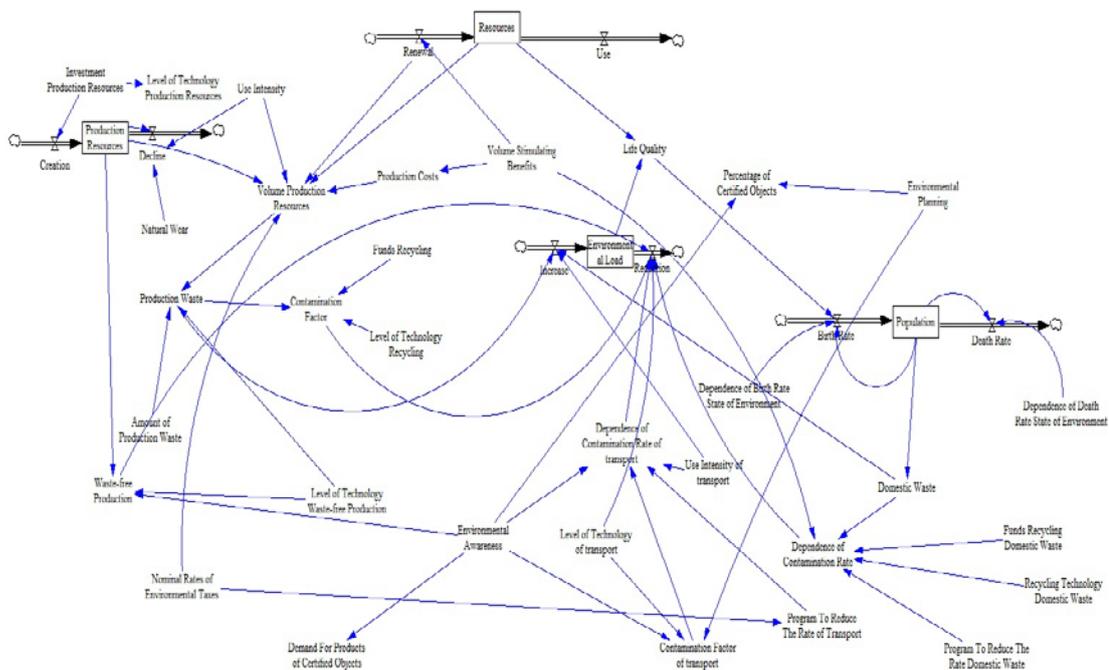


fig.2 The model "Analysis of environmental load"

For model construction using data published in the official information and reference portals [9, 10]. State of the city described by variables: population, production volume, environmental load, etc. External influences and management decisions determine the rate (the dynamics) of development the studied situation.

On the scheme (fig.2) presents the model that was constructed in system of Vensim [11].

Conclusions

Analyzed indicator is the environmental load. Considered the dynamics of this parameter in intervals of the 5 and 20 years of model time respectively.

As major regulators of the model stand out:

- nominal rates of environmental taxes (production and transport);
- volume of stimulating benefits on the introduction resource-saving technologies (production, utilities);
- environmental planning of territory development.

The proposed model allows to consider various options of development scenarios, compare different management strategies, and evaluate long-term effects of the current policy.

Implemented in the work simulation of anthropogenic load in conditions of city allowed compiling detailed static description of the modeled system, to conduct a structural analysis of the object and to identify key regulators of the model. Comparison of options strategic management allows better assessment of the long-term consequences of decisions. Obtained results are of practical interest for development of city environmental programs and choice of tax regulation ways.

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UDC 622.47

J11307-195

Nikulin A.N., Riabinin D.V., Zhadovsky I.T.

FEATURES OF LIGHTING OF UNDERGROUND WORKSPACE

National Mineral Resources University “Mining”

The paper proposed a technical solution for the organization of artificial illumination of the working area of underground miners. On the example of the

construction of the railway tunnel proposed variant of artificial lighting with compensation of UV – spectrum.

Keywords: lighting, lamp, LED, ultraviolet.

Our analysis systems of artificial lighting of underground mine workings showed that the majority of them is morally and technically outdated. Since the construction of the Navaginskaya railway tunnel used lamps type VZG LN60h1, LN100h1 and portable projector with lamps type GLN1000h1. They do not respond to current power requirements, the light output, energy efficiency and durability [1].

Engineering calculations of replacing outdated lighting fixtures with incandescent on the newest LED lighting products are made using a software DIALux 4.10 (figure 1). GOST 12.1.046-85 was used like as normative document. Found that the economic effect reaches more than 9 500 euro and the payback period of this event is 2.2 years.

However, normalization of the light environment is only part of the solution. The proposed solution will allow to regulate emission of UV radiation A and B spectra with a uniform visible light output. Lighting solution "Window in the mine" will create a favorable working environment reducing psycho-emotional stress during operation in confined conditions.

Solution of this problem is to develop LED lamps based on artificial windows in mines. The basis of the lamp is false panel with a picture of natural landscape, illuminated by LED with visible spectrum. Compensation for the lack of UV radiation in the A and B bands is proposed to come from LEDs, which contain crystals of gallium nitride (GaN) [2].

The intensity of UV emission of the lamp must be changed during the work shift is equivalent to the natural activity of the light of the day in the following ranges:

- UVA: 10 – 1000 mW/m²;
- UVB: 0,5 – 5 mW/m².

The brightness of the lamp should be in the range of 10 to 1000 cd/m².

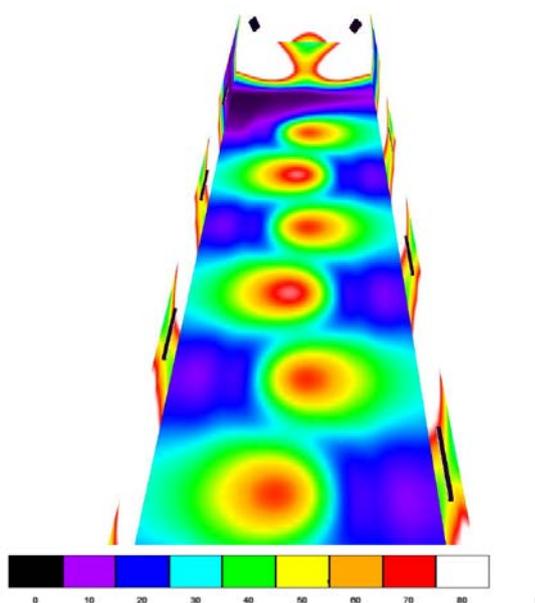


Figure 1. Gradation isolines of illumination

Initiating of background ultraviolet radiation stimulates the function of the circulatory, has a stimulating effect on the immune status and the protective properties of the organism, normalizes sympathetic-adrenal system and glucocorticoids function of adrenal. UV exposure also has a stimulating effect on the function of the thyroid and gonads. UV radiation acts on the nerve receptors, reducing their pain sensitivity. Other works of several researchers found that under the influence of UV-irradiation in relatively small doses may be an increase of tone of the cerebral cortex. UV irradiation is widely recommended for healing and hardening of the body, increasing resistance to infection (influenza, etc.) and the harmful effects of the environment.

Thanks to the proposed solution it is possible to create a favorable work environment which increases psychophysiological human potential and improving efficiency and reducing total sickness rate [3].

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UDC 519.219.2:519.237.5

J11307-196

Zaikina E.N.

THE IMAGE COMPRESSION SYSTEM USING STATISTICAL CHARACTERISTICS

Sevastopol National Technical University, Sevastopol, Universitetskaja, 33

A problem of constructing optimal principles of digital image (two-dimensional random fields) processing (compression) is actual now. The telecommunication systems and digital technical devices use algorithms based on those principles.

Modern image compression non-lossless algorithms applied to half-tone or colored images work with such limitations:

- 1) some images with superfluity (to a man's mind) cannot be compressed;
- 2) the edges of contrast areas are blurred (the Hibbs' effect is seen);
- 3) the more compression is the dissociation the image to basic blocks is been.

Non-lossless compression algorithms give the best compression values on specially generated images and the value of such coefficient is not big.

Those features are limited usage the algorithms in digital processing systems with high precision. The improving such algorithms is possible.

The scheme of compression system for 2-dimensional random fields (images) is considered in the article.

A mathematical description of digital image can use a 2-dimensional random field because of a large amount of different types of images. (Statistical approach is used). The most useful characteristics of 2-dimensional random field are the covariance and the power spectral density. The characteristics have some features for modeling such objects. For example, the power spectrum must be decreasing in a large wave-numbers area and must have a limited variance [1].

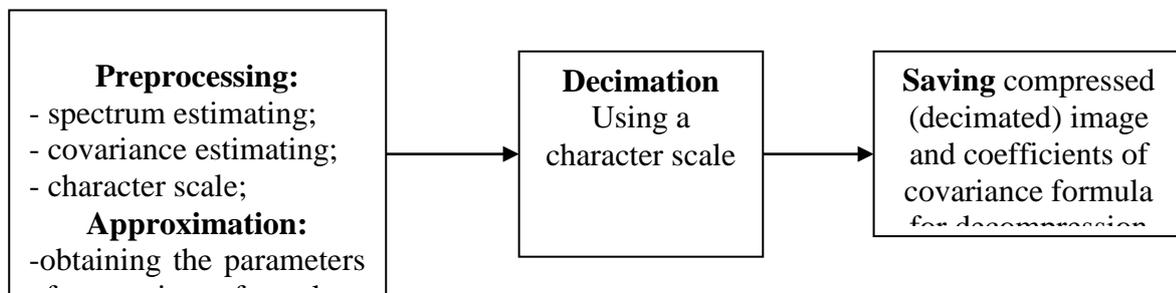


Fig. 1. A scheme of compression system

In the first block a preprocessing of an image (2-dimensional random field) is doing. It consists of evaluating character scale in horizontal and vertical, power spectra estimating. Using power spectra the covariance formula parameters are evaluating by Viener-Khinchin transform [1]. The homogeneity of a processing field can be estimated by a shape of a covariance.

In a second block a decimation of an image is doing. Parameters of a decimation considered a field's character scale.

In a third block decimated image is written into a graphical file. The coefficients of a covariance are written to the same file as a commentary. The written image can be compressed with non-lossless methods.

Decompression of an image uses the optimal linear interpolation formulas. The main part of a covariance is approximated with asymptotical series. An optimal linear interpolation gives the minimal error for reconstructing field.

The results of such image processing are given on a fig.2.

Fig.2 a) contains a half-tone (in 256 grey positions) image of a biological objects – cells. On a fig.2 b) the image is decimated and can be transmitted for a preview. The compression coefficient is 5.1. On a fig.2 c) recovered image is given. A little blurring can be seen where high contrast pixels are neighbors.

The mathematical criteria are: image fidelity 0,998; signal-noise rate is 26.28. For JPEG-compression the same image with approximately the same compression coefficient SNR is 26,97.

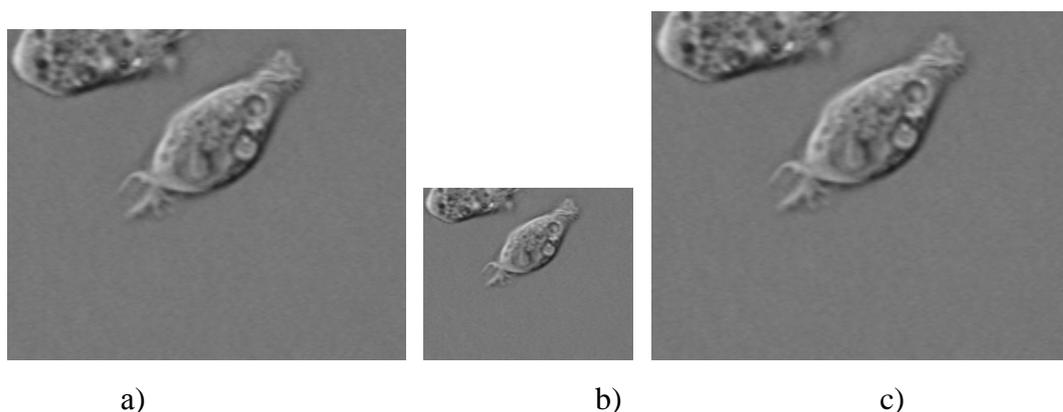


Fig. 2. Results of a processing

Another mathematical criteria of a quality estimating – the cross-correlation original and recovered image, normalized mean square error, laplasian mean square error and so on) – have just the same values for the statistical method and for JPEG applied to one image.

A mathematical analysis of an image, covariance and spectra estimating need a large amount of a computer's memory. They were investigated using the Matlab programming system with IDE. Matlab provides an export of the quick algorithms of a big matrix transforms to an exe-file to design a system unit.

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J11307-197

Petrov O.V., Kozlov L.G., Pavluk O.O.,

Pechenkin P.O., Fedotenkov Y.O.

**IMPROVEMENT OF THE DESIGN ELEMENTS OF HYDRAULIC
UNITS BASED ON COMPUTER SIMULATION OF HYDRODYNAMIC
PROCESSES IN CAD/CAE SYSTEM**

Vinnitsia National Technical University

The paper considers the possibility of using of the known CAD/CAE SolidWorks FLOW MOTION system for investigation of hydraulic losses of pressure by computer-aided design of hydrodynamic processes in 3D-model of directional control valve.

Key words: hydraulic drive, hydrodynamic process, computer simulation.

Introduction

Research, design and manufacturing of hydraulic equipment for hydraulic drives of mobile working machines is being extensively developed in Ukraine today. At the stage of designing hydraulic units there is a necessity to determine the properties of products. Particularly, this concerns the choice of such components of hydraulic units that would ensure their efficient operation, simplicity of production, minimal traveling losses of pressure, etc [1]. These tasks can be solved using modern CAD/CAE systems either at the product design stage or for improvement of the already existing constructions. Implementation of the new design and research forms at the domestic enterprises specializing in the production of hydraulic units is the task of current importance.

Main results of the research

One of the basic requirements to the characteristics of a hydraulic unit is minimization of the traveling losses of pressure caused by hydrodynamic processes taking place in its construction. Modern CAD/CAE systems make it possible to create 3D-model of a hydraulic unit and to perform computer simulation of hydrodynamic

processes. Solid Works CAD/CAE system that includes FLOW MOTION module is one of the leading programs of such type [2]. FLOW MOTION module, fully integrated into Solid Works, allows computation of flow, heat exchange and heat transmission with the end result error of 5%. In addition, input data description and visualization of the results take place directly in the Solid Works environment, which simplifies considerably analysis and optimization of geometry of the object or device in the shortest time possible [3].

At the Department of Manufacturing Engineering Automation (VNTU) research is conducted on the influence of hydraulic unit design components on the traveling (hydraulic) losses of pressure in it. In particular, 3D-model of the directional control valve has been created and hydraulic pressure losses have been determined at the portion «working module input – hydraulic engine output» (fig. 1).

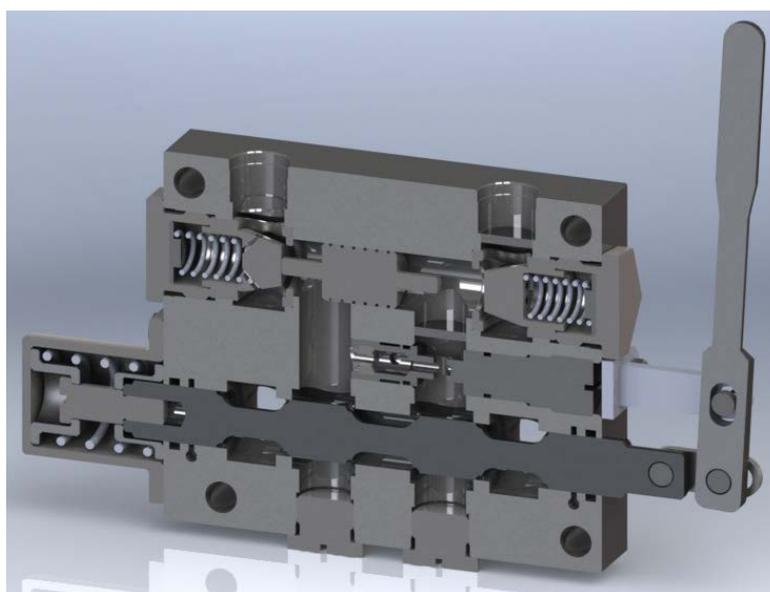


Fig.1. 3D-model of the working section of directional control valve

In order to perform computer simulation of hydrodynamic processes in 3D-model, a number of parameters that describe the conditions of process occurrence are to be identified. Among the parameters the basic ones are: input value of the working fluid pressure, working fluid, flow rate, working fluid density and temperature (fig. 2).

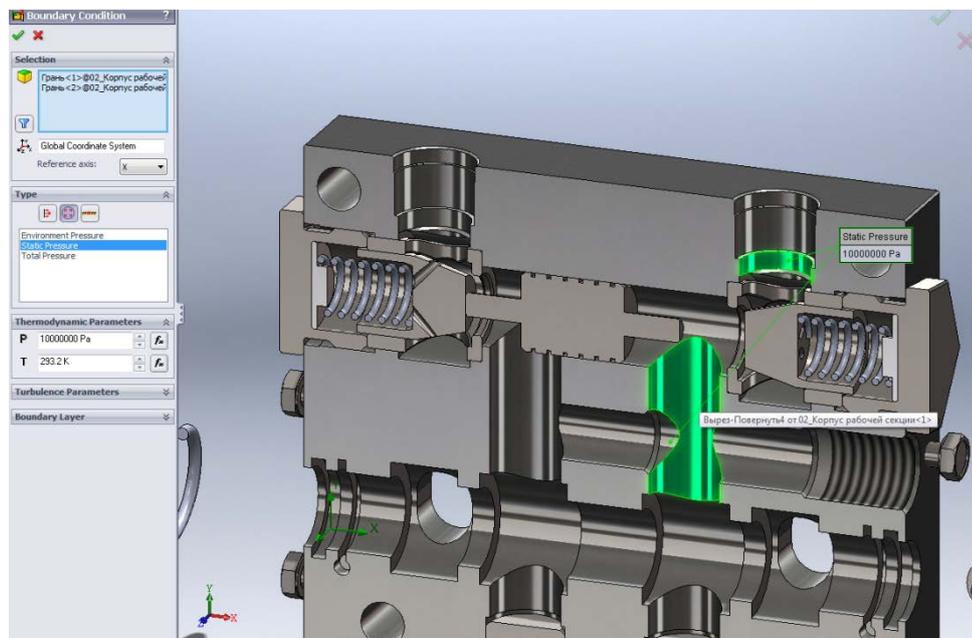


Fig.2. Identifying parameters of the hydrodynamic process simulation

A hydrodynamic process simulation in 3D-model is described by Navier-Stokes equations and depending on the complexity of model construction could take quite a long time. Simulation takes place interactively, which makes it possible to observe transient processes in the model. Intermediate and final parameters are presented in special tables of results.

In order to demonstrate how this tool works in the construction of the working section of directional control valve comprising 56 parts of various forms and sizes, the possibility of changing the layout of a built-in two-way hydraulic lock was considered. As a result of simulation of hydrodynamic processes it was determined that hydraulic pressure losses in the investigated portion of the working section amount to 0,31 MPa (fig. 3).

In order to reduce hydraulic pressure losses it is proposed to replace the piston plunger and cone-type locking element with a shank of the two-way hydraulic lock by a piston plunger with a shank and a ball-type locking element (fig. 4.).

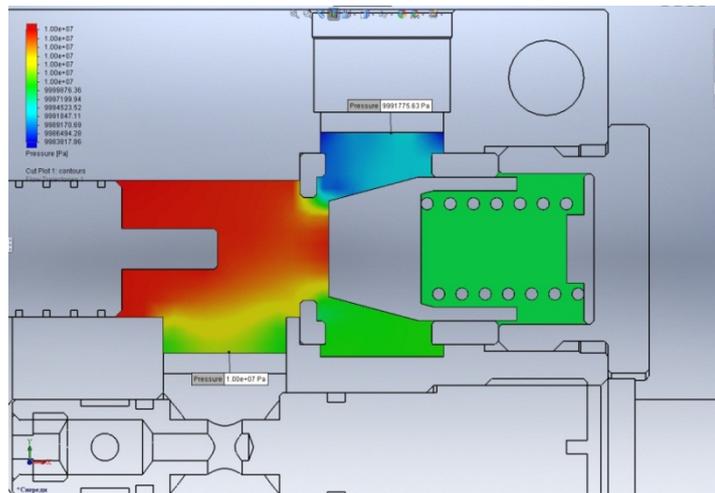


Fig.3. Investigation of the hydraulic lock with a cone-type locking element

As a result of the hydrodynamic processes simulation in the changed 3D-model of the working section of the directional control valve, hydraulic pressure losses were found to be 0,17 MPa.

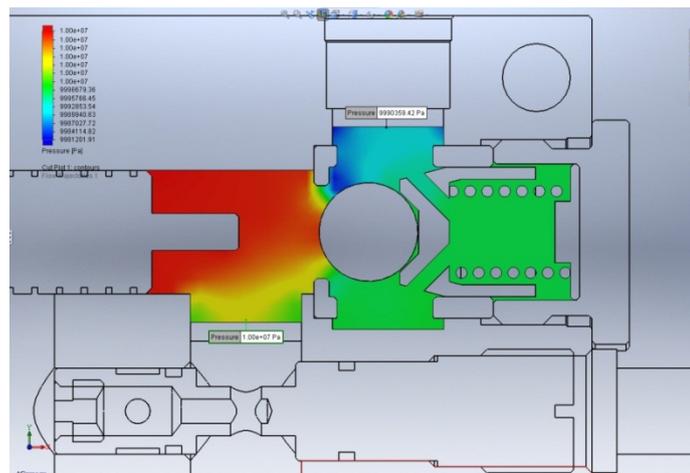


Fig.4. Investigation of the hydraulic lock with a ball-type locking element

Thus, on the basis of the research on improvement of the design of directional control valve it could be recommended to change the elements of the built-in two-way hydraulic lock, which will make it possible to reduce hydraulic pressure losses in the hydraulic unit.

Conclusions

It has been determined that at the stage of designing hydraulic units application of modern CAD/CAE systems enables creation of a 3D-model and performing

engineering analysis of the product design features. Simulation of hydrodynamic processes in 3D-model of hydraulic units using CAD/CAE systems makes it possible to determine and to evaluate peculiarities of the pressure fluid overflow in hydraulic units already at their design stage. Pressure losses occurring while fluid passes through the channels of the hydraulic unit could be estimated as a result of simulation of hydrodynamic processes, which enables reduction of traveling losses of pressure at the stage of taking decision on the choice of the hydraulic unit design elements.

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Molokanova L.V., Lukomskiy Y.O.

**COMPREHENSIVE APPROACH TO COMPOSITE STRUCTURE
ELABORATION OF CHOPPED HALF-FINISHED PRODUCTS MADE OF
RABBIT MEAT**

Donetsk National University of Economics and Trade named after Michail Tugan-Baranovsky, Donetsk, Shchorsa 31, 83050

The possibility and expediency of chopped rabbit meat half-finished products elaboration with bean paste aimed on the improvement of consumer properties and assortment widening are examined in the article.

Key words: chopped half-finished products, rabbit meat, bean paste, protein, phaseolamin, mathematical modeling.

Foodstuffs that are ideally suited to modern life rhythm are half-finished products. They allow to save time on cooking, that's why firmly established in our lives. They also fully satisfy the nutritional needs of people. This fact is the reason for increased requirements to their quality.

The output of meat half-finished products in a wide variety and price range is regulated in Ukraine nowadays. In this situation a manufacturing enterprise can get a customer not only by steadily improving the quality of meat half-finished products but also by using innovative approaches in the development of recipes and techniques. But practice shows that rather often companies, guided by the desire "to impress" the buyer, produce half-finished products made of raw materials that are badly combined with each other. To reduce production cost they put soya and so-called "vegetable" substitutes of protein into the recipes of meat half-finished products more and more often; bread and flour in amounts that are greatly exceed the "traditional" ones (of course on the expense of meat quantity). This is especially true for chopped meat half-finished products in which meat is subjected to restructuring. This allows us to enter a wide variety of supplements into minced meat. Even in SSDU 4437 such concepts as "meat" and "meat-vegetable" half-finished products are introduced [1].

Putting into minced chopped half-finished products of bread and flour caused by the necessity of technological character-during heat processing minced meat half-finished products can ruin due to lack coherence of stuffing.

To maintain the shape of finished products and their succulence it is necessary to improve coherence, moisture resistance ability and stickiness of stuffing, that is solved by adding of flour and bread.

In half-finished product of general prescription, that are mainly subjected to frying, the content of these components in the mincemeat is quite high – 14-16% [2].

Meanwhile, wheat bread, especially of higher quality, contains large amounts of carbohydrates namely starch and a small amount of protein, that reduce the total protein content in the finished product.

Solving this problem it is examined the possibility and expediency of making half-finished products – rabbit meat cutlets with added bean paste as an ingredient that acts as binding of stuffing and improves the total protein content in the finished product.

Rabbit meat as a basis of stuffing was selected because of its organoleptic, nutritious and highly dietary properties. Compared with beef, rabbit meat contains 1,46 times less fat at almost the same protein content and the protein content is more than in lean pork at 1,48 times. Vitamin content in rabbit meat aheads all other kinds of meat and contains in average 0,8 mg / 100 g of vitamin C, 0,12 mg / 100 g of thiamine, 0,18 mg / 100 g riboflavin, 6,2 mg / 100 g of nicotinic acid. Mineral content is presented by phosphorus (190 mg / 100 g), iron (3,3 mg / 100 g), calcium (20 mg / 100 g), manganese (25 mg / 100 g), sodium (57 mg / 100 g), potassium (335 mg / 100 g). Rabbit meat contains a lot of lecithin and little cholesterol, which is an excellent prophylaxis of arteriosclerosis. Rabbit meat is absorbed on 95% and is the only kind of meat that doesn't cause allergic reaction in any category of people [3].

The recipe of “Moscow” cutlets is taken as the basis where beef meat is replaced into rabbit meat and white bread is replaced into bean paste.

The research results showed that the replacement of bread into bean paste influenced positively onto the formation of cutlets consistency. It is explained by an actual increase in total amount of protein in the final product, which increases hydro-keeping ability of filling and raw meat products and provides a more coherent structure of the latter both in raw form and after heat treatment. Cutlets consistency after frying was characterized as succulent by the same reason.

At the same time cutlets had a thick texture which is a very positive factor from technological point of view since during frying and after it cutlets keep their shape very well. Together with it the finished products were very gentle.

The bean smell was felt in raw cutlets, but it disappeared completely after frying. The taste of finished cutlets was pleasant, typical for roasted rabbit with clearly tangible, pleasant nutty flavour.

The cutlets colour, both raw and fried, was significantly lighter than the colour of half-finished products made of slaughtered animals and more typical for products of poultry, but pleasant and uniform throughout the mass.

Thus, according to the properties of filling and organoleptic characteristics of raw and fried cutlets, combining of rabbit meat with bean paste is completely justified.

Meanwhile the problem of assimilability of new product arises. It is known that beans in their composition contain substances that inhibit the digestive processes and impede the digestion in general. Experts believe that a significant role in this effect plays phaseolamin – protein inhibitor of the enzyme α -amylase. Phaseolamin inhibit the activity of α -amylase of pancreas, and in this connection the time of splitting of complex carbohydrates into glucose and the time of digestion of food tangle increases in general [4]. Therefore, it is quite possible that the time of digestion, taking the cutlets with bean paste compared with cutlets with “traditimal” bread, will rise.

To understand the optimal conditions for the manifestation of phaseolamin properties it's necessary to examine its influence on temperature activity. Phaseolamin sample, removed from beans and purified by J. Mashall method [5], was combined with α -amylase for some time at a given temperature. The experiment was conducted at a temperature 0°C, 25°C and 37°C. The temperature effect on inhibit phaseolamin properties was studied through the activity of α -amylase which is measured as the rate of reduction of mixture shading force with iodine [6].

Based on these studies, we can conclude that the optimum temperature at which the inhibitor phaseolamin shows its properties is -37°C. After 35 min. the rise of inhibition indicator of α -amylase remains at the level of 65%.

At 0°C temperature it wasn't observed any change, but the results of other two temperature regimes displayed graphically (Fig.1).

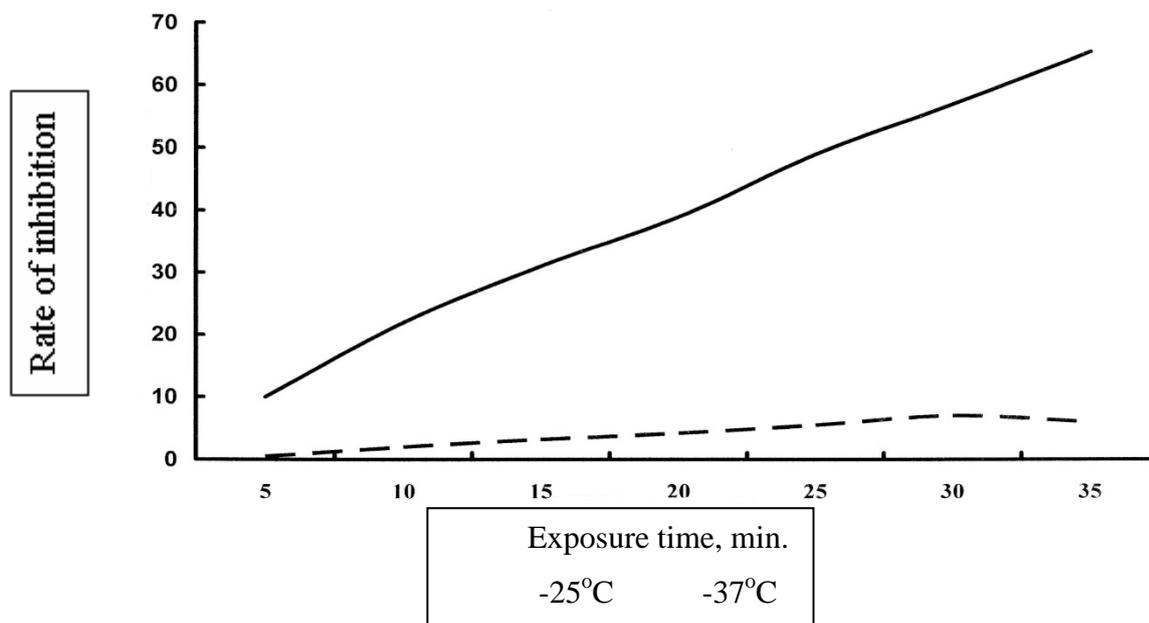


Fig. 1. The dependence of inhibitor activity of the temperature and exposure time

While cooking chopped meat half-finished products, the cutlets are fried, that is influenced by high temperatures. So the high temperatures influence on phaseolamin was examined, especially under 100°C. We studied three samples that differed by the time spent under the high temperature. The following time intervals were selected: 10, 20 and 30 min. To check the inhibitor activity after heat treatment, the methodology of determining α -amylase activity was applied. It was found that after 10 min. phaseolamin heating up to 100°C the inhibitor activity decreased significantly (by 92%) and after 20 min. heat treatment it was fixed complete inactivation of protein.

To determine the phaseolamin activity directly in bean paste the highly effective method of liquid chromatography was applied. In the chromatogram of raw mashed beans phaseolamin corresponds to the peak, that is 32,841 min. After heat treatment of beans (boiling) for 10 min. at 100°C corresponding peak in the chromatogram is significantly reduced and is completely disappears after treatment for 20 min. (Fig.2). We can assume that heat treatment does not only inactivate phaseolamin as enzyme, but also leads to a change in its chemical structure.

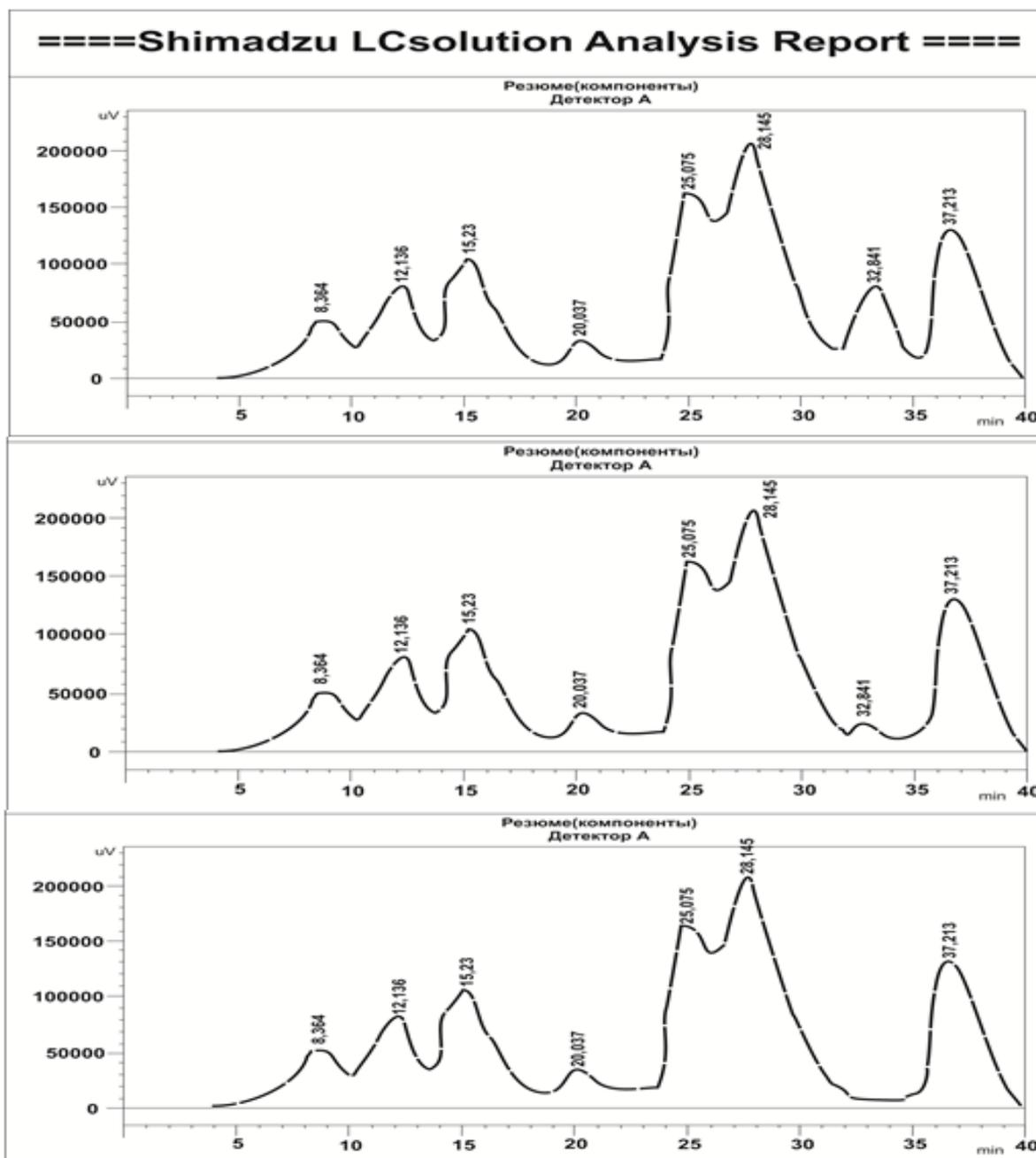


Fig. 2. Chromatograms of raw and heat-treated beans

When making paste beans are subjected to much longer influence of high temperature, that is also a guarantee of complete inactivation of the enzyme. It is important that this technology of phaseolamin inactivation allows to get bean paste and ready half-finished product without negative inhibitor properties and thus it is simple and it doesn't require additional material costs.

The received data allow us to get to the conclusion that phaseolamin presence in beans is not a negation for its use as a filling component of cutlets.

To establish the optimum content of bean paste in cutlets it was used regression analysis and systems with undistinct conclusion according to two criteria – the balance of amino acid composition and flavour characteristics. The initial stage of elaboration associated with the formalization of qualitative and quantitative representations about rational use of essential amino acids. The formalization takes into account mutual balance of essential amino acids, according to which 1 g of ideal protein should contain 40 mg. of isoleucine, 70 mg leucine, 55 mg lysine, 35 mg methionine and cysteine, 60 mg of phenylalanine and tyrosine, 10 mg of tryptophan, threonine 40 mg, 50 mg valine [3].

For modeling the amino acid composition of protein in cutlets it was used the regression model which allows to get optimal quality indices based on primary tasks.

Since cutlets consistency, both raw and fried, when bean paste was injected into filling, had certain characteristics, it should be determined that in terms of specific indicators of amino-acid composition and total protein amount, the ratio of components will change. In this connection the range of variation of bean paste and bread (as “controlling” ingredient) was established within 0-15%. The upper limit is chosen as the average indice of bread adding into existing recipes of cutlets; the bottem limit allows to exclude one of the ingredients in the recipes because of disparity of its chemical composition to the work tasks. Factors, that form the correlation of the components, perform the total protein content and amino acid composition, which, in the final product, should be close to optimal. Amino acid rate of change was laid within 80-120% of ideal, and the criteria of optimization is the total amount of protein in the finished cutlets. The task is described by the function (1).

$$f = \max \{0.214x_1; 0.21x_2; 0.076x_3; 0x_4\}, \text{ where (1)}$$

x_1 – the content of rabbit meat in mincemeat, %;

x_2 – the content of bean paste in mincemeat, %;

x_3 – the content of bread in mincemeat, %;

x_4 – salt content in mincemeat.

Factors before changeable describe the protein content in the component. To solve the problem of achievement of maximum amino acid content the following restriction variables were created:

$$x_1 + x_2 + x_3 + x_4 = 1;$$

$$x_1 \geq 0.83, x_2 \geq 0, x_3 \geq 0, x_4 = 0.2;$$

$$x_1 \leq 0.98, x_2 \leq 0.15, x_3 \leq 0.15.$$

The first restriction indicates that the total amount must be equal to the unit of measuring of the final product; the second and third ones correspondantly indicate the minimum and maximum component parts in the recipe of cutlets.

The minimum content of amino acids was introduced additionally, which was defined within 80% of the maximum possible amount for these ingredients taking into account optimal correlation.

$$1064 x_1 + 1120 x_2 + 348 x_3 \geq 1060 \text{ (valine);}$$

$$864 x_1 + 1030 x_2 + 318 x_3 \geq 847 \text{ (isoleucine);}$$

$$1734 x_1 + 1740 x_2 + 594 x_3 \geq 1483 \text{ (leucine);}$$

$$2199 x_1 + 1590 x_2 + 189 x_3 \geq 1165 \text{ (lysine);}$$

$$913 x_1 + 870 x_2 + 231 x_3 \geq 847 \text{ (threonine);}$$

$$327 x_1 + 2600 x_2 + 74 x_3 \geq 211 \text{ (tryptophan);}$$

$$758 x_1 + 430 x_2 + 261 x_3 \geq 741 \text{ (methionine + cysteine);}$$

$$976 x_1 + 1760 x_2 + 555 x_3 \geq 1271 \text{ (phenylalanin + tyrosine).}$$

The above-mentioned restrictions in amino acid composition were included in matrix A (coefficients of the left side of inequalities) and vector b (data of the right side of inequalities). Restrictions of inequalities type are given by commands:

$$A_{eq} = [111111]; beq = [1].$$

Minimum indexes of components content is specified by functions $lb = [0.83; 0; 0; 2]$, maximum indexes of components content is specified by function $rb = [0.98; 0.15; 0.15; 2]$. The final calculation was done by the command $x = \text{linprog}(f, A, b, A_{eq}, beq, lb, rb)$.

The result of mathematical planning of cutlets recipe makes the following

distribution of modeling system components – 83% of rabbit meat, 15% of bean paste and 2% salt.

Modeling the compositional structure of food products it is difficult to reflect in digital form some quality indicators, particularly organoleptic properties. In such cases it is advisable to use a system of indistinct conclusion that allows to take into account inaccuracy of research and get a better result.

In this study the results of expert organoleptic evaluations were used. They were modeled on the rate of bean paste with using the tool Fuzzy Logic Toolbox from the package MatLab. Taste properties were assessed for a 5-point scale, where 1 corresponds to unsatisfactory quality and 5 to excellent one. The amount of bean paste was changed from 3% to 15%, the endpoint is the total evaluation which is also in the range of 1-5 points. Data obtained in the result of using uncertain logic were visualized with the help of module Surface Viewer. They allowed to make a conclusion about specificity of distribution of cutlets flavour characteristics. Thus, the highest overall assessment indexes are observed at the minimum and maximum content of bean paste (Fig. 3). That is, if we except the minimum paste content, the best taste evaluation will have samples with its adding in the amount of 12-15%.

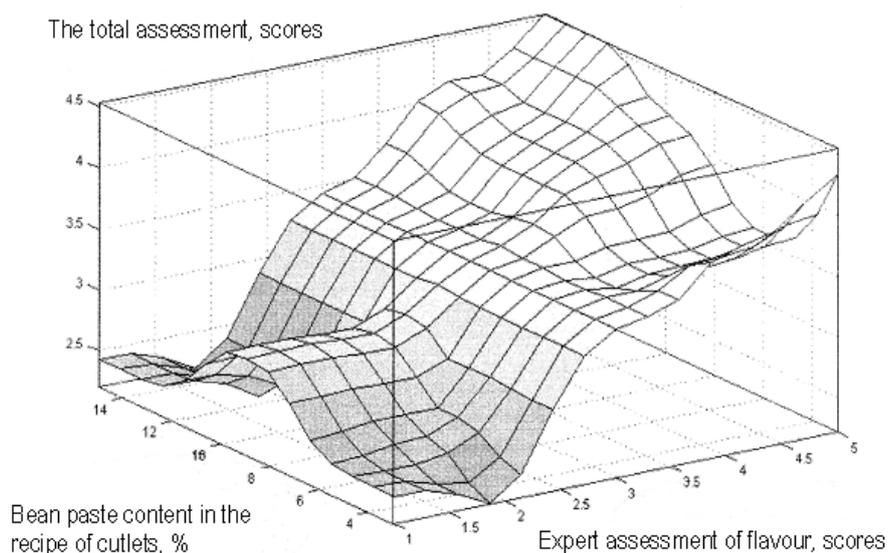


Fig. 3. Visualization of processing results using the system of uncertain logic

The results of modeling are coordinated with data of previous researches and confirm expedience of the replacing bread into bean paste in cutlets recipe. The

optimal ratio of components in the recipe, namely 83-86% of rabbit meat, 12-15% of bean paste and 2% of salt gives the possibility of introducing additional ingredients, such as onions, peppers or other spices, with the aim of harmonization of flavour characteristics of cutlets.

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J11307-199

Kompanets V.A., Kompanets M.A., Ugai S.M.

**MOTOR TRANSPORT AS A SOURCE OF AS A SOURCE OF NOISE
POLLUTION**

Far Eastern Federal University, Russia, Vladivostok

The article represents key points of the motor transport noise destructive physical

effects upon environment, analyses the reason of noise pollution origin and methods for traffic noise reduction in condition of settlements.

Key words: noise, noise protection, noise source.

Noise is one of the major common environmental hazards in communities. The main source of the noise pollution in urban areas is a motor transport, which negative impact on people is permanently increasing due to the constant growth of the number of vehicles. According to the data of the World Health Organization (WHO) the 60-80% of European (EU) population suffers from the road noise levels from 70 to 90 dB at a normal rate of the day 55 dB the during the day, that is the excess reaches 15-35 dB or 3 -4 times subjectively volume. According to the experts the excessive noise is responsible for almost 30% of diseases in the cities. Costs of fighting with the noise pollution in developed countries are constantly growing. These purposes take about 1% of the EU's total revenue. Over €50 billion is been spent only on noise protection glazing and screens construction in the EU annually.

The problem of noise protection is an important scientific and technical challenge. Noise protection is hold in many ways, the main of which considered to be as follows: the development of regulations and laws on noise control, creation of methods and means of protection against noise.

Methods to reduce the traffic noise can be classified into the next three categories:

1. By creating a barrier to the spread of noise (soundproofing);
2. By the attenuation of the sound while the noise spreads (sound absorption);
3. By means of use of personal protective equipment.

The use of one or another method or a combination of methods depends largely on the degree and nature of the need to reduce the noise in view of both economic and operational limitations.

The main factors determining the level of traffic noise are:

- Traffic intensity;
- The proportion of the noisiest vehicles;
- The nature of the roadside area;

- The road conditions, which determine the traffic mode.

Estimated value of the equivalent sound level while the motor transport flows (traffic noise performance – L_{imp}) is usually determined at a distance of 7.5 m from the axis of the near-lane vehicles, and at a height of 1.5 m above the level of carriageway coverage. [1]

To reduce the impact of traffic noise on the surrounding area we should use the full range of design solutions and traffic management measures. The choice of activities is determined by taking into account the specific conditions of technical and economic requirements.

Regardless of the sound level excess above the acceptable value while designing the road we should first of all consider enlarging of the distance to the housing systems to provide acoustic comfort. If the sound level exceeds 15 - 20 dB, to reduce traffic noise we can use special noise protection facilities. At exceeding rate up to 5 dB we can develop noise protection greenery and make the decision to change the individual geometric elements of the road.

When selecting measures for noise protection, we also should consider the subjective evaluation. Noise protection facilities are more effectively reduce traffic noise if the noise source (road) is no longer visible from the protected area. In some cases even a relatively small acoustic efficiency structures (about 5 dB), subjectively perceived as having much greater magnitude. At the same time a significant reduction in sound level, but with noise source, vehicular traffic, keeping visible is perceived less actually achieved.

In the mid-frequency range the value of insulation is determined by the mass relation: the heavier construction, the better it retains the sound and the less sound is spreading around. It must be remembered that even a small gap can negates expensive costs on sound insulation design construction. Using a soundproof barrier does not reduce the noise energy, as in the case of sound-absorbing coating, but just redistributes it: energy is stored before the barrier. Therefore, to achieve maximum effect insulating barriers should be necessarily completed by the sound-absorbing coating. We can reduce noise level by using sound-absorbing materials that reduce

the intensity of the sound waves. Sound energy is converted into heat energy due to the friction of air particles in the micropores of the sound-absorbing coating. The use of sound-absorbing coatings requires acoustic calculation, as both insufficient and excessive sound absorption leads to discomfort.

We also should consider that the sound can be transmitted not only by air, but also in construction: the walls, pipes, joists. Inside the constructions acoustic energy is distributed in the form of elastic waves (vibrations). In most cases, the appearance of the noise is caused by the conversion of vibration energy into sound energy. The sound comes from the vibrating surfaces of machines, partitions, etc.

At the beginning of XVIII century Thomas Young discovered the sound interference. Two sound waves from different sources with the same frequency, having superimposed on one another, can form the areas of high and low sound levels. If the waves propagate in the same direction, we can get complete quenching of the sound waves by varying their parameters in a certain area.

In the 1970s Soviet physicist G.D. Malyuzhinets has found the theoretical solution. He proposed to surround the source of noise by a closed surface, transmitting the sound, which has receivers and transmitters of sound placed in a certain way. A sound wave coming on a such surface from the inside comes out, completely repeating form of the initial sound field, but out of phase with the original wave. The result is a sound dampening field of arbitrary shape in a wide range of frequencies. More than 60% of all noise protection publications in the world are devoted to the active suppression. Active suppression system cost is rather high - much higher than the cost of similar passive systems. However, in some cases active suppression methods are the only affordable way to reduce the noise.

Due to the taken research it was found that some progress in noise reduction can be achieved by using the appropriate configuration of the tread pattern and tire design. However, the construction of tires with significantly reduced noise level comes in conflict with the pressing need to ensure traffic safety, prevent heating of the protector and ensure automobile efficiency. Thus, the creation of advanced alternative designs of pavement opens the great opportunities to reduce noise.

From the noise reduction point of view the structure of the road surface is important by itself in limiting the noise, whether it is formed by bituminous material with a random drawing of the structure, or covered with concrete, with a dominant transverse structure. The hold measurements allowed us to establish basic relationship between the resistance drift car, making on a given road surface, and the total noise level that is generated by the cars going at high speeds on the road surface. It was determined that this relationship is statistically independent from the structure of the road surface material. Unfortunately, although this result is useful for setting standards for the development of the road surface, which take into consideration the safety and environmental protection, it exposes the contradiction between the definition of road surfaces, characterized by the low noise level and satisfactory safety standards at high speeds. For example, a smooth road surface may be relatively low noise, but also completely unsafe for traffic in wet weather.

Surrounding noise level in the world is growing every year. This is mainly due to the increase in the specific capacity of the cars, because the sound energy of the production process makes up a certain share of the total energy produced by machines. In addition, we can see the tendency to facilitate the construction of machinery, reduce steel intensity in all industries; therefore their sound insulation is also reduced. The list of noise control methods is also constantly increasing and improving the means themselves. [2] So far, the only factor that significantly limits the wide use of noise protection is a necessity of the additional financial investments.

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UDC 539.4.013.3:669

J11307-200

Mylnikov V.V., Rozhkov I.I., Shetulov D.I.

Damage to the surface of rare-earth metals under cyclic loading with changes in cycle frequency

Russia, Nizhny Novgorod state technical university named after R.E.Alexeev

The paper estimates surface damageability for rare earth metals. The mathematical and graphical relationships to calculate surface damageability are provided.

Key words: surface damageability, microstructure, frequency of cyclic loading, fatigue, resistance, strength, durability.

Cycle frequency (ω) is known to have an ambiguous effect on fatigue resistance values. This parameter with its ambiguous effect was previously examined in several studies [1-16]. When the frequency of cyclic stresses is changed, so do strain rates, too, with surface layer of the sample being first to be deformed when loaded. Deformation to the surface layer is determined by surface effects. Surface effects are known as a consequence of those physical processes which occur in the layer with irregular properties. The paper focuses on changes which take place in micro and submicrostructure under cyclic loading. Multiple studies in fatigue in metals and alloys fail to provide researches with valuable data which could help reveal the nature and kinetics of fatigue process [17,18]. Currently a complete range of complex physical phenomena which occur in machine parts and constructions can hardly be anticipated [19,20]. The task to examine the nature of fatigue resistance in machine parts and constructions is now seen as important. Cyclic loading frequency was proved to have a complex effect on strength values, which makes it difficult to develop patterns that could be enough predictive to estimate a lifespan for parts based on ω . Accumulation of statistical data in surface damageability (F) in the shape of broad slip bands is seen promising. Fatigue resistance values are effected by multiple factors, one of them being loading cycle frequency (ω). To study physical

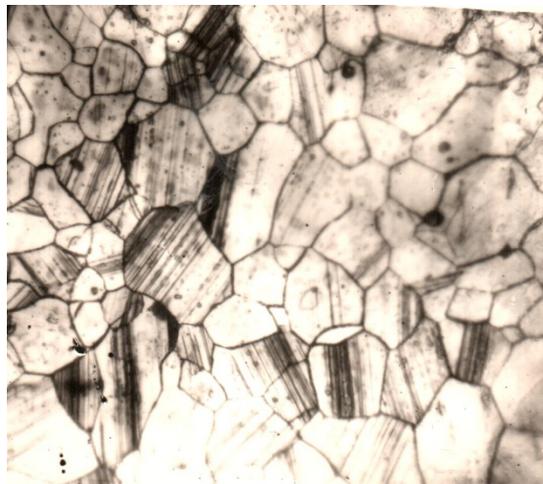
dependences for fatigue process we need to define its resistance values which include surface damageability (F) and fatigue curve slope to cycles axis ($\operatorname{tg} \alpha_w$) [1-16].

The purpose of the paper is to examine how variable cycle frequencies affect metal structure and surface damageability.

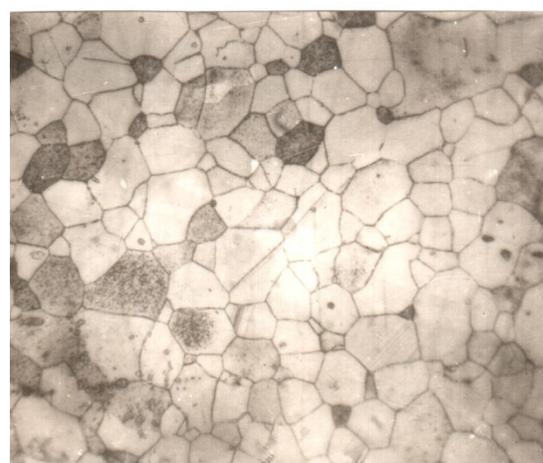
Pure cadmium which was tested under 3 cyclic loading frequencies (ω) [2, 16] has shown that an increase in ω (N) has caused an increase in sample durability, too. When frequency increased from 0.033 to 1.0 Hz, N also increased dramatically; an increase in frequency from 1.0 to 46.7 Hz has led to an increase in the number of cycles. A decrease in fatigue curve slopes to N axis was also observed. Consecutive examination of changes which occurred in the structure has clearly shown that the lower the frequency is, the sooner slip bands emerge, while stress levels are kept uniform (Fig. 1), so, with uniform N and $\omega = 0,033$ Hz slip bands emerge in greater numbers and they are far more grown as contrasted to $\omega = 46,7$ Hz. When ω increases in nickel, its cyclic strength rises, too; however when test frequencies showed 100 and 233.3 Hz, fatigue curves did not diverge (Fig. 2.). Cyclic strength value increased while $\operatorname{tg} \alpha_w$ decreased [2]. Nickel showed that band slips emerge better at lower frequencies, as they lie closer to each other as compared to tests with a higher ω (Fig. 2.). For example, when $\sigma = 217$ MPa, $\omega = 46,7$ Hz and durability equal to 10,000 cycles, the number of wide slip bands emerged is far higher as compared to almost unchanged voltages, increased frequency of load application and higher N value (Fig. 2.). Comparisons made across experimental data which came from tests where voltage was not much affected has revealed equivalent intensity of slip bands, provided that $\sigma = 217$ MPa, $\omega = 46,7$ Hz, N = 10,000 cycles and $\sigma = 191$ MPa, $\omega = 100$ Hz, N = 200,000 cycles, i.e. durability at increased frequency appears to be far better as compared to low frequency ω .

Slip bands in nickel are straight-shaped and emerge at the boundaries of neighboring grains uniformly. When they emerge at a certain stage, slip bands grow immediately full width across the grain area, then their number is kept constant, but they increase in size (Fig. 2.).

Unlike two previous metals bismuth (Fig. 3.) revealed a complex dependence between cyclic strength and load application frequency. Thus, when frequency increases from 0.033 to 1, and then to 46.7 Hz, fatigue strength increases too, which can be seen as fatigue curves shift [16]. $T_g \propto \omega$ decreases. However, with $\omega = 100$ Hz, experimental points are located at the bottom that indicates a decrease in cyclic durability. Comparison of structures obtained at $\omega = 0,033$ and 46.7 Hz, shows that in the first case, the number of slip bands is higher, i.e. they lay thicker and engage more grains, there are cracks in slip bands as well as along grain edges at $N = 290$ cycles, while in the second case, with $N = 1000$ cycles, the picture is quite different, i.e. bands show signs of undergrowth and lie loose across the area (Fig. 3.).



a)



b)

Figure 1. Microstructure of cadmium after fatigue test at 200C, (h600); $\sigma = 36$ MPa; $N = 103$; $\omega = 0,033$ (a) and 46.7 (b) Hz.

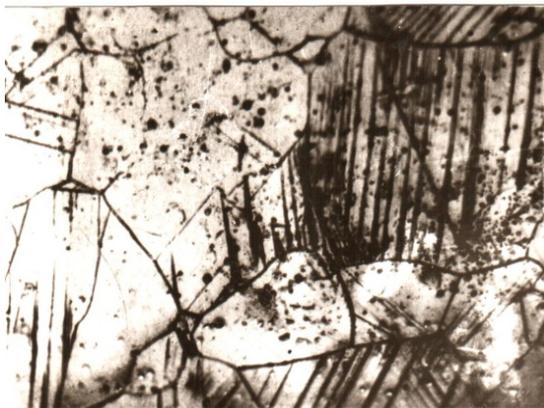
Sample diameter is 5 mm. Bending strain of rotating specimen



a)

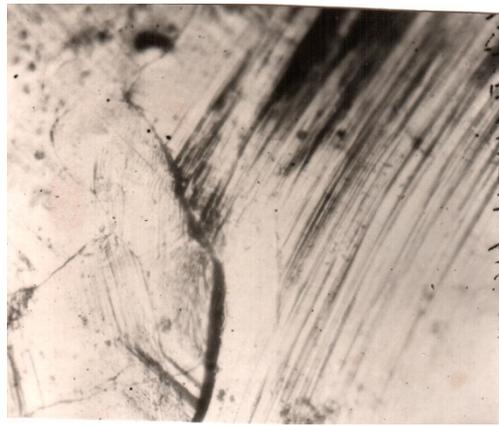


b)

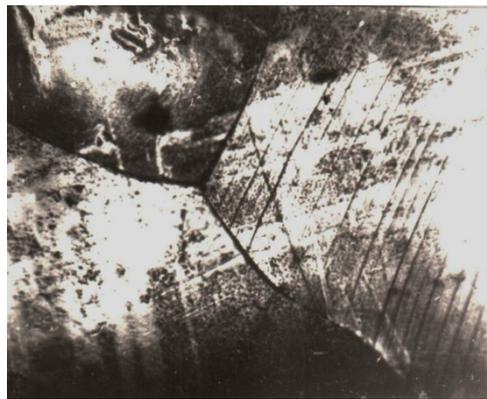


c)

Fig. 2. Nickel microstructure after fatigue test at 200C: (h340): $\sigma = 217$ (a), 191 (b) and 183.9 (c) MPa; $N = 104$ (a), $2 \cdot 10^5$ (b) and $5 \cdot 10^4$ (c) cycles; $\omega = 46,7$ (a), 100 (b) and 233.3 (a) Hz



a)



b)

Fig. 3. The microstructure of bismuth after fatigue test at 200C

(*340): a) and b) σ is identical and equal to $\sigma = 16,9$ MPa; $N = 290$ and 1000 cycles, $\omega = 0,033$ and 46.7 Hz. The deformation of the curved rotation sample of 2 mm diameter

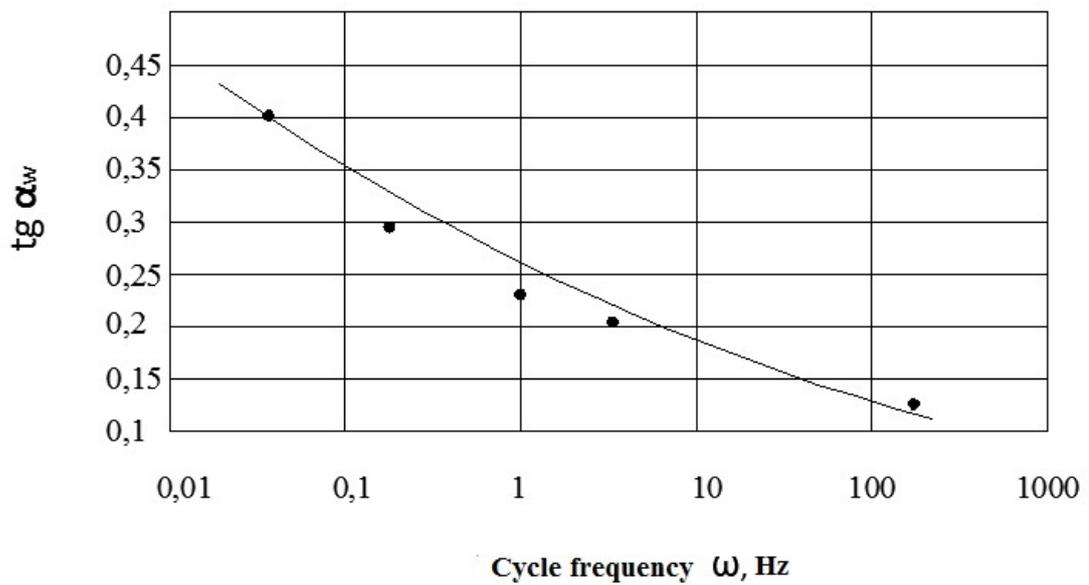


Fig. 4. The dependence between fatigue resistance $tg\alpha_w$ and loading cycle frequency (ω)

Experimental data were then processed in such a way that average values for $\lg a_w$ were defined with $\omega = \text{const}$ and then dependences $\lg a_w = f(\omega)$ were plotted. Computerized processing showed that the data makes a curve (Figure 4.). The following dependence was discovered: $\lg a_w = 0,262 \omega - 0,1301$

CONCLUSION

Tested rare earth metals show a reduction in surface damageability as load cycle frequency values (ω) grow. Fatigue resistance values improve as ω increases. It was also found that an increase in loading cycles frequency together with mitigation in stress leads to a dramatic decrease in fatigue resistance parameter, which is explained by improvements into hardenability across sample surface layers (pieces), which in its turn reduces fatigue damageability across the surface.

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J11307-201

Tabekina N.A.

**DEVELOPMENT OF THE DEVICE FOR CONTACTLESS CONTROL OF
THE SMALL SIZES**

Belgorod Shukhov State Technological University, Belgorod, Kostyukova str., 46

The purpose of this work is development of the effective and exact device for the automated contactless control method of the sizes and sorting of products.

The analysis of various sources, and also inspections of the enterprises which are letting out the exact tool, showed that now in the market the simple and reliable device used in the control and sorting equipment (KSO), allowing to within 1 micron to measure small products it is not offered. The leader on production of similar devices – the KEYENCE company offers devices in cost from 20000\$, but not

having automatic (a program choice) sections of a product for measurement of the size and possessing superfluous consumer properties.

Therefore the method of contactless measurement of the sizes in which basis CCD matrix use is necessary is received. This method allows to create various devices for an evaluation not only the sizes, but also microdistortions of a surface of a received product.

These devices allowing operatively and contactless to check the demanded size, will interest the consumers who are letting out small products, demanding 100 % of control of the sizes, for example:

- Medical tools;
- Autotractor equipment;
- Electrotechnical equipment;
- Cable and wire production

Development of control schemes

The shadow method is put in a basis of operation of the device. The micrometer consists of two modules: radiator 1 and receiver 2. Radiation of the semi-conductor laser 3 is collimated by a lens 4. At placement of object 5 in the field of the collimated bunch the formed shadow image is scanned by a line of CCD photodetectors 6. Under the provision of shadow border (borders) the processor 7 counts the provision of object (fig.1).

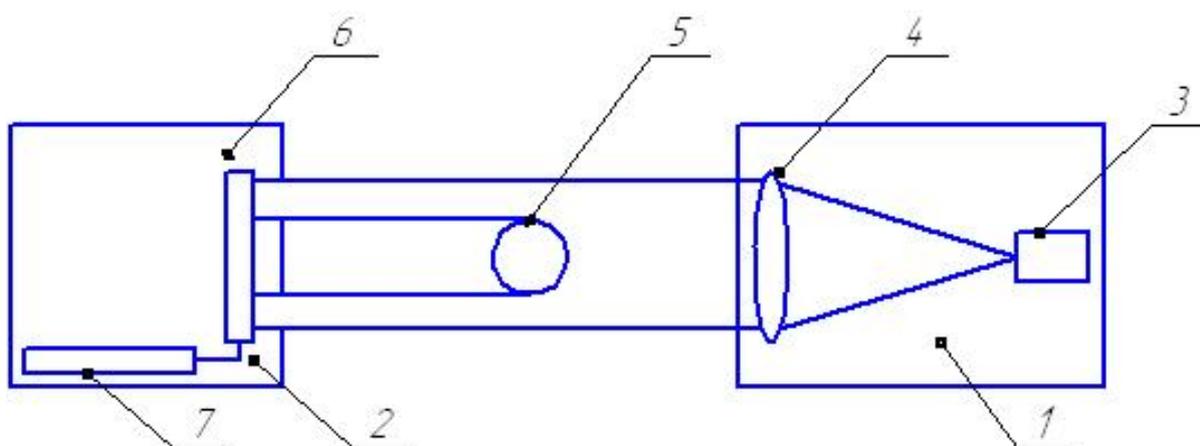


fig.1. The principle of the optical control device

The device for exact contactless control of the small sizes

The device represents the setup for measurement of diameter of rather small preparations or details (to 2,5 mm). It is connected to the personal computer and

allows to observe the increased image of measured object. Also tracking of quality of a surface of object is possible. Circuit of the device is represented on fig. 2.

In the case 1 installed the shaded mine 2, when the laser 3 is fixed. In the case and in mine performed 2 coaxial holes for place the measured object. A chip 4 has the CCD matrix, which located directly below the radiation source (1). Also on board are located the chip power port 5 and laser power port 6. The lower and upper parts of the case have holes for card power cables and laser.

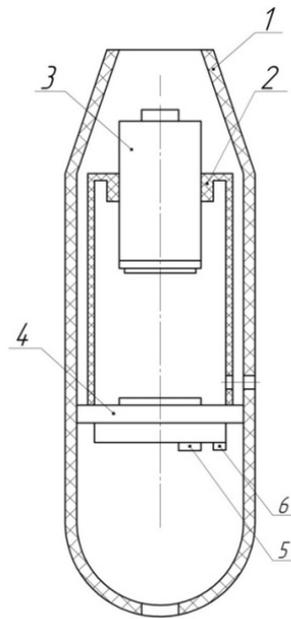


fig.2. Construction of the device for measurement of the micro-sizes

1-case; 2-shaded mine; 3- radiation source (laser); 4-chip with a CCD matrix; 5 - chip power port; 6- laser power port.

Functional description of the device

The function of the device is based on the light striking the CCD matrix 1 (charge-coupled device) with collinear light source 3, in this case by means of laser radiation. Workpiece or component 2 is placed in a hole in the case and the shaft so that it fell under the radiation. As a result, the CCD matrix creates a shadow from the object which is being processed by the matrix and is transmitted as an enlarged image on the PC monitor (fig.4).

Initial experiences with the device confirmed the stated assumption about possibility of obtaining the exact image of a product without optics, i.e. without its

optical increase. Apparently from the scheme of measurements, it hasn't got optical system, that allows to avoid additional distortions of the picture.

The functional chart of the device showed on fig.3

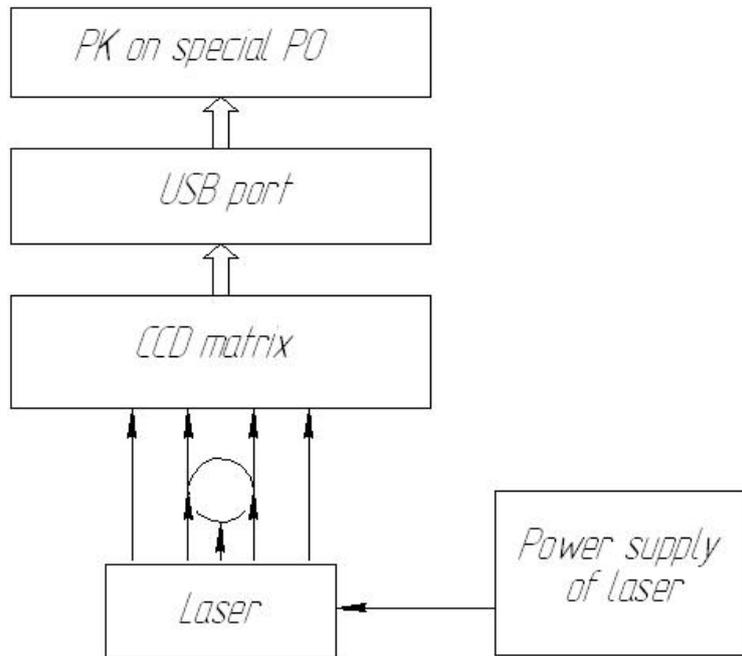


Fig. 3. Functional chart of the device

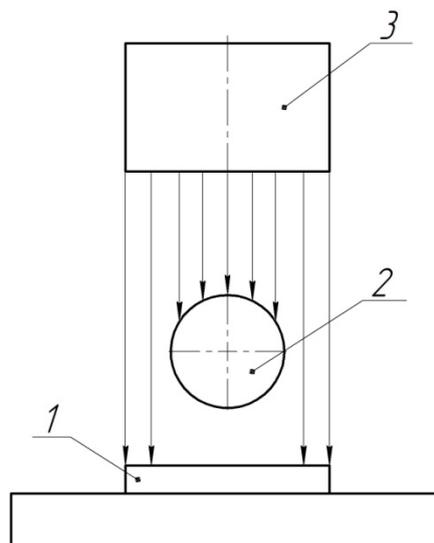


Fig.4. Scheme of the light striking of the CCD matrix

1-CCD matrix; 2- measurement object; 3- radiation source.

For calculation of diameter of measured object according to the received image it is necessary to know number of pixels which is the share of the measured diameter (fig. 5).

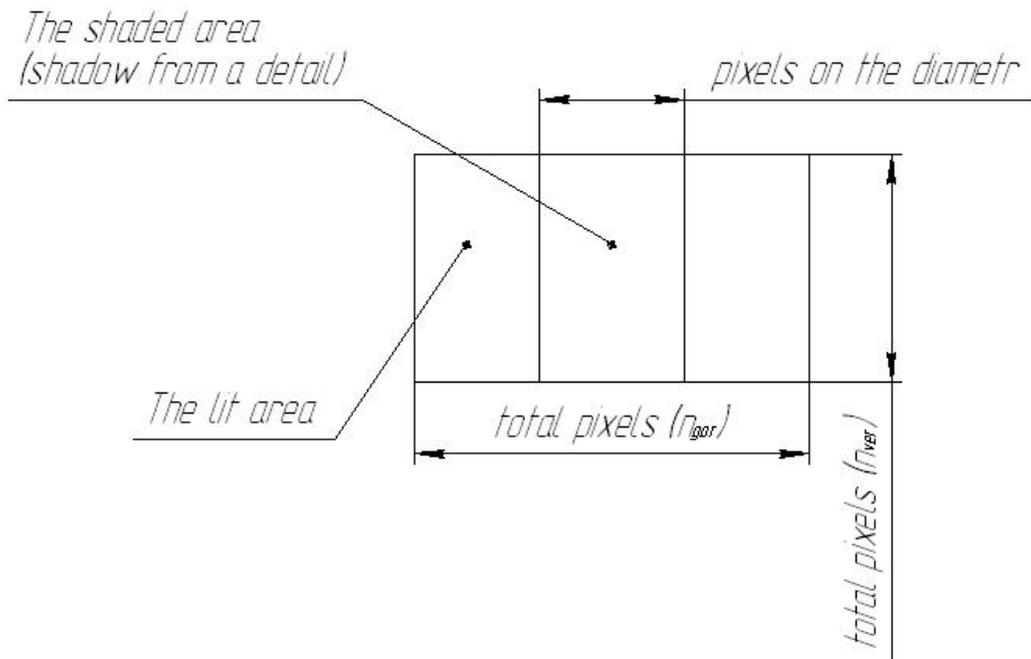


Fig.5. The display scheme on PC

$d = \text{pixels in diameter} \cdot \Delta$, where Δ - price pixel in mm;

$$\Delta_{\text{gor}} = \frac{b}{n_{\text{gor}}}, \text{ mm} \quad (1)$$

$$\Delta_{\text{ver}} = \frac{h}{n_{\text{ver}}}, \text{ mm} \quad (2)$$

b – length of the CCD matrix;

h – width of the CCD matrix.

In the result algorithm of the image processing and obtaining exact value for the sizes in pixels with transfer it in a metric values is obtained (fig.6).

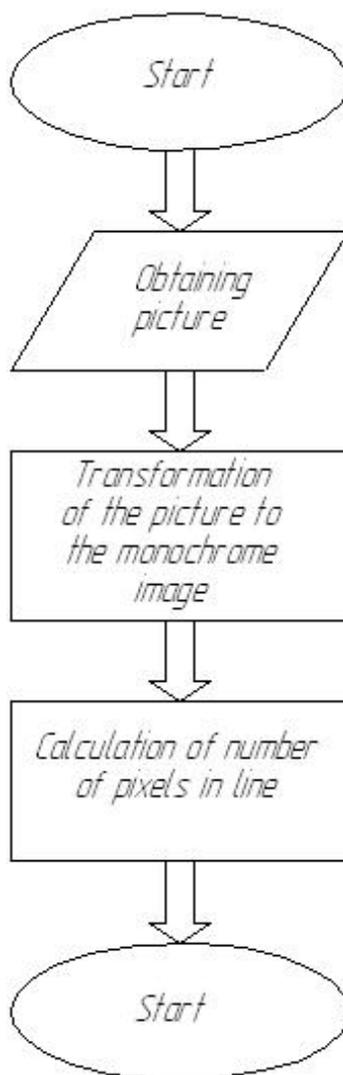


Fig. 6. A block diagram of the image processing

Conclusion:

The most effective for use in KSO is the contactless way of measurement of a shadow of the image received by radiation of a product by a collinear light source;

The method of contactless measurement of the sizes in which basis use of a CCD matrixes is necessary is received;

Permission of CCD matrixes let out now allows to construct the simple, effective, exact device having small prime cost, for automatic measurement of the small sizes to within 0,001 mm;

The algorithm functioning on the found method of contactless measurements allows to carry out measurements of the small sizes to within 1mkm;

The device operated by means of received algorithm, allowing to realize the found way of automatic contactless measurements is developed;

The contactless way of realization of the offered method of measurement of the small sizes to within 1 mkm allows to create various devices for an evaluation not only the sizes, but also microdistortions of a surface of a received product. These devices will interest the consumers who are letting out small products, demanding 100 % of control of the sizes, for example: medical tools, autotractor equipment, electrotechnical equipment.

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J11307-202

Denisov M. V., A. Kizim

**DECISION SUPPORT FOR ROAD WORKS AUTHORITY AND
MONITORING EQUIPMENT**

Volgograd State Technical University

This article describes a decision support system in the management of road works and monitoring equipment.

Key words: GPS, Glonass, navigator.

Currently in Russia and has a project to reform the road sector, one of the points which is improving the structure of road management. According to the order of the Ministry of Transportation January 26, 2012 № 20 "Framing vehicle satellite navigation" from 1 January 2013 vehicles carrying passengers and dangerous goods must be equipped with the GLONASS satellite navigation equipment. Data transmitted by GLONASS, can be used to remotely control the execution of road works. This provides, in particular, the ability to monitor work performance, as well

as the square of the NAC eniya information on the technical condition of each item of equipment, and on its basis - n lanirovaniya its maintenance and and repair.

Feature of construction and road works, is to distribute road construction equipment at the branches. Central Division road organization is responsible for the performance and distribution of equipment for the work. For a more rational distribution of technology to create a system that, based on information about the location of equipment and ongoing work will decide Swapping technology and planning, as well as its maintenance and repair. In operational control department, based on data transmitted from branches, compiled information on the state of roads and the work of art on the road. At the moment the transfer is made by telephone. To gather the data process and decision-making dispatching department takes time .. So necessary develop a decision support system based on data transmitted.

Thus, the creation of problem-oriented management systems, decision support, and remote monitoring of operational execution of road works in preventing accidents and emergency situations, as well as the implementation of optimal distribution eniya equipment for road works is an important task.

Continuous process monitoring of road works and engineering

The process of monitoring road works and equipment consists of the steps:

1. Filling operator branch attire.

The operator of each branch has a user name and password that provide a specific user rights to fill attire. Each branch to put certain objects (roads).

2. Obtaining data on the situation by satellite technology.

Carried out to obtain data on the status of the satellite technology with the hardware and software of global positioning system.

3. Monitoring of road works and technology administrator.

The sequence of steps is cyclic. Thus, a process called Continuous monitoring of road works and engineering. In Figure 1, the monitoring of road works and engineering.



Fig. 1 - Continuous monitoring of road works and engineering

The problem of decision support systems, and control roadworks

The general problem of decision-making in the organization of maintenance and repair of equipment made in [1]. Based on [1] and [2] carry out its detailed formalization. Suppose: X - the set of all possible making supervisory control to assure proper road work - making a rapid response to emergencies, development plans and road design; R - many options for decision making; V - the set of technical and economic feasibility assessments management decisions roads.

Consider the function F effectiveness select the option for control problems because of its physical realization of the mapping of the Cartesian product $X \times R$ in the set count, ie

$$F: X \times R \rightarrow V \quad (1)$$

The problem is characterized by a set of $Z_n(X, R, F)$. M elements of $x^* \in X$, is a solution of Z_n and is characterized by a predicate $P(x^*, Z_n)$.

$$P(x^*, Z_n) = (x^* \text{ is a solution of } Z_n) \quad (2)$$

Similarly, we denote the problem of decision-making on the management of other particular roads respectively regional roads - through Z_v , federal roads - through Z_e . Bodo m characterize the problem Z_e, Z_v sets $(X_e, R_e, F_e), (X_v, R_v, F_v), (X_t, R_t, F_t), (X_g, R_g, F_g)$ and (X_c, R_c, F_c) . In almost important cases, we can assume $X = X_e \times X_v, R = R_e \times R_v \times R_t \times R_g \times R_c$ and Z_e consider the problem as a restriction on the set of the problem Z_n X_e, Z_v the restriction of Z_n , with $x^* = (x_e, x_v, x_t, x_g, x_c)$. Separate tasks control certain types of roads $Z_{ij} (i \in \{1, 2\}, j \in (N_1 \cup$

N_2), can also be formulated in the form of (1) and are characterized by sets of $(X_{ij}, R_{ij}, F_{ij}, Q_{ij})$. The total amount of Z_{ij} equal to $(N_1 \cup N_2)$.

For example, as problems $Z_{2j}, j = 1, N_2$ can provide enterprise solutions for the problem: defining the scope of work under certain road works, calculation of the characteristics of individual road sections, the definition of the activities at the operational response to emergencies arising in the areas of roads, and other tasks. With definition S_v be determined $x_v \in X_v$, and this fact will be characterized by the operator

$$X_v = \Theta_v(S_v) \quad (3)$$

Similar arguments will take place in the definition of local problems in decision-making for the management of all types of road works. Using this notation, we formalize the basic principles used to support decision-making for the road works. Selecting a decision in the management of road works carried out on the basis of the availability of free equipment and its location, as well as the availability of resources. Other words - in solving problems Z_e, Z_v must form a vector S_n , which gave rise to a solution of Z_n , minimizes the costs of meeting road works.

In turn, the solution of problems of a lower level, for example, the tasks should be formed vector S_v , which gave rise to the solution of Z_v . In formalized form it can be written as:

$$\exists (Z_{2j}, x_{2j}, j = \overline{1, N_2}) : P(x_{2j}, Z_{2j}) \Rightarrow P(x_v, Z_v) \left| \begin{array}{l} x_v = \Theta_v(S_v) \\ S_v = (x_{21}, \dots, x_{2, N_2}) \end{array} \right. \quad (4)$$

Более частым является достижение экстремума целевой функции F_v , определенной на множестве решений задачи Z_v . В этом случае имеем:

More frequent extreme is to achieve the objective function F_v , defined on the set of solutions of Z_v . In this case, we have:

$$\begin{aligned} & \exists (Z_{2j}, x_{2j}, j = \overline{1, N_2}) : P(x_{2j}, Z_{2j}) \Rightarrow \\ & \exists (S_v^* = (x_{21}^*, \dots, x_{2, N_2}^*), x_{2j}^* = \{x_{2j}\}, j = \overline{1, N_2}) \\ & : F_v(\Theta_v(S_v^*)) = \text{extr}_{x \in H_v} F_v(x_v). \end{aligned} \quad (5)$$

The architecture of decision support system

According to [2], and automatized information decision support system for managing road works must satisfy the principles of hierarchical structure, the coordination of individual tasks, interoperability and modifiability. Decision support system will be set up in NetBeans in the programming language PHP [3], using the framework Yii [4]. The system will store the data in the database MySQL.

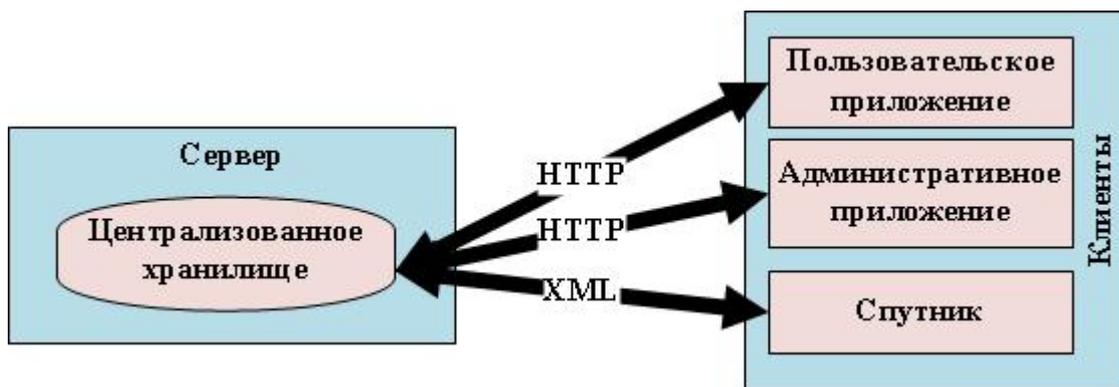


Fig. 2 - The system architecture for monitoring of road works and engineering.

Figure 2 shows the architecture of a decision support system. User applications will transmit data on road works and the number of working machinery. From the satellite to receive the data on the situation of technology. Administrative Applications will monitor and support decision making.

Realized for control of road works and engineering should have the right and the administrator. The administrator works in an interface that is different from the user.

Testing and implementation of decision support systems

System and decision support management and control of road works equipment in branch offices will be tested and implemented in the Regional State Unitary Enterprise "Volgogradavtodor." The structure of client applications and user wakes enter the administrative part.

In this regard, the development of the system is taken into account the requirement [5] on the separation of user interfaces and administrative side.

Conclusion

The analysis of the problem of dispatching control and WEP. Formulated stages of collection, processing and transmission of information on road works and dispatching processes in the management of road works. Architectures developed a

supervisory control and monitoring of road works and technology and decision support. Developed hardware and software remote control utilities for DSS OGUP "Volgogradavtodor" and the prototype of an automated monitoring system for road works and engineering, planned trials and experimental studies of the system.

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J11307-203

Sumkin K.S. Morozova T.Y., Akimov D.A.

**AUTOMATION OF STEREOZVRENIYA ON METHODS OF ALLOCATION
CONTROL ACTIONS AND FUZZY LOGIC**

LTD "Neocom",

In this report discusses the use of methods for the isolation of control actions stereo vision and fuzzy logic, working in real time to control the video stream of the low resolution and high noise

Key words: stereo vision, methods of control actions, fuzzy logic, control, video stream low resolution

Need for mechanisms operating in Stereoscopic video stream low resolution justified by the following factors. There is a need to manage complex technology and information resources. Thus, from the point of view of the user interface controls should be as comfortable as possible. For this purpose, a new software systems, aimed at facilitating the transfer of information from the user to the computer, in particular, various contactless interfaces based on computer vision technology. The user is not always convenient, and in some cases impossible, to use hands to operate a computer or a technical system, especially when there is a need to process large amounts of data. Development of control systems, solves these problems [1].

Development of advanced technologies for industrial production, scientific-technical sphere, transport and defense accompanied by an increased degree of automation, computer hardware components intellectualization jobs while increasing functional load on the higher mental functions of operators.

This raises the need for effective information and computer technology of decision support and visualization of large volumes of related information.

In recent years, the market there was a set of relatively cheap non-contact input devices, obeying the human eye. Focused primarily on people with disabilities, they are, nevertheless, have been used in games, smartphones, digital cameras and other consumer electronics [2].

Born in the depths of military laboratories, contactless interfaces finally escaped to the operating room of the consumer market, surpassing the mouse, and in part - the keyboard. However, the vast majority of users do not even know of the existence of such devices to the public, yet the price is falling rapidly and came closer to around \$ 100.

This will require a Web-camera the middle class (pic. 1).



Pic. 1. Computer controlled by eye video from web-cameras

If pupils are drawn off-center eye, it is perceived as a glance in the direction aimed at a very specific object, the location of which is easy to calculate mentally extending the look or drawing line connecting center of the eye to the center of the pupil. She would gaze direction in axonometric or perspective projection. This is the case if the head is turned in the direction of the subject under consideration, would otherwise have to make appropriate adjustments [3].

Offset relative to the center of the pupil eyes (pic. 2) is registered with any camcorder (reasonable) linear resolution and easy to work with microprocessors.



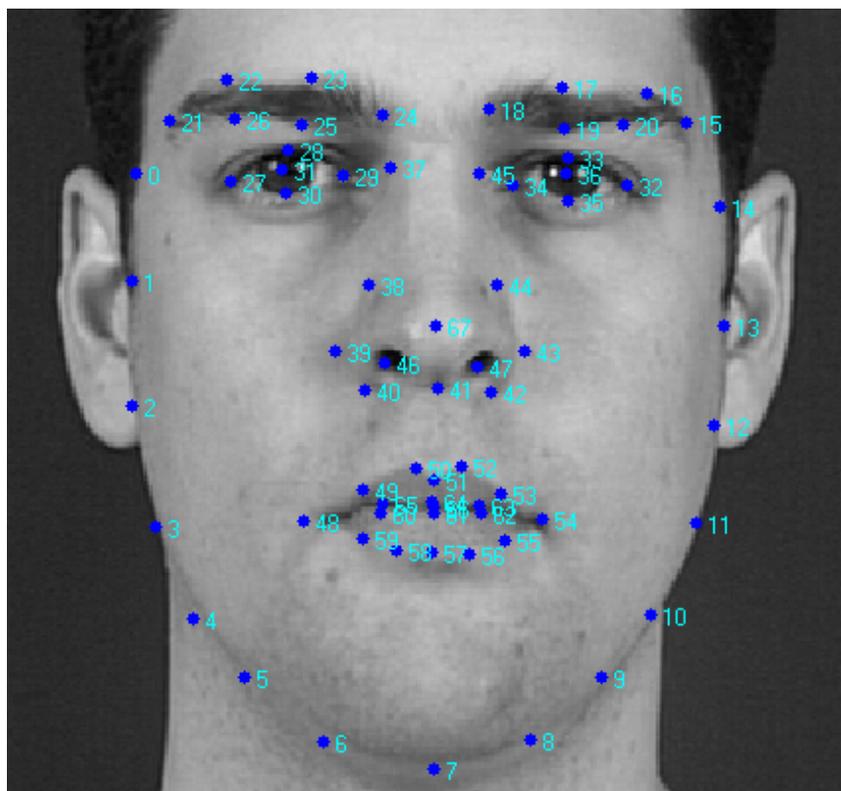
Pic. 2. The control system should be able to look with maximum accuracy the center of the eye and pupil

To determine the orientation of the head algorithmic way is not easy, but the creators of the first guidance systems used in jet fighters, found a very elegant solution, installed the camcorder directly to the helmet wearing by the pilot, resulting in rotation of the head relative position of the camera remains the same, as the camera is turned along with the head. Another camera synchronizes the movement of the head with the movement of the helmet. Knowing the distance from the eye to the camera and determining the relative displacement of the pupil, the angle of viewing direction is calculated in terms of trigonometric functions. The image is captured by the second camera, and is an object that is at a given angular distance from the optical axis, and then increase it and a framing rectangle, grabbing a goal and automatically tracking its movement, and the pilot's hand is operating the aircraft.

Modern contactless interfaces have a lot of flaws in attempts practical applications: low accuracy, uncertainty, a large number of false alarms, etc. Meanwhile, the management view is not only fast, convenient, but also extremely reliable. In a well-designed and well-implemented system of the false positive rate to zero.

In active appearance models simulate two types of parameters: the parameters associated with the form (shape parameters), and the parameters associated with a statistical model of the image or texture (the parameters of appearance). Before using the model must be trained on a set of pre-marked images. Layout images manually or semi-automatically when using an algorithm to find approximate location tags, and then they are specified by the expert. Each tag has a number and determines the characteristic point, which would have to find a model in adapting to a new image (pic. 3).

In the example shown in the picture there were 68 marks forming the shape of the model of the active appearance. This form represents the outer face contour, the contours of the mouth, eyes, nose and eyebrows. This layout allows the character to further define the various parameters on it in the face, which can be used for further processing by other algorithms.



Pic. 3. Facial markings

For example, it may be identification algorithms, audio-visual speech recognition, determine the emotional state of the subject [4].

The learning procedure of active appearance models begins with the normalization of all forms in order to compensate for the differences in scale, slope and offset. It uses the so-called generalized.

Once all the forms are normalized element of their points matrix is $S = [s_1, s_2, \dots, s_m]$ formed, where $S_m = [x_1^m, x_2^m, \dots, x_N^m, y_1^m, y_2^m, \dots, y_N^m]^T$, where x, y – coordinates. After highlighting the major components of this matrix, we obtain the following expression for the synthetic form $s = s_0 + \Phi_s b_s$, where s_0 – the form, averaged over all realizations of the training set (base form), Φ_s – the main vectors of the matrix, b_s – the shape parameters. This expression means that the form can be expressed as the sum of the base form s_0 and a linear combination of its own forms contained in the matrix Φ_s . By changing the parameter vector b_s , we can get different types of deformation of the shape to fit it under the actual picture.

It should be noted that distinguish the active appearance model with rigid and rigid deformation. Models with rigid deformation may be only an affine transformation, while the models with non-rigid deformation, and may be subject to other types of deformations. In practice, a combination of both types of strains. In this case, the parameters are added to the form and location settings.

The learning procedure for the components look performed after compute the components of the form (basic form of the matrix of principal components). The learning process is composed of three steps. The first step is the extraction of the training texture images that best match the base form. Performed for this triangulation marks basic shape and form, consisting of the labels of the training image. Then use the piecewise interpolation the displaying the resulting triangulation of the training images in the regions affected regions formed texture.

Unsolved problem of determining the degree of rotation of the head, which can not be solved by exact mathematical methods due to some uncertainty with values: a *little, medium* and *hard*.

To solve this problem it is proposed to use fuzzy logic to solve problems related to the uncertainty.

To solve this problem it is proposed to use fuzzy logic, which is proposed as a consequence of the formalism of representation of fuzzy production rules and fuzzy inference algorithm (NLV). The main difference between the algorithm shown NLV from traditional methods (eg, Mamdani, Tsukamoto, Sugeno 0 of order and others) is that the rules is not only fuzzy implication Mamdani but any calculations required for access [5].

Fuzzy production rules are constructed as follows:

$P_i : IF \ y \ \text{there is} \ \mu(y)_i \ \text{and} \ x \ \text{there is} \ \mu(x)_i \ \text{and(or)} \ \text{raro} \ \text{there is} \ L \ \text{and(or)} \ \text{cwv} \ \text{there is} \ M \ \text{then} \ d_i = \rho^{-1}.$

where Π_i — rule for determining the necessary change $i = \overline{1, n}$, where n — number of rules, *raro* — degree of random rotation, *cwv* — degree of rotation when viewing. Presented an example of the possible values *raro*, *cwv* (tabl.1).

Table 1.

Example values *raro*, *cwv*.

Variable \ Parameter	1	2	3
<i>raro</i>	Not a chance	Random	Planned
<i>cwv</i>	Not controlled	Controlled	Planned

Algorithm steps NLV.

Step 1. Fazifikatsiya.

Step 2. Computation of degrees of response for each of the premises of the rules — α_i .

Step 3. Activation of the conclusions for each of the rules — $\langle \alpha_i, \beta_i | \beta_i = f_i(\alpha_i) \rangle$, где $f_i(\alpha_i)$ — turn function with parameter α_i , computed in the second stage.

Step 4. Defuzzification.

$$D = \frac{\sum_{i=1}^n \alpha_i d_i}{\sum_{i=1}^n \alpha_i}, \quad (4)$$

where D — rotation value.

Suggested approaches to the creation of non-contact interface for managing large amounts of data correspond to the world of scientific and technical data. In our country and abroad are being developed for new, more efficient mathematical methods and computer vision for solving visualization and management of information in science and technology.

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J11307-206

SYVAK R.I., KOTSUBIVSKA K.I., SYVAK I.O.

**TENSOR MODEL OF DAMAGE ACCUMULATION PROCESS DURING
NONMONOTONIC LOADING**

Vinnitsa National Agrarian University, Vinnitsa, Solnechnaia 3

Vinnitsa National Technical University, Vinnitsa, Hmelnitskoe shose, 95

Keywords: plastic deformation, stress, nonmonotonic loading, deformation paths, failure.

The paper studies metal plasticity in the process of lateral extrusion of the axially symmetric flange with its further upsetting. This process is distinguished by a non-monotonic loading. Therefore, calculation of the stress deviator components is performed using Bakhauz anisotropic strengthening model.

As the known tensors of the failure accumulation process model for non-monotonic loading are very cumbersome, this paper substantiates the transition from a tensor model to a 3D scalar model. Stressed state stiffness index and Nadai-Lode parameter are used as main characteristics of non-monotonic loading. Three components of the failure deviator in 3D space of the main stresses is introduced instead of 6 components of the failure tensor. Approximation of the function is proposed that describes the loading history influence on plasticity and takes into

account the deformed metal sensitivity to the stressed state scheme. Stressed state influence on plasticity is given by the ultimate strain surface that describes the ultimate strain dependence on the two invariant indices of stressed state.

The developed model for evaluation of the metal plasticity under complex non-monotonic loading is used to evaluate the influence of the parameters of the flange lateral extrusion process on the ultimate strain. The proposed procedure of the combined extrusion design enables rational use of the extruded metal plasticity resource.

The main task of plastic metal working is obtaining workpieces of a definite form without continuity violation. Therefore, the problem of deformed metal plasticity evaluation has still been of current importance, especially for nonmonotonic deformation. The mechanism of failure accumulation and healing under nonmonotonic deformation is not fully understood at present. That is why there is no single view as to the evaluation of metal deformability under nonmonotonic loading [1-5].

The model of failure accumulation under nonmonotonic loading is based on the hypothesis that failures have a directional character and are described by the second rank tensor. This tensor components are determined by the mechanics of plastic deformation in a definite manufacturing process as well as by material functions that describe physico-mechanical properties of the material.

In accordance with A.Iliushin [6] and G.Del [5], we introduce failure tensor ψ_{ij} , the components of which are defined as follows:

$$\psi_{ij} = \int_0^{e_u^*} F(e_u, \eta, \mu_\sigma) \beta_{ij} de_u, \quad (1)$$

where $F(e_u, \eta, \mu_\sigma)$ – a positive function that characterizes the material sensitivity to the stressed state scheme.

Components of the guide tensor β_{ij} are given by [5]

$$\beta_{ij} = \sqrt{\frac{2}{3}} \frac{d\varepsilon_{ij}}{de_u}. \quad (2)$$

From the relationships of the flow theory

$$d\varepsilon_{ij} = \frac{3}{2} \frac{de_u}{\sigma_u} S_{ij} \quad (3)$$

it follows that

$$\frac{d\varepsilon_{ij}}{de_u} = \sqrt{\frac{3}{2}} \beta_{ij} = \frac{3}{2} \frac{S_{ij}}{\sigma_u} \quad (4)$$

or

$$\beta_{ij} = \sqrt{\frac{3}{2}} \frac{S_{ij}}{\sigma_u} \quad (5)$$

where S_{ij} – stress deviator components,
 σ_u – stress intensity.

Let us represent tensor σ_{ij} in the form of

$$\sigma_{ij} = S_{ij} + \sigma \delta_{ij} \quad (6)$$

where $\sigma = \frac{1}{3} \sigma_{ij} \delta_{ij}$ is mean pressure.

Besides, we use the known relationships

$$\mu_\sigma = \frac{2S_2 - S_1 - S_3}{S_1 - S_3} \quad (7)$$

$$S_1 + S_2 + S_3 = 0, \quad 2\sigma_u^2 = (S_1 - S_2)^2 + (S_2 - S_3)^2 + (S_3 - S_1)^2, \quad (8)$$

where μ_σ is Nadai-Lode parameter.

After solving system (7), (8), we find

$$\frac{S_1}{\sigma_u} = \mp \frac{1}{3} \frac{\mu_\sigma - 3}{\sqrt{\mu_\sigma^2 + 3}}, \quad \frac{S_2}{\sigma_u} = \pm \frac{1}{3} \frac{2\mu_\sigma}{\sqrt{\mu_\sigma^2 + 3}}, \quad \frac{S_3}{\sigma_u} = \mp \frac{1}{3} \frac{\mu_\sigma + 3}{\sqrt{\mu_\sigma^2 + 3}}. \quad (9)$$

From (5) and (9) it follows that main components of tensor β_{ij} are given by

$$\beta_1 = \mp \frac{1}{\sqrt{6}} \frac{\mu_\sigma - 3}{\sqrt{\mu_\sigma^2 + 3}}, \quad \beta_2 = \pm \frac{1}{\sqrt{6}} \frac{2\mu_\sigma}{\sqrt{\mu_\sigma^2 + 3}}, \quad \beta_3 = \mp \frac{1}{\sqrt{6}} \frac{\mu_\sigma + 3}{\sqrt{\mu_\sigma^2 + 3}}. \quad (10)$$

It is assumed that under nonmonotonic loading failure occurs if a certain function of the invariants of tensor ψ_{ij} reaches a definite value. The first invariant of

this tensor is equal to zero due to incompressibility of the material - $\beta_1 + \beta_2 + \beta_3 = 0$. Without taking into account the influence of the third invariant, failure condition can be written as

$$\psi_1^2 + \psi_2^2 + \psi_3^2 = 1. \quad (11)$$

In order to determine the form of function $F(e_u, \eta, \mu_\sigma)$ that is included in (1), we consider a simple loading where β_{ij} , η , μ_σ remain constant. Then [5]

$$\psi_{ij} = \beta_{ij} \int_0^{e_u^*} F(e_u, \eta, \mu_\sigma) de_u = \beta_{ij} \varphi(e_u, \eta, \mu_\sigma), \quad (12)$$

$$\text{where } \varphi(e_u, \eta, \mu_\sigma) = \int_0^{e_u^*} F(e_u, \eta, \mu_\sigma) de_u. \quad (13)$$

As $\beta_1^2 + \beta_2^2 + \beta_3^2 = 1$, it follows from (11) that under failure conditions if $e_u = e_p$, $\varphi(e_u, \eta, \mu_\sigma) = 1$. Besides,

$$\varphi(0, \eta, \mu_\sigma) = 0. \quad (14)$$

Satisfying these conditions, we assume that [5]

$$\varphi = \sum_{k=1}^m b_k \left(\frac{e_u}{e_p(\eta, \mu_\sigma)} \right)^{n_k}, \quad \sum b_k = 1, \quad n_k > 0. \quad (15)$$

In accordance with (15) and (14) we will further adopt

$$\varphi = (1 - a) \frac{e_u}{e_p(\eta, \mu_\sigma)} + a \frac{e_u^2}{e_p(\eta, \mu_\sigma)^2} \quad (16)$$

where $e_p(\eta, \mu_\sigma)$ is the surface of ultimate strain, a – a constant that depends on the mechanical characteristics of the metal. Here a is adopted to be equal to $a = 0,48$.

Satisfying relationships (1), (13), (16) we assume that in general case

$$\psi_1 = \int_0^{e_u} \left(1 - a + 2a \frac{e_u}{e_p(\eta, \mu_\sigma)} \right) \beta_1 \frac{de_u}{e_p(\eta, \mu_\sigma)}. \quad (17)$$

Analogous expressions can be written for ψ_2 and ψ_3 that are included into the failure condition (11).

Failure criterion (11) is used for studying the process of lateral extrusion with further upsetting of a cylindrical billet made from steel 10. The process scheme is presented in fig.1. At the first stage the lateral extrusion process is realized (fig.1, a) and at the second stage – upsetting of the obtained flange (fig.1, b). The strained state calculation was performed by the method of coordinate grids using the procedure described in [7]. The process of extrusion and the upsetting process were conducted in three stages. Deformation paths $\eta(e_u)$, $\mu_\sigma(e_u)$ were built taking into account the influence of the main technological parameters: relative thickness of the flange $h/2R_0$ and relative value of the curvature $r/2R_0$ of the transition edge. As deformation paths in e_u , η , μ_σ coordinates are not practically dependent on the material, for the strained state investigation samples (cutted into halves), made from antimonous lead were used ($d_0=28,2\text{mm}$, $l_0=60\text{mm}$). On the polished surface of one of the composite sample halves rectangular dividing grid with the base of 2mm was drawn with a sharpened cutting tool. Then the samples were soldered and extrusion of separate samples was performed to different deformation degrees within three transitions. After the last transition of the lateral extrusion 3 samples were used to realize three transitions of contour upsetting. Thus, each sample characterizes strained state at the end of the corresponding stage. After each stage the samples were unsoldered and coordinates of the deformed grid nodes were measured.

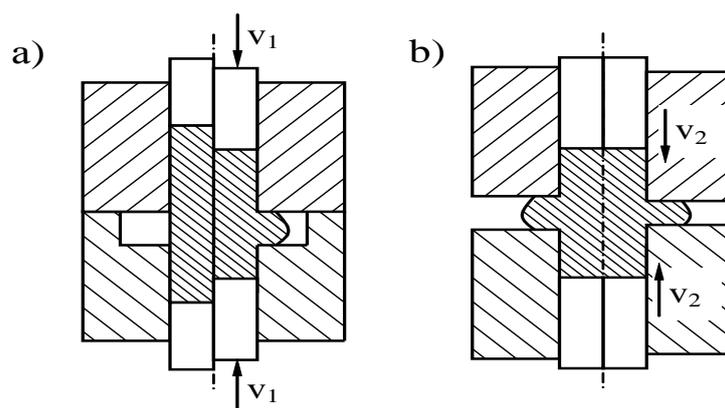


Fig.1. Scheme of the process of lateral extrusion with further upsetting of the obtained flange

a – lateral extrusion; b – upsetting

Besides, a dividing grid was also drawn on the side surface of samples made from steel 10 and lateral extrusion with further contour upsetting was performed according to the same scheme as the samples made from lead were deformed.

Accumulated deformation was found by the formular

$$e_u = \int_0^t \dot{\varepsilon}_u d\tau,$$

where $\dot{\varepsilon}_u$ - intensity of the deformation rates, t - deformation time.

Stress deviator components were calculated using relationships that enable taking into account the influence of plastic deformation non-monotony [8] which is observed in the process under consideration.

$$S_{ij} = \frac{2}{3} \sigma_u(e_u) \frac{\dot{\varepsilon}_{ij}}{\dot{\varepsilon}_u} - \frac{1}{3} \int_0^{e_u} (1 - \beta(e_u^*)) \sigma(e_u^*) \cdot \varphi(e_u^* - e_u^0) \frac{d^2 \varepsilon_{ij}}{de_u^2}(e_u^*) de_u^*. \quad (18)$$

Dependences $\beta(e_u)$, $\varphi(e_u - e_u^0)$ for steel 10 were obtained experimentally using the procedure [8]. Experimental results were approximated by functions

$$\beta = 0,34 + 0,66 \exp(-62e_u), \quad (19)$$

$$\varphi = 0,19 + 0,81(-22,3(e_u - e_u^0))^{0,806}. \quad (20)$$

Constants included in (19) and (20) were determined by the method of least squares.

The stress tensor components were found by integration of the balance differential equations

$$\frac{\partial \sigma_r}{\partial r} + \frac{\partial \tau_{rz}}{\partial z} + \frac{\sigma_r - \sigma_\varphi}{r} = 0, \quad \frac{\partial \tau_{rz}}{\partial r} + \frac{\partial \sigma_z}{\partial z} + \frac{\tau_{rz}}{r} = 0 \quad (21)$$

using the integral equation

$$P = 2\pi \int_0^R \sigma_z r dr, \quad (22)$$

where R – the radius of the workpiece to be deformed, P – the force that is measured in the process of the investigated workpiece deformation.

The obtained results of the stresses and deformation calculation were used for building loading paths $\eta(e_u)$, $\mu_\sigma(e_u)$ and also for β_I and φ values calculation.

In the process under consideration destruction starts at the points located on the free surface of the workpiece in the horizontal plane of symmetry. So Fig. 2 presents loading paths of these points for cases when $d_0=28,2$ mm, $\frac{r}{d_0} = 0,05; 0,15; 0,25$, a

$$\frac{h}{d_0} = 0,354.$$

Fig. 2 also presents the surface of limit deformations for steel 10, which was approximated by the dependence obtained in [7]

$$e_p(\eta, \mu_\sigma) = 0,68 \exp(0,43\mu_\sigma - 0,71\eta). \quad (23)$$

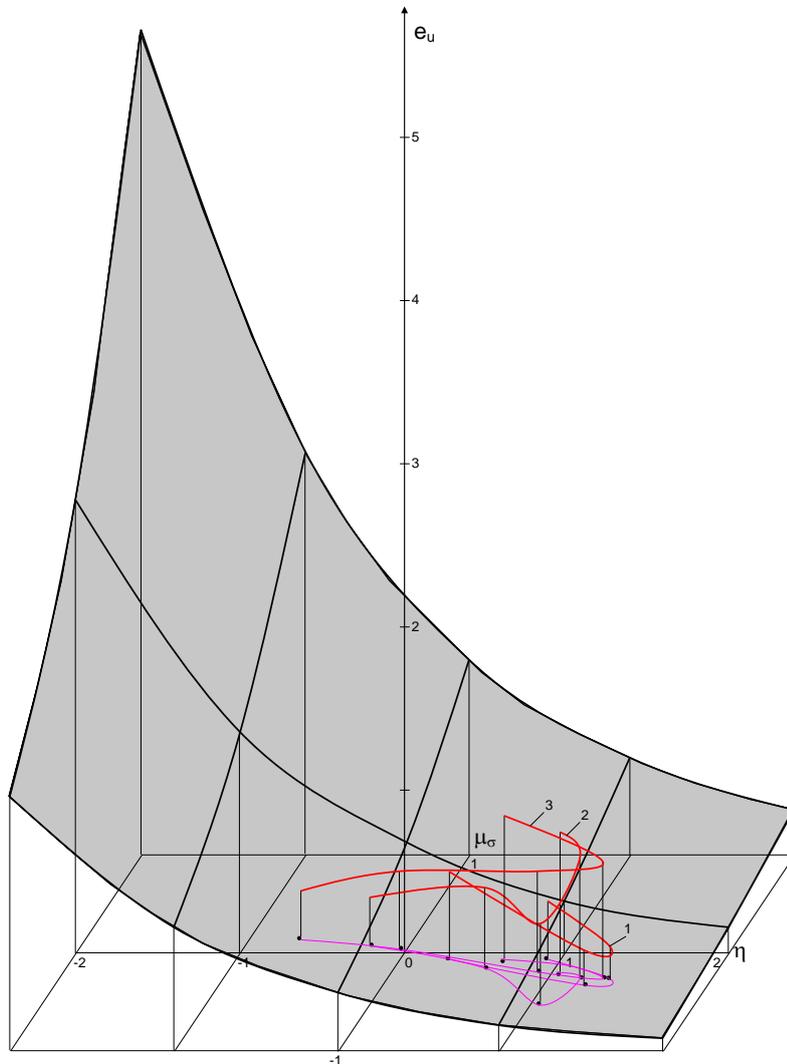


Fig. 2 – Surface of limit deformations $e_p(\eta, \mu_\sigma)$ and the paths of deformation for the

particles of dangerous zone (1 – $\frac{r}{d_0} = 0,05$; 2 – $\frac{r}{d_0} = 0,15$; 3 – $\frac{r}{d_0} = 0,25$)

From the analysis of the obtained results it follows that if relation of the rounding radius of matrix r to the initial workpiece diameter $\frac{r}{d_0} < 0,15$, then plasticity resource at the dangerous point is practically exhausted and for $\frac{r}{d_0} = 0,25$ the used plasticity resource ψ does not exceed 0,84.

Calculation of the used plasticity resource according to criterion (11) has made it possible to give satisfactory description of the experimental results. Discrepancy with the experimental result does not exceed 20%. It should be noted that application of the distinguishing features of plastic deformation non-monotony makes it possible to obtain flanges with the diameter that exceeds by 60-80% the flange diameter under usual lateral extrusion.

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Krylov M.B, Sovinskiy V.M.

MEMORY TYPE INFLUENCE ON GPGPU PERFORMANCE

St.Petersburg National Research University of Information Technologies, Mechanics and Optics; Russia, St.Petersburg, Kronverkskiy pr., 49, 197101

This article is a research of opportunities to increase GPGPU performance by utilizing different graphics card memory types. It is based on several test implementations of a mathematical task with large amounts of source data, which requires a parallel solution. Tags: CUDA, GPGPU, GPU.

1. Introduction.

General-purpose computing on graphics processing units (GPGPU) is the utilization of graphics processing unit to handle non-graphical data. GPU architecture was initially designed to do video processing, which requires performing same operation on multiple data simultaneously. As a result, GPU can do large amounts of mathematical operations faster than CPU. Due to this fact, more and more software products that process large data sets can use a data-parallel programming model to speed up the computations and improve user experience. However, the architectural complexity of GPU's makes developers to choose computation resource utilization strategy very carefully.

Our research goal is to evaluate dependency between utilized GPU memory type (we attempt to use shared memory instead of global) and GPGPU software performance.

2. GPGPU programming model.

A GPU is built around an array of Streaming Multiprocessors (SMs). A multithreaded program is partitioned into blocks of threads that execute independently from each other, so that a GPU with more multiprocessors will automatically execute the program in less time than a GPU with fewer multiprocessors. Data-parallel processing maps data elements to parallel processing threads. When a CUDA program on the host CPU invokes a kernel grid, the blocks of the grid are enumerated and distributed to multiprocessors with available execution capacity. The threads of a thread block execute concurrently on one multiprocessor, and multiple thread blocks can execute concurrently on one multiprocessor. As thread blocks terminate, new blocks are launched on the vacated multiprocessors.

To manage such a large amount of threads, GPU employs a unique architecture called SIMT (Single-Instruction, Multiple-Thread). The SIMT architecture is akin to SIMD (Single Instruction, Multiple Data) in that a single instruction controls multiple processing elements. A key difference is that SIMD vector organizations expose the SIMD width to the software, whereas SIMT instructions specify the execution and branching behavior of a single thread.

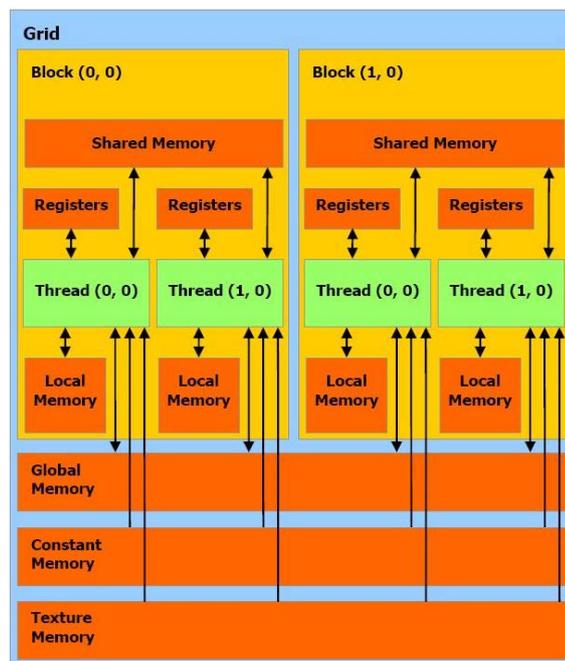


Fig. 1. GPU memory model

CUDA threads may access data from multiple memory spaces during their execution as illustrated by fig. 1. Each thread has private local memory. Each thread block has shared memory visible to all threads of the block and with the same lifetime as the block. All threads have access to the same global memory. There are also two additional read-only memory spaces accessible by all threads: the constant and texture memory spaces. Shared memory is expected to be much faster than global memory.

3. Experiment description and results.

In order to compare execution time, we implemented two GPGPU based matrix multiplication algorithms (for shared memory based solution and global memory based solution), and one CPU based algorithm. We ran these benchmarks on two PC's (hardware is listed in tab. 1). Each algorithm was executed 300 times for every matrix size, and then the results were averaged (tab. 2).

Table 1

Testing hardware

	PC 1	PC 2
CPU	Intel Core i7-3770 @ 3,4Ghz	Intel core i5 2500K @ 3,3Ghz
GPU	NVIDIA GeForce GTX 680	NVIDIA GeForce GTX 580
RAM	16 GB	4 GB
OS	Windows XP x64	Windows 8 x64

Benchmark algorithm was organized the following way.

First, we allocated in RAM and initialized matrices of the required size. Then source matrices were transferred to video RAM, split into chunks, and, according to current resource management approach were either transferred to shared memory or stored in global memory. Each chunk was processed by a separate thread, then all results were merged into a result matrix and returned to RAM.

Table 2

Mean execution time (ms)

Processor	GPU		CPU
Memory type	Shared	Global	-
100x100	0,02	0,03	2,80
250x250	0,14	0,35	42,16
500x500	1,09	3,03	436,64
750x750	3,61	10,18	1712,72
1000x1000	8,52	29,46	6010,72
1250x1250	21,50	50,67	12511,32
1500x1500	27,07	78,64	25717,49
1750x1750	43,14	125,21	44449,18
2000x2000	63,81	180,17	57996,52
2250x2250	93,30	273,11	97215,73
2500x2500	127,85	381,26	134023,28
2750x2750	165,18	499,72	180461,76
3000x3000	212,81	645,80	229601,55

Table 3

Code snippets

<pre> float Csub = 0; #pragma unroll for (int k = 0; k < wA; ++k) { Csub += A[tid/wA+k] * B[k*wA+tid%wA]; } C[tid] = Csub; </pre>	<pre> #pragma unroll for (int a = aBegin, b = bBegin; a <= aEnd; a += aStep, b += bStep) { __shared__ float As[BLOCK_SIZE][BLOCK_SIZE]; __shared__ float Bs[BLOCK_SIZE][BLOCK_SIZE]; As[ty][tx] = 0.0f; Bs[ty][tx] = 0.0f; if ((a + tx <= (aEnd)) { As[ty][tx] = A[a + wA * ty + tx]; } if ((b + wB * ty + tx < (wA*wB)) { Bs[ty][tx] = B[b + wB * ty + tx]; } __syncthreads(); } </pre>
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The following code snippets (tab. 3) illustrate how we implement transfer data to global memory and shared memory respectively. Using shared memory makes code more complicated (extra variables declarations are omitted).

Fig. 2 states mean execution time (execution time for different hardware configurations was averaged).

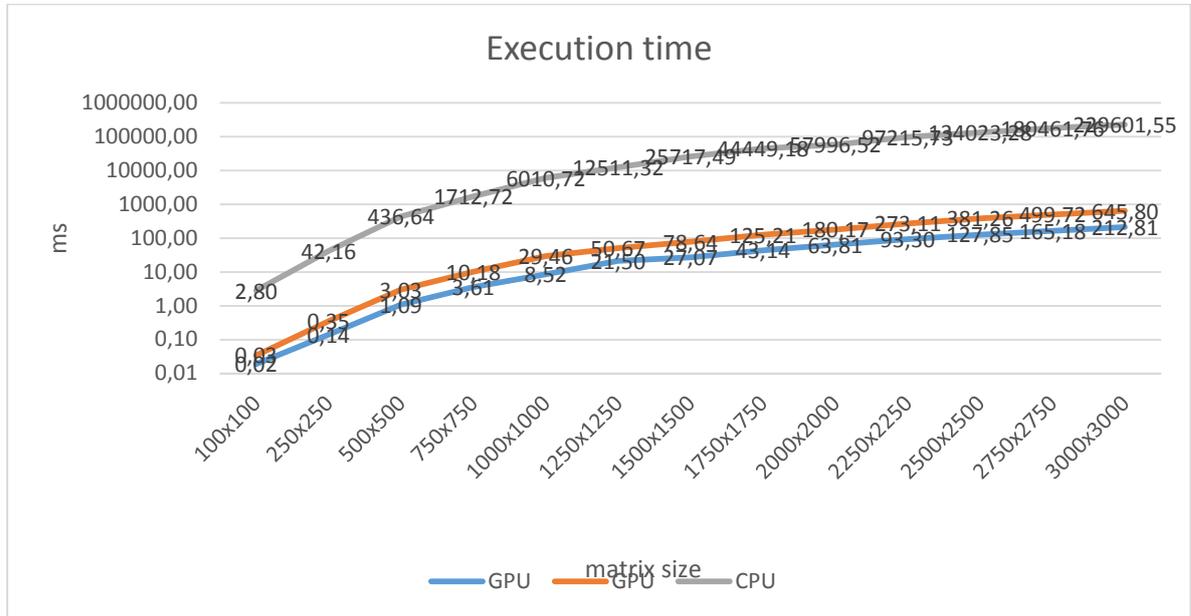


fig. 2. Execution time

Fig. 3 shows how performance increase depends on source matrix size.

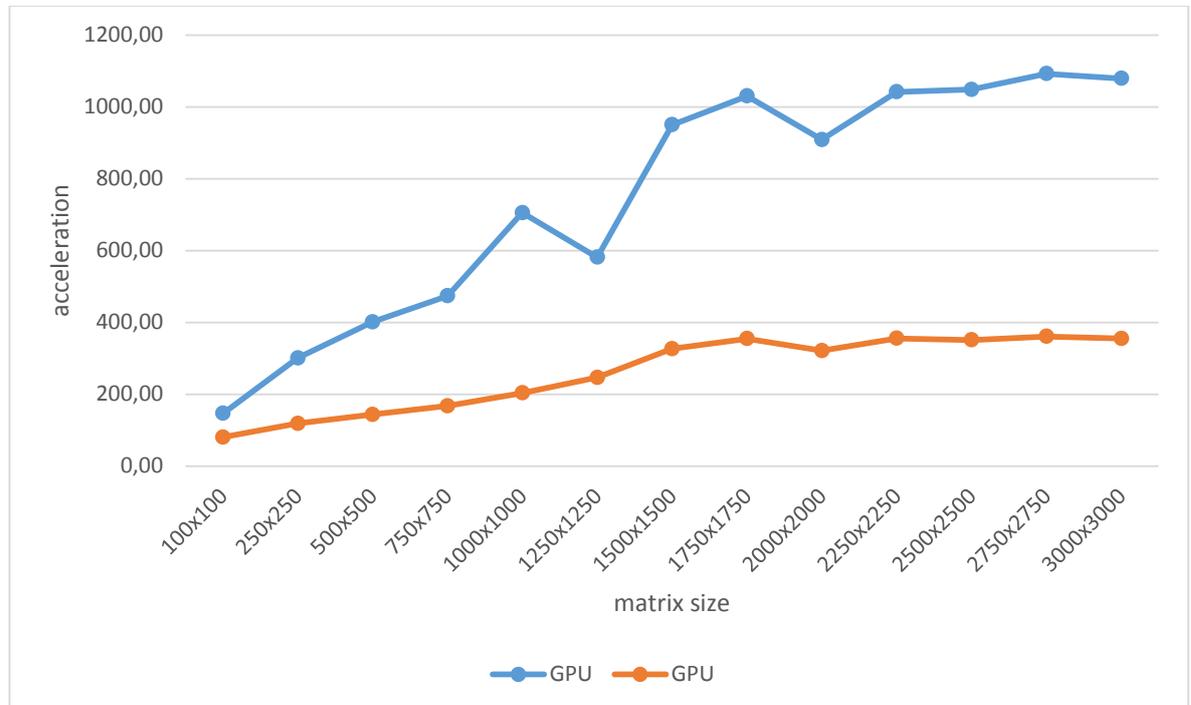


Fig. 3. Acceleration

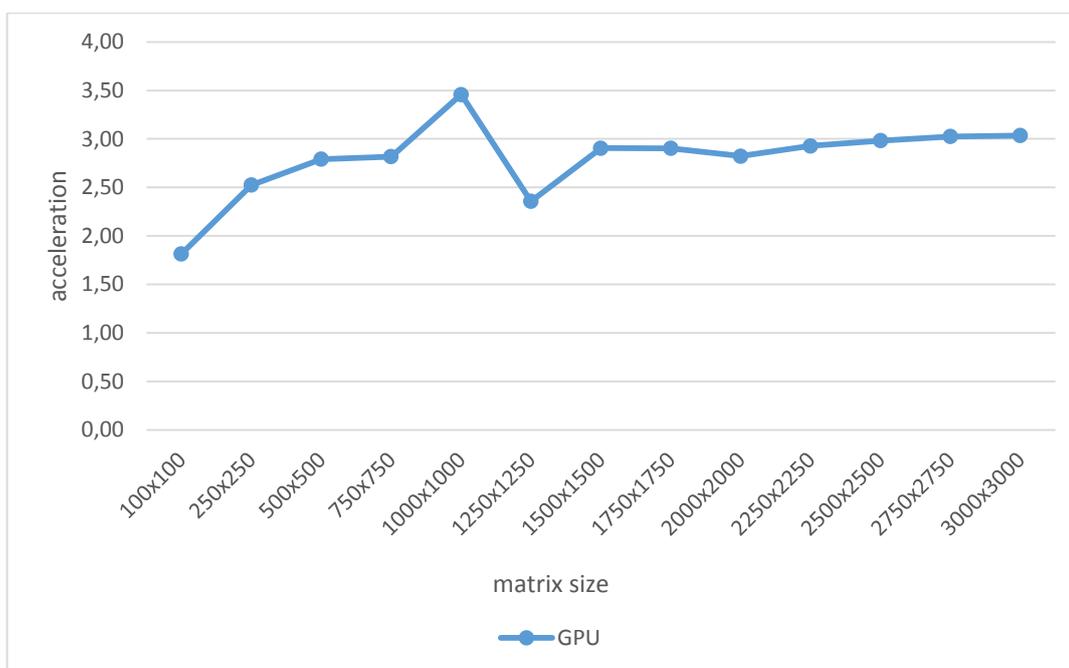


Fig. 4. Relative acceleration

Fig. 4 is focused on performance difference between shared memory and global memory implementations, CPU results are not taken into consideration.

4. Conclusion.

Research results led us to the following conclusions:

Shared memory usage makes software logic more complicated because it requires manual splitting of source data into chunks and transferring it to shared memory.

Any GPGPU implementation can give a significant performance boost in comparison to CPU implementation if task algorithm can be implemented using data parallel model. Shared memory utilization can speed up a program in 3,5 in comparison to trivial global memory implementation depending on source data amount.

Developers should take into consideration the amount of source data, if the amount is small, it might be not reasonable to utilize shared memory because the increasing complexity of code is not justified by achieved performance boost.

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Sabirov O.V., Korshunova G.F.

**HIGH PRESSURE TECHNOLOGY OF WHOLE MUSCLE MEAT
PRODUCTS**

Donetsk National University of Economics and Trade named after Mykhailo Tugan-Baranovsky,

The article is devoted to development of high pressure technology of whole muscle meat products from pork. The opportunity of manufacturing of meat products with replacement of process of cooking by processing by high hydrostatic pressure is established. Process of achievement of culinary readiness by meat is proved at processing by high hydrostatic pressure.

Key words: technology of meat products, high hydrostatic pressure, culinary readiness, quality indicators.

The problem of improving the quality of meat production with a simultaneous volumetric gain of its production can be solved by improvement existing and introduction of new productions technology. Many authors (V.Sukmanov, S.Tumenov, M.Zhaksilikova, E. Batterham, A. Carlez, P. Cheah, J. Cheftel, G. Gould, F. Jimenez-Colmenero, K. Karłowski, D. Knorr, L. Kurth, J.J. Macfarlane, T.

Shigehisa, C. Suzukis) offer application of high hydrostatic pressure (HHP) in technologies of whole muscle meat products [1,2]. HHP processing can inactivate microorganisms, attach new functional-technological and consumer properties to foodstuff. After HHP processing natural odour, colour, texture of products is conserved.

However, now pressure in meat industry is mostly used for an intensification of process of salting. The problem of its using as replacement of traditional heat treatment for whole muscle meat products (WMMP) has not lost the urgency. Therefore before experts there are problems to probe HHP processing upon degree of culinary readiness WMMP, change of their structurally-mechanical, physical and chemical, biochemical, microbiological properties.

The work purpose is the scientific substantiation and working out of high pressure technology of whole muscle meat products.

Object of research – high pressure-treated whole muscle meat products (HPMP) from pork that was made at different parameters HHP and processing time.

We define influence of pressure and time of processing for quality indicators of culinary readiness HPMP.

Products are processed by standard brine. Research of HHP influence of pressure and time of processing for quality indicators of products was made in a pressure range - 300 ... 700 MPa with distance 100 MPa, exposure time - $(5 \dots 25) \cdot 60^1$ s with intervals $5 \cdot 60^1$ s.

Necessary condition of culinary readiness achievement of meat food is inactivation of a fabric ferments. Influence of HHP and exposure time of processing for lysosome ferments activity was defined. It is positioned that activity of ferments does not depend on processing time. Ferment activity which answers culinary readiness in accordance with normative documents is reached at pressure in 200 MPa. Activity of acid phosphatase which answers control is reached at pressure in 600 MPa.

The hydroxy-proline weight fraction in products reaches values at control level (3,15mg %) after processing by pressure in 500 ... 700 MPa and exposure time $(15 \dots 25) \cdot 60^1$ s.

Ability to connect a moisture of HPMP has higher indexes, than in traditional products (71,42 %) on all set interval of pressure and processing time.

Yield of HPMP with increase in pressure from 300 to 700 MPa and exposure time from $5 \cdot 60^1$ to $25 \cdot 60^1$ s decreases from 132 % to 106 %. But on all time interval and pressure the yield has higher indexes, than thermally processed (97,73 %).

On the found dependences optimum parametres HHP and processing time ($P=625 \dots 635$ MPa; $\tau = (14,5 \dots 15,0) \cdot 60^1$ s) are found.

We develop high pressure technology of whole muscle meat products which exclude heat treatment process (fig. 1).

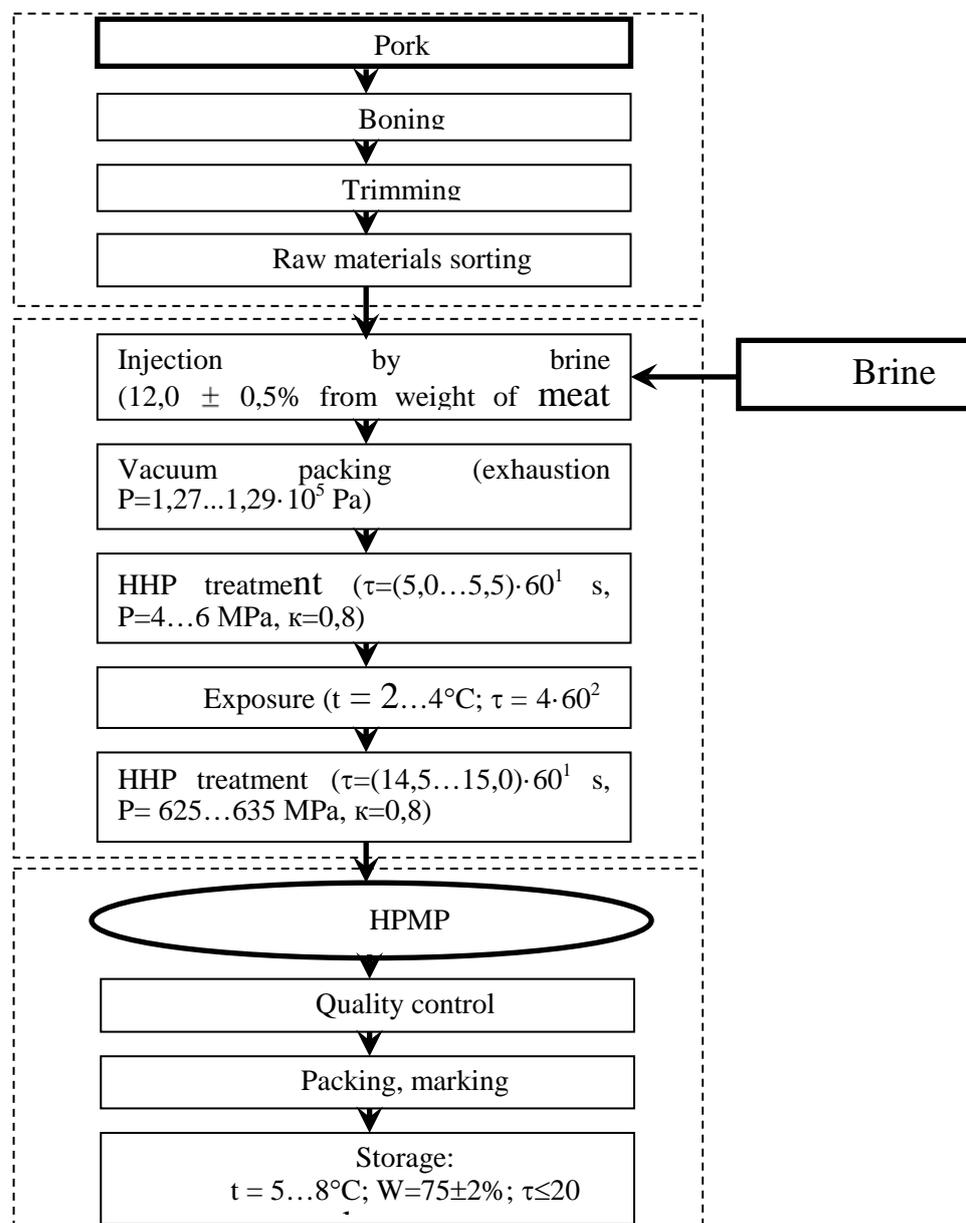


Fig. 1. Technological scheme of HPMP: A, B, C – subsystem

On the basis of received data of fabric ferments activity, microstructural changes, maintenances of hydroxy-proline, ability to connect a moisture and a yield are found regression dependence of this parametres on pressure and exposure time. It is proved their statistical reliability by Fisher's criterion.

It is defined that at processing by pressure vitamins in products are conserved better, than at traditional heat processings: B₁ - on 27 %, B₂ - on 33 % (tab. 1).

Dynamics of accumulation of free amino acids in exploratory samples smaller in comparison with the control. However developed HPMP have the best indexes on biological value (on 9,4 ... 13,8 % above than control) and factor of protein utility (on the average in 1,9 times).

Also, products are characterised by the better digestibility, than traditional products on 7,1 %.

It is positioned that storage throughout 20 days has not led to essential changes of quality indicators. Partial allocation of pickle is noted, juiciness and tenderness has worsened.

Table 1

Nutritional and biological value of finished products

Index	Control	HPMP
Protein, %	21,06±0,75	21,12±0,71
Fat, %	15,26±0,54	15,30±0,51
Carbohydrate, %	residues	residues
Ashes, %	3,52±0,07	3,64±0,06
Vitamins, %:		
B ₁	0,35±0,01	0,48±0,02
B ₂	0,06±0,01	0,09±0,01
Energy value, g kcal/100	199,55	222,18
Biological value	72,4	83,8
Factor of protein utility	0,78	0,85
Digestibility, tyrosine mkg on 1 g of protein	14,45	15,48

Throughout storage occurs increases acid and peroxide numbers (fig. 2) on 0,8 % and 0,024 % accordingly. But dynamics of accumulation of peroxides and acids more low, than in control. After a storage on peroxide number the product has an estimation «fresh, but without the further storage».

It is proved that microbiological indexes stable in the set parametres throughout the recommended shelf-life (tab. 2).

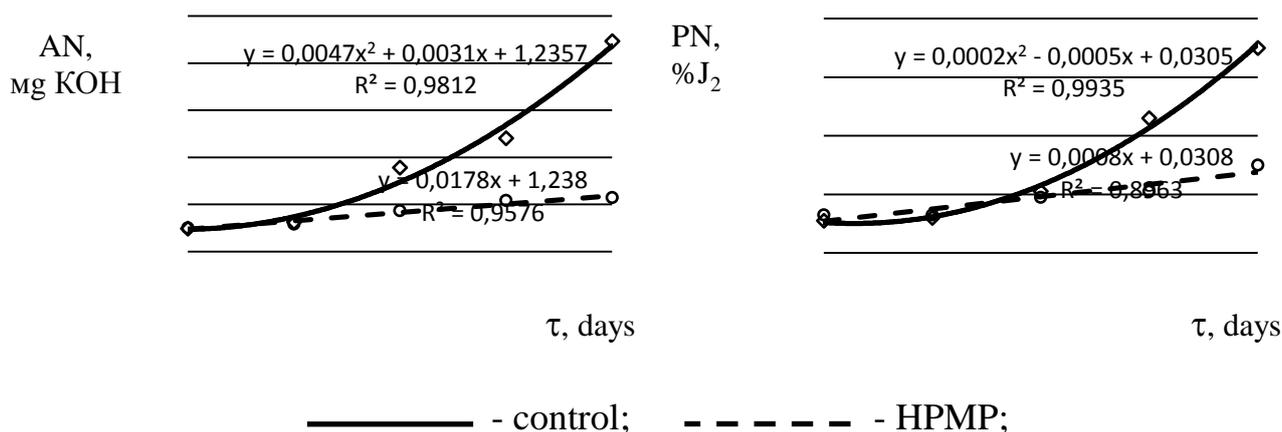


Fig. 2. Acid and peroxide number changes at storage of meat products

Table 2

Results of microbiological studies of products

Indexes	Admissible level	Shelf-life, days		
		0	10	20
QMAFAnM, CFU in 1 g	1,0x10 ⁵	(3,9...5,7) x10 ³	(5,6...7,5) x10 ³	(8,0...9,6) x10 ³
Coliformes; in 1 g	inadmissible	not revealed		
Pathogenic microorganisms, including salmonellas, in 25 g	inadmissible	not revealed		
Sulphite-reducing clostridium; in 0,01 г	inadmissible	not revealed		

Thus, we found the optimum processing conditions of high hydrostatic pressure for production the whole muscle meat products. The developed products surpass traditional meat products in quality indicators.

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Adzhieva A.F.

INFORMATION ASPECTS OF FINANCIAL SYSTEM

FGBOU VPO Stavropol State Agrarian University, Russia, Stavropol, trans.

Zootechnical, 12

In this paper, the technique that allows you to make a qualitative assessment of the level of effectiveness of the risk management of the credit institution in the field of information technology.

Key words: "information technology, financial and credit system, information security, banking services and risks."

Introduction.

Currently, use of advanced information technology is the hallmark of the financial and credit system of the world, including our country. Application of information technology on the one hand, extends the information service of the banks, on the other hand, leads to the emergence of new types of banking services and banking clients of credit institutions. However, the use of information technology is associated with changes in the structure of the main banking risks and the selection of specific risks, which puts to credit institutions the task of building a risk management system in the field of information technology. Effective risk management system in the field of information technology is designed to provide information security - the state of security interests and objectives of the credit institution in the field of information.

The rapid development of electronic technology, going from the middle of the last century, their intensive introduction to the financial sector of the economy leads to the expansion of banking services and banking clients of credit institutions' capacity for data collection, storage, processing and storage of various internal and external information used by banks in their activity. The most striking examples of the implementation of information technology in the banking sector, in particular, are the appearance and continuous improvement of electronic payment systems, the introduction of remote customer service, development of intra-data communications to significantly increase the volume and speed of the Bank's payments, extend the temporal and geographic boundaries of customer service, to increase volumes from a variety of sources to build systems of quality management accounting, to ensure rapid calculation of various financial and economic indicators in order to analyze, assess and predict risks of banking activities and decision on this basis effective management decisions. These advantages, as well as quite a tough competition in the financial sector lead to the fact that it is impossible to imagine a modern bank that does not use in its operations or that information technology (IT).

The widespread use of credit organizations of information technology causes the increase in number of banking risks, above all, operational, strategic and legal. In this case, it is possible to extract a common subject area of research that combines the changes in the levels of key risks. This area is the bank information - obviously critically important resource of any financial institution.

There are the main types of risks the credit institution arising from the use of information technologies, which determine the main directions of improving the level of core banking risks: risks of institutional, threats from external infrastructure, the integrity of information threats, threats that confidential information; threatened breach of the availability of information .

Information risk management system is an integral part of the overall risk management of the credit institution.

When checking of the credit organization of information technology it is important to define the goal pursued by the inspection team.

Specified task is intended to address risk management of the credit institution in the field of information technology - a set of interrelated or interacting elements that develop and implement a set of measures and procedures for the identification, analysis, measurement and control of the main types of IT risk, development and application of countermeasures restriction. In this case, the main purpose and performance criteria of risk management KO in IT is the information security of the credit institution.

To achieve this goal information risk management system must meet certain requirements.

Mandatory in the system of information security is a clear definition of the roles of all personnel of the credit organization, divided into the following groups: management of a credit institution, or a person authorized by the specialists unit (service) information security professionals of IT and other departments to ensure the maintenance and operation of the corporate network and ABS, and users - staff using IT services to solve their functional tasks.

We should also focus on the functions of the bank's information security services, led by the head (CISO), which could include the following: the development of the concept and policy of the IB KO, including regulations and corporate standards, guidelines, and the relevant sections of the job descriptions of staff, development of principles of classification of information and assets to assess their vulnerability to threats to information security, information risk assessment and the development of countermeasures to reduce them; training of bank practices for information security, awareness training and periodic monitoring of knowledge and skill execution policy requirements IB credit institution advising managers KO on risk management IT, coordination and approval of private information security policies and procedures among departments KO, participation in working groups or expert panels to assess the risks of the current strategic and business development bank control over the IT department with the right of verification and reconciliation of internal reports and documents together work with the service security in the areas of both units, and the interaction with the service staff of the bank for verification of

personal data for people who want to work for CO and the development and organization of a set of measures to address emergency situations or accidents in information security in a comprehensive manner; information support management's regular inquiries and analyzes the current state of information security, information on the monitoring and verification of information security policy of the credit institution, providing a bank manager, in particular, the management of IT, information support on issues of information security, including information about legal and regulatory framework in the field of information security, review gadgets, and more.

Information risk management system should provide protection from the threats posed by the use of a credit institution IT, the implementation of which can lead, in particular: to obtain unauthorized access to information resources stored on servers and workstations, corporate LAN and ABS (the threat of privacy); to the modification and destruction of information (threat to the integrity) to denial of service, or to obtain unauthorized control elements ABS (threat availability) to limit the ability of an information infrastructure does not allow to be given to the current business processes and / or Strategic Business Development CA (threat of timeliness).

Basic level of information security suggests that the model for the neutralization of the most probable set of threats must be developed and adopted countermeasures, which include: information resources, software resources, physical resources, services.

The process of identifying and selecting countermeasures in accordance with risk assessment includes the following possible approaches: reducing risks, risk aversion, the changing nature of risk (for example, through insurance asset), the assumption of risk.

Mandatory in the management of information risks are procedures for checking compliance of selected countermeasures goals and objectives to ensure information security and, where appropriate, the development of measures to optimize the level of risk.

Thus, in our opinion, the inspection team should primarily make an assessment of the risk management system of QRs in the IT field, it is assumed that: the inspector must verify that the risk management system CS IT, the inspector should evaluate the effectiveness of the organization of data management and risk management; inspector should verify the practical aspects of the implementation of the risk management process TO IT, a special role in the verification process should be given to assessing the effectiveness of monitoring the state of risk management in the IT field.

Conclusion

Effective risk management system in the field of information technology involves determining the roles of all personnel of the credit organization, including management, information security officers, specialists of information, as well as users of automated resources.

The risk management system in the field of information technology to provide protection against major security threats of the credit institution, namely the threat of violation of the confidentiality, integrity, availability and timeliness of information - a critical resource of any bank - in this case, to neutralize these threats have be developed and adopted countermeasures to all information assets and business processes of the credit institution. Mandatory risk management in information technology are the procedures verify that the selected countermeasures goals and objectives for information security and, where appropriate, the development of measures to optimize the level of risk.

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Kozub Y.G.

STRESS-DEFORMED STATE OF RUBBER-METAL VIBRATION AND SEISMIC ISOLATORS

Taras Shevchenko Luhansk National University, Luhansk, Oboronnaya 2, 91011

The different going is considered near the decision of task about the tensely-deformed state of rubber-metal vibration isolators are considered The method of the solution of a task about deformation of constructions from nearly incompressible material on application moment scheme of finite elements is offered.

Keywords: finite element method, vibration isolator, nearly incompressibility.

The considerable part of the population of the globe lives in the seismoactive territory. Therefore protection of buildings, constructions, infrastructure objects against adverse effect of pulse and vibration loadings of a geological and technogenic origin is actual. Traditional systems of seismoprotection provide seismic stability at the expense of increase of bearing ability of designs and their connections that stimulates creation of stronger, rigid and monolithic constructions. Thus construction cost in seismic countries in comparison with not seismic increases by 4-12% depending on seismodanger size.

Use of nonconventional systems of vibroseismoprotection allows to provide safety of buildings and constructions at earthquakes and technogenic influences. Thus the budget cost of construction decreases by 3-6%, a material capacity of buildings and constructions for 5-10%, and also the scope of standard designs by control of

areas with the increased seismicity extends, height of buildings increases when using the same designs.

Among nonconventional ways of vibration and seismic protection the most perspective is application of vibration and seismic isolators on the basis of rubber-metal designs. On many parameters – simplicity of production, reliability, dimensions, costs such designs surpass traditional schemes of the same appointment. They allow to find essentially new constructive solutions of responsible knots of protection of modern technical systems. The analysis of world practice of vibration and seismic protection of cars, buildings and constructions shows that systems with use of rubber-metal blocks is the most perspective. Such systems allow to protect cars and buildings at seismic influences not only in the horizontal and vertical planes, but also from torsion. Besides, application of rubber-metal layered vibration isolators allows to protect buildings and the people who were in them from influences of the subway, motor and railway transport. Besides, application of rubber-metal layered vibration isolators allows to protect buildings and the people who were in them from influences of the subway, auto and railway transport. The problem of calculation intense the deformed condition of polymeric elements of designs is rather actual [Lavendel E. E. 1976, Dymnikov S. I. 1968, Kirichevskiy V. V. 2005, Biderman V. L, Sukhova N. A. 1968, Malkov V. M 1998, Ray M. 2010, Dyrda V. I. 2010, Grigolyuk E. I., Kulikov G. M. 1988, Peng R. W. Landel R. F. 1975, Mooney M.A., 1940].

Rubber elements of vibration isolators have rather simple form. However conditions of loading are defined not only external loadings, but also a form of the metal elements of vibration isolators interfaced to them. Besides, rubber possesses weak compressibility. Calculation of parameters intense the deformed condition of such elements of designs probably various methods – experimental, empirical, approximate analytical, numerical. One of the main characteristics of a vibration and seismic isolators is rigidity on compression at vertical loading.

Let's consider the multilayered vibration isolators consisting of three metal plates of rather big thickness and two rubber blocks of a cylindrical form. For such vibration

and seismic isolators during static tests rigidity on compression was defined at the various size of loading of rubber blocks: diameter 400mm, height 120mm. As a result of simple recalculations it is possible to define dependence between an deformation of a support and the enclosed loading:

$$\Delta = \frac{P}{C_{st}}, \quad (1)$$

where Δ – seismic support contraction; P – compression loading; C_{st} – vertical rigidity of a seismic support.

On the other hand, for small deformations ($\varepsilon < 0.1$) Dyrda V.I. received analytical dependence between an contraction of a cylindrical rubber layer with free end faces and enclosed loading by the method of Ritz:

$$\Delta = \frac{P_0 h}{3\pi R^2 G} \left(1 - \frac{R}{h\sqrt{6}} th \frac{h\sqrt{6}}{R} \right), \quad (2)$$

where P_0 – compression loading on rubber layer with free end faces; h – height of a rubber layer R – radius of a rubber layer; G – module of shift of rubber.

At axial compression for small deformations ($\varepsilon < 0.1$) dependence between an contraction of a rubber layer and enclosed loading is defined by a formula;

$$\Delta = \frac{P_0 h}{3\pi R^2 G}. \quad (3)$$

At calculation of seismic support it is necessary to consider that end faces of a rubber layer is vulcanized to metal plates. Then instead of loading P_0 it is necessary to insert the corrected value of real loading P which considers increase in rigidity at the expense of fixing of end faces into formulas (2) and (3):

$$P_0 = \frac{P}{\beta}, \quad (4)$$

where $\beta = 1 + 0.413\rho^2$ [Payne A. R., 1959] or $\beta = 0.92 + 0.5\rho^2$ [Lavendel E. E., 1976].

V. I. Dyrda suggested to calculate coefficient β on a formula:

$$\beta = 1 + 0.83\rho^2, \quad (5)$$

where $\rho = \frac{R}{h}$; β – coefficient of increase in rigidity at the expense of fixing of end faces.

Universal numerical method of calculation of rubber vibration and seismic isolators which allows to consider asymmetry of loadings and fixing, and also to receive a full picture intense the deformed condition is finite element method. Thus the traditional final element method doesn't allow take account for a weak compressibility of rubber. For constructions from elastomers the moment scheme of finite elements with use of threefold approximation a component of a vector of movement, a tensor of deformations and function of change of volume of rubber is used. Approximating functions are accepted in the form of square polynomials:

$$u_i = \omega_i^{(000)} + \omega_i^{(100)}\psi^{(100)} + \omega_i^{(010)}\psi^{(010)} + \omega_i^{(001)}\psi^{(001)} + \omega_i^{(110)}\psi^{(110)} + \omega_i^{(101)}\psi^{(101)} + \omega_i^{(011)}\psi^{(011)} + \omega_i^{(111)}\psi^{(111)} + \omega_i^{(200)}\psi^{(200)} + \omega_i^{(020)}\psi^{(020)} + \omega_i^{(002)}\psi^{(002)} + \omega_i^{(210)}\psi^{(210)} + \omega_i^{(201)}\psi^{(201)} + \omega_i^{(120)}\psi^{(120)} + \omega_i^{(021)}\psi^{(021)} + \omega_i^{(102)}\psi^{(102)} + \omega_i^{(012)}\psi^{(012)} + \omega_i^{(211)}\psi^{(211)} + \omega_i^{(121)}\psi^{(121)} + \omega_i^{(112)}\psi^{(112)},$$

$$\varepsilon_{11} = e_{11}^{(000)} + e_{11}^{(001)}\psi^{(001)} + e_{11}^{(010)}\psi^{(010)} + e_{11}^{(011)}\psi^{(011)} + e_{11}^{(100)}\psi^{(100)} + e_{11}^{(110)}\psi^{(110)} + e_{11}^{(101)}\psi^{(101)} + e_{11}^{(020)}\psi^{(020)} + e_{11}^{(102)}\psi^{(102)} + e_{11}^{(111)}\psi^{(111)} + e_{11}^{(021)}\psi^{(021)} + e_{11}^{(012)}\psi^{(012)},$$

$$\varepsilon_{22} = e_{22}^{(000)} + e_{22}^{(001)}\psi^{(001)} + e_{22}^{(010)}\psi^{(010)} + e_{22}^{(101)}\psi^{(101)} + e_{22}^{(001)}\psi^{(001)} + e_{22}^{(110)}\psi^{(110)} + e_{22}^{(011)}\psi^{(011)} + e_{22}^{(002)}\psi^{(002)} + e_{22}^{(102)}\psi^{(102)} + e_{22}^{(111)}\psi^{(111)} + e_{22}^{(201)}\psi^{(201)} + e_{22}^{(012)}\psi^{(012)},$$

$$\varepsilon_{33} = e_{33}^{(000)} + e_{33}^{(100)}\psi^{(100)} + e_{33}^{(010)}\psi^{(010)} + e_{33}^{(110)}\psi^{(110)} + e_{33}^{(001)}\psi^{(001)} + e_{33}^{(200)}\psi^{(200)} + e_{33}^{(020)}\psi^{(020)} + e_{33}^{(101)}\psi^{(101)} + e_{33}^{(011)}\psi^{(011)} + e_{33}^{(210)}\psi^{(210)} + e_{33}^{(120)}\psi^{(120)} + e_{33}^{(111)}\psi^{(111)},$$

$$\varepsilon_{12} = e_{12}^{(000)} + e_{12}^{(001)}\psi^{(001)} + e_{12}^{(100)}\psi^{(100)} + e_{12}^{(110)}\psi^{(110)} + e_{12}^{(100)}\psi^{(100)} + e_{12}^{(101)}\psi^{(101)} + e_{12}^{(011)}\psi^{(011)} + e_{12}^{(002)}\psi^{(002)},$$

$$\varepsilon_{13} = e_{13}^{(000)} + e_{13}^{(100)}\psi^{(100)} + e_{13}^{(010)}\psi^{(010)} + e_{13}^{(001)}\psi^{(001)} + e_{13}^{(110)}\psi^{(110)} + e_{13}^{(020)}\psi^{(020)} + e_{13}^{(011)}\psi^{(011)} + e_{11}^{(020)}\psi^{(020)},$$

$$\varepsilon_{23} = e_{23}^{(000)} + e_{23}^{(100)}\psi^{(100)} + e_{23}^{(010)}\psi^{(010)} + e_{23}^{(001)}\psi^{(001)} + e_{23}^{(001)}\psi^{(001)} + e_{11}^{(200)}\psi^{(200)} + e_{11}^{(110)}\psi^{(110)} + e_{11}^{(101)}\psi^{(101)},$$

$$\theta = \xi^{(000)} + \xi^{(100)}\psi^{(100)} + \xi^{(010)}\psi^{(010)} + \xi^{(001)}\psi^{(001)} + \xi^{(101)}\psi^{(101)} + \xi^{(110)}\psi^{(110)} + \xi^{(011)}\psi^{(011)} + \xi^{(111)}\psi^{(111)}, \quad (6)$$

where u_i - components of a vector of movements; ε_{ij} – components of a tensor of deformations; θ - function of change of volume; $\omega_i^{(pqr)}$ – decomposition components; $\psi^{(pqr)}$ – a set of sedate coordinate functions of a look

$$\psi^{(pqr)} = \frac{(x^1)^p}{p!} \cdot \frac{(x^2)^q}{q!} \cdot \frac{(x^3)^r}{r!}, \quad (p, q, r = 0, 1, 2). \quad (7)$$

Let's find to a contraction for a two-layer seismic support under the influence of loading $P = 50\text{kN}$, (the module of shift of rubber $G = 0.63\text{MPa}$). Dyrda V. I. Lisitsa N.I., etc. received the solution of a nonlinear task a precipitation of the continuous cylinder taking into account toughening at end faces by means of the accuracy Runge-Kutt method of the fourth order. he received value a seismic insulator precipitation ($\Delta = 0.0127\text{m}$) rather well coincides with experimental data.

The analysis of behavior of vibration and seismic isolator at imposition of cyclic or impulsive loading requires the account of viscoelastic properties of rubber elements. A viscoelasticity determines it dumping properties. For description of viscoelasticity deformation it is possible to take advantage of Volterra's equalizations

$$\sigma = E_0 \left[\varepsilon - \int_0^t R(t-\tau)\varepsilon(\tau)d\tau \right]. \quad (8)$$

where $R(t-\tau)$ – kernel of relaxation.

In addition, for description of behavior of nearly incompressible material different nonlinear laws are used. For example, Peng-Landel's law [Peng R. W., Landel R. F., 1975.]

$$\sigma^{ij} = I_3^{1/2} \left[\mu \left(\left(-I_3^{-1/3} + \frac{2}{9}(2I_1 - 3)(I_3 - 1) \right) G^{ij} + I_3^{-4/3} g^{ij} \right) + \frac{B}{2}(I_3 - 1)G^{ij} \right], \quad (9)$$

where I_1, I_3 are invariants of tensor of deformations; μ, B are constant of material, G^{ij} is a metrical tensor.

We replace resilient permanent is the module of compression B and module of shear μ we get the Volterra's operators

$$\begin{aligned} \sigma^{ij} = I_3^{1/2} & \left[\mu \left(\left(-I_3^{-1/3} + \frac{2}{9}(2I_1 - 3)(I_3 - 1) \right) G^{ij} + I_3^{-4/3} g^{ij} \right) + \frac{B}{2}(I_3 - 1)G^{ij} - \right. \\ & - \mu \int_{-\infty}^t R_\mu(t - \tau) \left(-I_3^{-1/3} + \frac{2}{9}(2I_1 - 3)(I_3 - 1) \right) G^{ij} d\tau - \\ & \left. - \mu \int_{-\infty}^t R_\mu(t - \tau) I_3^{-4/3} g^{ij} G^{ij} d\tau - \frac{B}{2} \int_{-\infty}^t R_b(t - \tau)(I_3 - 1)G^{ij} d\tau \right]. \end{aligned} \quad (10)$$

The tensor of deformations can be presented as a sum linear and nonlinear constituents

$$\begin{aligned} \varepsilon_{ij} &= \varepsilon_{ij}^l + \varepsilon_{ij}^n, \\ \varepsilon_{ij}^l &= \frac{1}{2} (c_j^k u_{k,i} + c_i^k u_{k,j}), \quad \varepsilon_{ij}^n = \frac{1}{2} u_{k,i} u_{k,j}. \end{aligned} \quad (11)$$

Then the invariants of Cauchy- Green's tensor of deformations also can be presented as a sum linear and nonlinear parts:

$$\begin{aligned} I_1 &= I_1^l + I_1^n, \\ I_1^l &= \varepsilon_{11}^l + \varepsilon_{22}^l + \varepsilon_{33}^l, \\ I_1^n &= \varepsilon_{11}^n + \varepsilon_{22}^n + \varepsilon_{33}^n. \end{aligned} \quad (12)$$

We put (12) in (10) and we lay out I_3 in the Taylor series about with $I_3 = 1$ as the center of the circle of convergence. Then we cast aside by virtue of weak compressibility of material members of decomposition the second order of trifle and we get the linearized correlation. For the decision of task of nonlinear deformation of constructions different methods are used [Dymnikov S.I., 1968, Lavendel E.E., 1980, Kirichevskiy V.V., 2005]. Most effective among them is the modified Newton-Kantorovich method. At the use of this going near the decision of task on every step on loading get the specified linearized equalization

$$Ku^{i+1} = -N(u^i) - P_k, \quad (13)$$

where K is matrix of inflexibility of construction; $N(u^i)$ is a vector of the nonlinear additions, conditioned by physical and geometrical non-linearity; P_k is vector of key forces; u is a vector of the key moving. On the basis of this approach the task of determination is decided seismic support.

The problem is also solved on the basis of the moment scheme of finite elements on the basis of the obtaining complex «MIRELA+». In fig. 1-2 are presented finite element model and distribution of movements and tension in the radial section of a rubber element

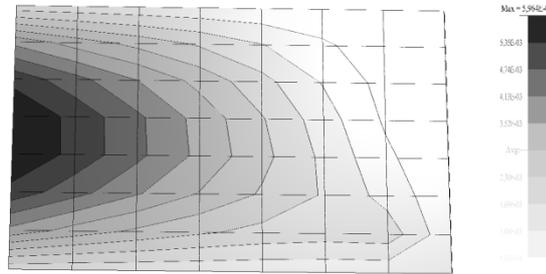


Fig. 1. Radial movement.

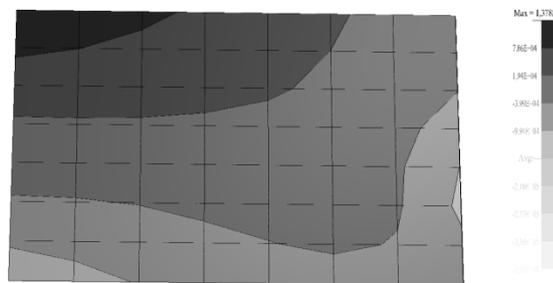


Fig. 2. Stress σ_{12} .

As comparison we will give a calculation example a precipitation of a rubber layer of a seismic support on formulas (2) and (3). Results of calculations are given in table 1.

Table 1.

Seismic support contraction

Indicator	Experiment	Formula		FEM
		(2)	(3)	
Δ, m	0.012	0.008 4	0.0128	0.0122

Conclusion. The method of calculation of vibration and seismic isolators is developed. The analysis of the received results shows that use of a finite element

method allows to receive a complete picture of distribution of tension and movements on the volume of an element of a design taking into account weak compressibility of a material.

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Mironova A.S., Shumkova A.A, Tolmachova Y.S..

**USE OF ALGORITHM OF FORMATION OF SESSION KEYS OF
NEEDHAM-SCHROEDER IN SYSTEM OF DIGITAL SIGNATURES ON
THE BASIS OF THE TASK OF THE DISCRETE LOGARITHMING**

Nakhimov's Navy Academy of Ukraine, Sevastopol

This article deals with the questions of improving the cryptostrength of systems based on electronic digital signature (EDS) discrete logarithm problem examining the use of construction algorithm session key Needham-Schroeder.

Keywords: electronic digital signature, discrete logarithm problem, the Needham-Schroeder algorithm, session key.

Introduction. The importance and relevance of information security has long been one of the first places among the problems solved in the design, development and use of modern information systems. The reasons for this increased attention to

this problem is quite obvious - the quality of the protection measures depends on information security.

In the exchange of electronic documents through network significantly reduces the cost of processing and storing documents, speeding up the search. There is a problem authenticating the document author and the document itself, authentication of the author and the lack of change in the output document. In the normal (paper) record keeping these problems are solved by the fact that the information in the document and handwritten signature of the author strictly related to the physical media (paper). The electronic documents on storage media such connection existed. In today's electronic document authentication widely used digital signature.

The electronic digital signature provides check of integrity of documents, establishment of the person who has sent the document that allows to improve procedure of preparation, delivery, the account and document storage, to guarantee their reliability. The sign-code signature represents rather small amount of the additional digital information transferred together with the signed text. In procedure of generation of EDS the secret key of the message sender, and in procedure of verification of the signature - public key of the sender is used.

As weak systems EDS we shall understand those from them which suppose a fake of the signature. The last means formation of the signature to some set message without knowledge of a confidential key.

Many systems of EDS considered as resistant, allow possibility of formation without knowledge of secret key of accidental values h and (r, S) which satisfy to the equation of verification of the signature. Let's review an example: let the equation of the signature look like: $r = y^k a^{rS} \pmod{p}$. Let's carry out a fake of the signature without knowledge of a confidential key. There is some document, value of hash-function from which is equal h . Further we operate on following algorithm [2]:

1. Select some value z .
2. Calculate $r = a^S y^h \pmod{p}$.
3. If $\text{GCD}(r, p-1) > 1$, else repeat steps 1 and 2 until you execute the condition $\text{GCD}(r, p-1) = 1$.

4. Calculate $S = z / r \bmod (p - 1)$, receive $z = Sr \bmod (p - 1)$.

5. Place the in the signature of a hash function h is a pair of numbers (r, S) .

In order to avoid attacks on the r option of the electronic digital signature, the authors suggest a random value (k) when calculating the r option to use session keys generated using Nidhema-Schroeder.

The main material of the study. Discrete logarithms are group-theoretic analogues of ordinary logarithms. In particular, an ordinary logarithm $\log_a(b)$ is a solution of the equation $a^x = b$ over the real or complex numbers. Similarly, if g and h are elements of a finite cyclic group G then a solution x of the equation $g^x = h$ is called a discrete logarithm to the base g of h in the group G .

Cryptostrength EDS on the basis of the task of the discrete logarithming is based on high computing complexity of reversal of an exponential function [1].

Let the greatest common divisor (GCD) of numbers of a and n is equal to unit. Smallest of numbers γ for which comparing is executed $a^\gamma \equiv 1 \bmod n$, is called as an index to which the number of a belongs on the module n . The numbers belonging to an index $\varphi(n)$ where $\varphi(n)$ – Euler's function, are called as primitive roots on the n module [1].

Selected a large prime p and the corresponding primitive root $a < p$. To ensure the stability of the system by the number of EDS p imposes the following conditions: the decomposition of $p-1$ factoring must contain at least one large prime factor, the size of p must be at least 1024 bits. Each subscriber chooses his secret key x and computes the corresponding public key y by the formula $y = a^x \bmod p$. For each session, the procedure Needham-Schroeder [3], user A and B compute the session key value in the following way: if for some time subscribers A and B have agreed to m -communications, and A and B are m -generated session key sequentially hash the m -times common to them arbitrary information (M) $h1 = H(M)$, $h2 = H(h1)$, ..., $hm-1 = H(hm-2)$, $hm = H(hm-1)$, and as session keys for messaging will apply the computed values in reverse order. In a digital signature schemes based on discrete logarithm problem, as the authors propose to use the randomizer k current

session key calculated by the algorithm Needham-Schroeder, to allow additional authentication of subscribers A and B.

In Java implemented the following signature algorithms based on the discrete logarithm problem with the session key Needham-Schroeder, presented equations authentication EDS and EDS form equations [2]:

$$a^h = y^S r^r \bmod p, \text{ и } S = \frac{(h - kr)}{x} \bmod (p - 1) \quad (1)$$

$$a^h = y^r r^S \bmod p, \text{ и } S = \frac{(h - xr)}{k} \bmod (p - 1) \quad (2)$$

$$a^S = y^r r^h \bmod p, \text{ и } S = xr + kh \bmod (p - 1), \quad (3)$$

$$a^r = y^h r^S \bmod p, \text{ и } S = \frac{(r - xh)}{k} \bmod (p - 1), \quad (4)$$

$$a^r = y^S r^h \bmod p, \text{ и } S = \frac{(r - kh)}{x} \bmod (p - 1). \quad (5)$$

An example of implementation of the scheme № 1 in Java using as randomizer k session key generated by the Needham-Schroeder algorithm is presented below.

The programming environment of IDE NetBeans 7.1 represents the modular integrated development environment (IDE) written in the Java programming language. The environment NetBeans 7.1 allows to execute integer operations with big digit capacity. In case of implementation of algorithms of EDS used the class BigInteger which is stored in Java.math library and the methods of this class given below:

add(x) – the operation this "+" x;

mod(x) – a remainder of division of object of this on argument of a method x;

modInverse(x) – a remainder of division of number, reverse to object of this, on argument x;

modPow (n, m) – a remainder of division of object of this erected in a level of n, on m;

multiply(x) – the operation this "*" x;

subtract(x) – the operation this "-" x.

The algorithms of EDS implemented in the Java language on the basis of the task of the discrete logarithming passed test for correctness of results of creation and check of EDS and can be used for information security from unauthorized access. In implementation process in the Java language of algorithms of EDS on the basis of the task of the discrete logarithming with use of formation of session keys of Nidkhema-Schroder, received the following results EDS equation (1).

At a preparatory stage we generate a large prime number of p in size of 1024 bits after that the subscriber A selects secret key x , any number $1 < x < p-1$:

$x=24005374998643679835238974703722256226019076038499169769662989$
05791513713835366147386957317053853232760040384395890084131885191212
83088674119150560058447452786495182393230312742162004635657067325521
41447586999086459200588203682955054908688229735901893426099235648436
9784872932901509954849922748961514012930103.

Then we calculate public key of y on a formula $y = a^x \text{ mod } p$:

$y=87460337512132546400137787506384914295697326949174692362290611$
67603739059861188957812829401294671781650108267149301018755739178762
87958840939031495976095759582062839173314488961550309433632720415605
32601935366522494171190274091703345348160861811388906715517796600309
4078539462106838370484889129266395040987902

We select the next session key created on algorithm of Nidkhema-Schroder

$k=44935448813565677364042021872156867202486359$

Then we select a random number of $a < p$, and we calculate the EDS r parameter on a formula $r = a^k \text{ mod } p$:

$r=14246914838159199033936884700458254547611235402677463702845360$
58288406369283292259806585909274824012333044082811177685636392917139
42143999313613572264248874422860254978210379827288583799116166162703
78809097511810357406554261075478809103516208510347251700148579902522
1407613491234111257539200935957568903160301

The initial message of M (message) is hashed, is exposed processings by means of hashing function. We receive hash value a document:

$h=7152392942269110646151437128549323330051380$.

Then on a formula $s = \frac{(h - kr)}{x} \bmod (p - 1)$ directly we calculate parameter s, couple of numbers (r,s) will be a digital signature of this document.

$s=83277358301111586364773804978331491104869525913984880188065343$
08820523685455547605209049366652051920615634414580596910919125616887
25515515883076645509501596441443499286349187968928729484213344483018
98027131067040666725195521987571118959030180272973429296329241261240
2705839309817933994116831111519916859338755.

For EDS check the software calculates separately the left and right parts of the following equation

$$a^h = y^s r^r \bmod p,$$

and also checks parameter value r on a formula $r = a^k \bmod p$, using next session key k generated on Nidkhema-Schroder algorithm.

Right_member_of_equation_of_check=56555605467617264346890946412298
66336607650800172237113323998756257001887262879402398176289466344019
09822226690907410712917977404564531749527224689851706016446459492835
55317861123244435362040179113468898000824263330443100072964430946546
13286608574660995638309985824570202896370097567578580030220173823686
18349.

Left_member_of_equation_of_check=565556054676172643468909464122986
63366076508001722371133239987562570018872628794023981762894663440190
98222266909074107129179774045645317495272246898517060164464594928355
53178611232444353620401791134688980008242633304431000729644309465461
32866085746609956383099858245702028963700975675785800302201738236861
8349.

The right member of equation of verification of the signature is equal to the left member of equation of verification of the signature - according to EDS authentic. As additional verification of the signature of the subscriber A the subscriber B calculates

r parameter value on a formula $r = a^k \bmod p$, using as k the current value of a session key of Nidkhema-Schroder calculated on algorithm.

Outputs. Use of the session keys created on Nidkhema-Schroder algorithm, as values of the randomizer k allows to increase cryptostrength of considered diagrams EDS at the expense of additional check of parameter r which is part of EDS. Without knowledge of the session key created on Nidkhema-Schroder algorithm, the malefactor won't be able correctly to calculate a parameter value r and s of electronic sign-code signature.

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Kurzheevskiy I.V., Tolmachova Y.S., Shumkova A.A.

**THE USE OF ADDITIONAL PARAMETERS TO INCREASE THE
CRYPTOSTRENGTH OF THE ELECTRONIC DIGITAL SIGNATURE ON
THE BASIS OF THE PROBLEM OF DISCRETE TAKING THE
LOGARITHM**

Nakhimov's Navy Academy of Ukraine, Sevastopol

This article deals with the questions of improving the cryptostrength of algorithms of electronic digital signature (EDS) based on the problem of discrete finding the logarithm. To improve the cryptostrength of schemes based on EDS problem of discrete finding the logarithm the authors propose the use of additional parameters: a session key k , formed on the basis of the Needham-Schroeder

algorithm and parameter H' , which is the hash value of the users shared secret key K , calculated on the Diffie-Hellman algorithm and EDS parameters r and S .

Keywords: electronic digital signature, discrete logarithm problem, the Needham-Schroeder algorithm, Diffie-Hellman algorithm.

Introduction. The development of modern information technologies and the widespread introduction of computers into all areas of society makes the problem of information security urgent. Currently, most organizations have moved to electronic documents. To ensure the integrity of electronic documents and give them legal significance electronic digital signature is widely used.

The electronic digital signature can be used by the recipient of a message to verify that the message has not been altered during transit as well as ascertain the originator's identity. A digital signature is an electronic version of a written signature in that the digital signature can be used in proving to the recipient or a third party that the message was, in fact, signed by the originator. Digital signatures may also be generated for stored data and programs so that the integrity of the data and programs may be verified at any later time.

Cryptostrength of the majority of EDS systems is based on absence of effective algorithms for solving within a reasonable time the following two tasks:

- number decomposition on prime factors (factorization);
- solution of the task of the discrete logarithm.

The EDS algorithm of ElGamal with the composite unit is based on complexity of solving the factorization task. Factorization of a natural number is its expansion in product of prime factors. Multiplication of two big prime numbers is not challenging task, thus the reverse task – expansion on multiplicands – extremely labor-consuming.

Discrete logarithms are group-theoretic analogues of ordinary logarithms. In particular, an ordinary logarithm $\log_a(b)$ is a solution of the equation $a^x = b$ over the real or complex numbers. Similarly, if g and h are elements of a finite cyclic group G then a solution x of the equation $g^x = h$ is called a discrete logarithm to the base g of h in the group G .

Cryptostrength EDS on the basis of the task of the discrete logarithming is based on high computing complexity of reversal of an exponential function [1].

Let the greatest common divisor (GCD) of numbers of a and n is equal to unit. Smallest of numbers γ for which comparing is executed $a^\gamma \equiv 1 \pmod{n}$, is called as an index to which the number of a belongs on the module n . The numbers belonging to an index $\varphi(n)$ where $\varphi(n)$ – Euler's function, are called as primitive roots on the n module [1].

Let's consider some attacks on EDS, based on algorithms discrete logarithm. As weak systems EDS we shall understand those from them which suppose a fake of the signature. The last means formation of the signature to some set message without knowledge of a confidential key.

Many systems of EDS considered as resistant, allow possibility of formation without knowledge of secret key of accidental values h and (r, S) which satisfy to the equation of verification of the signature. Let's review an example: let the equation of the signature look like: $r = y^k a^{rS} \pmod{p}$. Let's carry out a fake of the signature without knowledge of a confidential key. There is some document, value of hash-function from which is equal h . Further we operate on following algorithm [2]:

1. Select some value z .
2. Calculate $r = a^S y^h \pmod{p}$.
3. If $\text{GCD}(r, p-1) > 1$, else repeat steps 1 and 2 until you execute the condition $\text{GCD}(r, p-1) = 1$.
4. Calculate $S = z / r \pmod{p-1}$, receive $z = Sr \pmod{p-1}$.
5. Place the in the signature of a hash function h is a pair of numbers (r, S) .

In order to avoid attacks on the r option of the electronic digital signature, the authors suggest a random value (k) when calculating the r option to use session keys generated using Nidhema-Schroeder.

Application of EDS schemes, such as the El Gamal, a composite module instead of simply due to the fact that a large number of such schemes does not provide resistance to attacks based on signature is calculated by matching the parameter as:

$$r = \alpha^t y^u \text{ mod } p \quad (1)$$

When creating a EDS option must be a one-off, as when generating the signatures and to two different messages are prerequisites for calculations, and a secret key. If there are two signatures have the following system of two equations with unknown and that the attacker can solve

$$h(m) = xr \text{ mod } \varphi(n) \quad (2)$$

$$h(m) = xS \text{ mod } \varphi(n) . \quad (3)$$

Parameter r specifies the signature generation unknown in an equation that varies with each signature generation process. This prevents attacks attempt to compute the secret key of a signature equation [2].

Always leak the secret key elements, so if a and b are subscribers to the long business communication using EDS, cryptographic techniques are needed.

Statement of the problem. To improve cryptographic schemes based on EDS challenges the discrete logarithm problem in this paper, the authors offer as additional parameters, use the randomizator k , generated using Nidhema-Schröder [3] and a parameter that represents the hash value from the shared, secret key that is generated by users of the Diffie-Hellman algorithm [4] and EDS and settings.

The main material of the study. Wide application received EDS scheme ElGamal with a simple module p , which, in the opinion of many experts, not in some cases provide the reliability required. Therefore, it is advisable to use a digital signature scheme ElGamal with a composite modulus [2].

A number of possible arrangements for implementing digital signatures with a composite module odnarazovym session key k and an additional parameter H' is shown in table 1.

Where n - a composite module, which is a product of large prime numbers p and q ; H - the hash of the document; x - the private key; y - public key; G - generated a large prime size of 160-256 bits, which is a subgroup of large prime numbers p and q ; s - the smallest number such that $gs \equiv 1 \pmod{n}$; the parameter signature r is given by: $r = \alpha^t y^u \text{ mod } p$ [2]; K - a shared secret key generated by Diffie-Hellman; H' - hash concatenation of numbers, H , and K ; a set of numbers S is the signature of the document. A detailed discussion of the

algorithm signature generation and verification on the example of figure 1, presented in table 1.

Table 1

EDS options with a composite unit and an additional parameter H' .

№	Check equation signature	The equation of signature	Signature
1	$r^H = y^r \alpha^S \text{ mod } n$ $H_1 = h(r, S, K)$	$kH = xr + S \text{ mod } q'$ $H' = h(r, S, K)$	(r, S, H')
2	$\alpha^H = y^r r^S \text{ mod } n$ $H_1 = h(r, S, K)$	$H = xr + kS \text{ mod } q'$ $H' = h(r, S, K)$	(r, S, H')
3	$r^H = y^{rS} \text{ mod } n$ $H_1 = h(r, S, K)$	$kH = xrS \text{ mod } q'$ $H' = h(r, S, K)$	(r, S, H')
4	$r^H = y^{r+S^2} \text{ mod } n$ $H_1 = h(r, S, K)$	$kH = xr + S^2 \text{ mod } q'$ $H' = h(r, S, K)$	(r, S, H')
5	$r^S = \alpha^{r+H} \text{ mod } n$ $H_1 = h(r, S, K)$	$kS = r + H \text{ mod } q'$ $H' = h(r, S, K)$	(r, S, H')

The owner of the private key selects two large prime numbers p and q multiplies them to obtain the module:

$$n = pq \tag{4}$$

Values of prime factors p and q are kept secret or destroyed after computing the Euler function:

$$\varphi(n) = (p - q)(q - 1) . \tag{5}$$

User A selects as the private key x belonging to the set $x \in \{1, \dots, q' - 1\}$. To ensure the impossibility of calculating the private key x on the basis of the known signature public key y is used:

$$y = \alpha^x \text{ mod } n . \tag{6}$$

Open information of the subscriber A are numbers (y, n, α) .

Length of number α can be chosen rather small (less than a size of used values p and q), such that:

$$\alpha^{q'} \text{ mod } n = 1 \tag{7}$$

For a potential intruder to generate the signature equation has two unknown sizes: x and k . Therefore, he has no opportunity is likely to compute a secret key x . As a random value k in the calculation of the parameter r use the values of session keys generated by the algorithm Needham-Schroeder.

For each session, the procedure Needham-Schroeder [3], user A and B compute the session key value as follows. Suppose that for some time subscribers A and B have agreed to m -communications, and A and B are m -generated session keys sequentially hash the m -times common to them arbitrary information (M) $h_1 = H(M)$, $h_2 = H(h_1)$, ..., $h_{m-1} = H(h_{m-2})$, $h_m = H(h_{m-1})$ as well as session keys for messaging will apply the computed values in reverse order. In a digital signature schemes based on the factorization problem, as the authors propose to use the randomizer k current session key calculated by the algorithm Needham-Schroeder, to allow additional authentication of subscribers A and B.

From Scheme 1 by the equation of signature subscriber A is calculated parameter r :

$$r = \alpha^k \bmod n. \quad (8)$$

To improve the cryptostrength of digital signature scheme with a composite module can also be applied the algorithm Diffie-Hellman.

A shared secret key K for subscribers A and B is formed as follows. Subscribers know some two numbers g and p' that are not confidential and may be known to other interested parties (p' - a random prime number, g - a primitive root modul p'). In order to create, unknown to anyone over the secret key, both parties generate large random numbers: user A - the number a , the subscriber B - number b . Then a subscriber A calculates:

$$A' = g^a \bmod p' \quad (9)$$

and sends it to the subscriber B, which calculates:

$$B' = g^b \bmod p' \quad (10)$$

and transfers the subscriber A. In the second stage the first person on the basis of available a and received on the network B' calculates:

$$B'^a \bmod p' = g^{ab} \bmod p', \quad (11)$$

and the other person on the basis of available numbers b and A' calculates:

$$A'^b \bmod p' = g^{ab} \bmod p'. \quad (12)$$

Thus, subscribers A and B forms the shared secret key K as follows:

$$K = g^{ab} \bmod p'. \quad (13)$$

The attacker will meet almost impossible (for a reasonable time), the problem of computing (11) or (12) in the intercepted $g^a \bmod p'$ and $g^b \bmod p'$, if the numbers p' , a and b selected large enough [4]. In practical implementations for a and b are used numbers about 10^{100} and p' about 10^{300} .

From scheme 1 by the equation of signature (see table 1) is calculated S :

$$kH = xr + S \bmod q' \quad (14)$$

To everyone's secret key K added values of EDS and a set of numbers r and S and it is hashed. The resulting hash H' is optional digital signature, the use of which, according to the authors, enhances the cryptostrength signature scheme ElGamal with a composite module. Signing the electronic document in this case is a set of values (r, S, H') .

Procedure to check the authenticity of the document signed with a digital signature with a composite unit and an additional parameter H' , as follows. The recipient has passed an electronic document with a digital signature (r, S, H') . User B knows the value of a public key y , number α and the composite module n , as well as the generated shared secret K .

EDS verification equation, the scheme 1 (see Table 1) is as follows:

$$r^H = y^r \alpha^S \bmod n \quad (15)$$

Calculated separately the left lch and right pch side of the equation:

$$lch = r^H, \quad (16)$$

$$pch = y^r \alpha^S \bmod n. \quad (17)$$

Recipient of an electronic document shall concatenation formed previously shared secret key K and the parameters r and S :

$$M = K \| r \| S \quad (18)$$

and computes a hash H_1 :

$$H_1 = h(M). \quad (19)$$

If both sides of the equation are equal and $H' = H_1$ validation (user B can be sure that the subscriber A knows the shared secret key K), then the digital signature corresponds to the document, and it can be considered authentic. If the results differ, the signature forged. As an additional check signatures subscriber A subscriber B in a calculated value r of the formula $r = a^k \bmod p$, using as k current session key calculated by the algorithm Needham-Schroeder.

Consider also the signature algorithms based on the discrete logarithm problem modulo p and using one-time session key k , generated by an algorithm Needham-Schroeder and additional parameter H' . Selected a large prime p and the corresponding primitive root $a < p$. To ensure the stability of the system by the number of EDS p imposes the following conditions: the decomposition of $p-1$ factoring must contain at least one large prime factor, the size of p must be at least 1024 bits. Each subscriber chooses his secret key x and computes the corresponding public key y by the formula $y = a^x \bmod p$. According to the algorithm Needham-Schroeder [3], the earlier, for each communication session subscribers A and calculate the value of the session key k . In a digital signature schemes based on discrete logarithm problem, as the authors propose to use the randomizer k current session key calculated by the algorithm Needham-Schroeder, to allow additional authentication of subscribers A and B.

In Java implemented the following signature algorithms based on the discrete logarithm problem with the session key Needham-Schroeder, presented equations authentication EDS and EDS form equations [2]:

$$a^h = y^S r^r \bmod p, \text{ и } S = \frac{(h - kr)}{x} \bmod (p-1) \quad (20)$$

$$a^h = y^r r^S \bmod p, \text{ и } S = \frac{(h - xr)}{k} \bmod (p-1) \quad (21)$$

$$a^S = y^r r^h \bmod p, \text{ и } S = xr + kh \bmod (p-1), \quad (22)$$

$$a^r = y^h r^S \pmod{p}, \text{ и } S = \frac{(r - xh)}{k} \pmod{(p-1)}, \quad (23)$$

$$a^r = y^S r^h \pmod{p}, \text{ и } S = \frac{(r - kh)}{x} \pmod{(p-1)}. \quad (24)$$

Conclusions. Implemented in object-oriented programming language Java environment in NetBeans IDE 7.0.1 signature algorithms based on the discrete logarithm problem with the use of one-time session key k , generated by an algorithm Needham-Schroeder and an additional parameter H' , which is the hash of the concatenation of the results to the shared key, calculated using the Diffie-Hellman and the parameters (r, S) , were tested for the validity of the generation and verification of digital signatures. The use of composite modulus and additional parameters k and H' allows to build the cryptostrength EDS scheme.

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Osyka V.A., Koptiuh L.A.

**THE DEVELOPMENT OF A METHOD FOR OBTAINING THE
GREASEPROOF PACKING PAPER FOR FOOD PRODUCTS**

Kyiv National University of Trade and Economics

In this report we describe the development of a method for obtaining the

greaseproof packing paper for food products by processing it with aqueous solution of polyvinyl alcohol, glycerol, crystalline sodium sulfate and sodium carboxymethylcellulose. The method and mechanism of applying it to the paper base are analyzed. The research of the results of properties of the obtained material are given and the scope of its implementation is determined.

Key words: packing paper, greaseproofness, airtightness, polyvinyl alcohol, carboxymethylcellulose.

Packing is an integral part of manufacturing, storage and consumption of food and non-food products, and in developed countries it has become as important as the products inside.

Among various materials designed for packing goods and products with high fat content, including food products, paper holds one of the leading positions as it perceives well such types of processing as impregnating, varnishing, surface coating and printing, moreover it has a relatively low cost. It is also necessary to pay attention to the environmental friendliness of using paper in the packaging industry as waste and used packaging can be re-used with high efficiency through processing and production of new materials and products.

The aim of the research carried out is to develop the composition of paper for increasing its greaseproofness, to study the method and mechanism of applying it to the paper base and the properties of the obtained material and to determine its scope of application.

We have set the following objective: to create packing paper by means of its surface processing with oleophobic and waterproofing solutions and formulations that provide a high complex of barrier and protective properties which are assessed according to the resistance to penetration of fat, water and free vapors, gases, flavours and according to other criteria depending on its dedication and application conditions and type of products that it is used for (solid, pasty or liquid state).

The combination of the properties of cellulose fibers in the paper with the properties of the applied on it surface coating or the properties of non-cellulosic fibers that are added to its composition gives an opportunity to get a wide range of

materials and applications. For instance, it can absorb gases and chemical compounds, not conduct fat and water or other liquids, diffuse light and heat, withstand high or low temperatures.

Creating such materials helps meet a broad range of requirements placed on technology of packaging and storage of specific food products and are determined by their chemical nature (presence of fat, acid content), physical state (liquid, paste, a solid product), sensitivity to moisture, oxygen, light and necessity of a certain isolation from the environment during storage or transportation.

Formation of coating, which determines the properties of a fibrous material with coating, starts with the moment of putting aqueous solution or a layer of polymer on its surface. The composition for coating penetrates to a definite depth into pores and capillaries of a fibrous material, at the same time there is a partial separation of water and its absorption by fiber. The depth and speed of penetration into a fibrous material are determined by such factors as wet-out of base surface with a composition for coating, its efficient viscosity, water detention, electrostatic charge.

Speed of penetration is reduced proportionally to an increase of viscosity of the solution, the stability of which is essential for coating within the prescribed limits and allows to accurately control its use during application and even distribution on the surface of the paper, on which after drying there forms a greaseproof, sometimes invisible film that is connected to it by adhesion.

There are some well-known methods of improvement of fibrous material greaseproofness with the help of sodium silicate, latexes, which are highly concentrated colloidal dispersions and emulsions of synthetic polymers. However, greaseproof coatings obtained through these technologies are brittle, their application processes causes increased foam formation, which reduces the uniformity of structure and stability of the material's barrier properties. The base of material must be pre-glued, have a dense and smooth surface structure, which makes manufacturing technology more complicated and increases the cost of the obtained greaseproof packing material.

An effective way to increase greaseproofness is using fluorine derivatives of chemical compounds that can be added to a composition, from which material is produced or directly onto its surface.

However, they did not find practical application in packaging of food products for the reasons that fluoride compounds have harmful health effects, and therefore there is no sanitary permit from the Ministry of Health of Ukraine for their use in materials and products that contact with food, and because of high cost and scarcity.

Greaseproofness of a fibrous material is also reached through coating from polyvinyl alcohol(-CH₂-CH(OH)-) (PVA) - water-soluble vinyl resins representative. Coatings from PVA are transparent, do not interact with oils and fats, are applied without primer layer and physiologically harmless. They have high protective properties, but not elastic enough, not resistant to water and are easily damaged during the bending process, causing leak, reducing the protective properties of packaging and, of course, premature spoilage. They have high protective properties, but not elastic, not resistant to water and easily damaged during flexion, causing loss of tightness, reducing the protective properties of packaging and, of course, premature spoilage of packed products [1].

Penetration level of fat into the paper or cardboard is determined by the factor of greaseproofness, which according to the current test method is measured in milligrams (GOST 13525.13) and is based on determining the number of transformer oil that passes through the paper onto the substrate at a certain temperature, pressure and time using the device for measuring greaseproofness GP-1. Greaseproofness index is determined by the mass difference of filter paper substrate before and after the test, indicating the amount of oil that has passed through the test sample, in mg. High greaseproofness index means that the greaseproofness of paper decreases, i.e. the material has low resistance to the passage of fat, which is undesirable, and conversely, a decrease in greaseproofness means raising greaseproofness of material - and improvement of its barrier and protective properties.

The task given was being solved through the development of composition for greaseproofness containing at various mass ratios, wt. % such components: polyvinyl alcohol, glycerol, crystal in sodium sulfate, sodium carboxyl methyl cellulose, water.

The solution was applied to the surface of the paper base, which after drying has received increased resistance to penetration of fat – greaseproofness property.

Selecting a composition for providing greaseproofness to paper is determined by the following specific properties of its components.

Polyvinyl alcohol refers to elastic polymers with dense structural packing (ordering), and cellulose is an amorphous, less dense packing. In this regard, the mass fraction (concentration) of PVA should be maximal for its penetration into the canvas paper to be minimal, and therefore one of the functions of crystalline sodium sulfate ($\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$) is increasing its viscosity.

It is known that activity factor of aqueous nonelectrolyte solution in the presence of an electrolyte, for example, in salt solution increases. The same level of the surface tension of the PVA solution in the presence of salt is achieved at a lower alcohol concentration than in pure water. Thus, we can assume that the solution of alcohol in a solution of sodium sulfate is more active than the solution of alcohol in water. Such increased activities explained by the fact that a part of water is bound by sodium sulfate, and the concentration of alcohol in the solution composition increases.

Carboxymethylcellulose (CMC) is a simple cellulose ether of the general formula $[\text{C}_6\text{H}_7\text{O}_2(\text{OH})_3 \times (\text{OCH}_2\text{COONa})]_n$, soluble in water, which makes it possible to use it in a mixture with polyvinylalcohol, glycerol ($\text{HOCH}_2\text{-CHOH-CH}_2\text{OH}$), and can be used as a coupling sizing agent, which by linking cellulose fibers in the composition of paper and gluing them for further drying contributes to obtaining microporous receivable, dense, closed, greaseproof structure of paper.

The evidence of this can also be increased density of paper coated with the composition in comparison with paper without surface treatment.

In our opinion, the incorporation of CMC and glycerol - triatomic alcohol into the composition that is applied to the surface of the paper, should lead to modification and stabilization of the required concentration and viscosity of the system, increase

flexibility, plasticity and mobility of the solution of the paper structure. The result is improved flexibility of paper and properties of greaseproofness given to it, i.e. increased resistance to fat penetration into its structure by forming of flexible, durable and resistant to water film on the surface.

While carrying out the work there have been conducted some studies for determining the mass fraction and the relationship between the components mentioned in the composition for increasing greaseproofness (PVA, glycerol, sodium sulfate, CMC in water), the amount of the solution coated on the surface of the paper base, properties of the paper base with various weights of 1 m² and their impact on the complex of barrier, strength, physical characteristics of the obtained material [2].

For obtaining the composition which provides increasing of paper greaseproofness the following components were added to the PVA aqueous solution and thoroughly stirred with a stirrer - glycerol, sodium sulfate, CMC in certain mass fractions (ratios). The obtained composition was applied to the surface of the paper by spraying or by immersion into the solution of paper base. To evaluate the effectiveness of the composition and its dependence on the structural properties of paper base samples of different paper mass with the area of 1m² (from 26 to 70 g/m²), density (from 0,60 to 0,95 g/cm³) and airtightness (from 12 to 120 cm³/min) were used for the research.

We have obtained 7 samples (variants) of paper with the area of 1m² which had different weights, airtightness index, the ratio of the components and mass fraction of the solution applied on the surface of the base, and 2 samples (8 and 9) for the closest analogue for comparison. There has been carried out a study of the properties of paper with the researched composition coated on its surface with different mass (2, 4 and 8 g/m²) and paper – analogue produced by using known technologies. The results of paper samples testing according to the indicators of greaseproofness, airtightness, relative elongation before and after processing with the specified composition are summarized in the tab. 1.

Table 1

Comparative analysis of the paper base samples before and after processing with solution of developed composition and according to analog.

Indicator Name	Indicator Values								
	Samples								
	1	2	3	4	5	6	7	8 (ana- log)	9 (ana- log)
Weight of paper base with the area of 1m ² , g	26,3	40,6	50,2	58,0	26,3	58,0	70,4	70,4	26,3
Density, g/cm ³	0,72	0,71	0,70	0,60	0,72	0,62	0,95	0,95	0,72
Airtightness of paper base, cm ³ /min	12	30	40	60	12	60	120	120	12
Composition for coating, components ratio, wt. %									
polyvinyl alcohol	4	6	8	10	4	10	10	7,0	7,0
glycerol	3	6	6	6	3	6	3	3,0	3,0
crystalline sodium sulfate	1,5	3	3	3	1,5	3	3	-	-
sodium carboxymethylcellulose	0,5	1,0	1,5	1,5	0,5	1,5	1,0	-	-
water	91,0	84,0	81,5	79,5	91,0	79,5	83,0	90,0	90,0
Weight of coated paper with the area of 1m ² , g	28,8	43,6	54,2	60,0	28,2	60,2	72,6	72,8	29,0
Coating weight, g/m ²	4	4	4	4	2	8	8	8	4
Airtightness of coated paper, cm ³ /min	2,0	1,4	2,0	1,8	4,0	0,4	0,6	6	10
Relative elongation, %									
in the machine direction	2,76	2,98	2,66	2,72	2,76	2,8	2,8	2,2	1,9
in the crosswise direction	7,0	7,6	7,0	7,2	7,4	7,6	7,0	4,8	4,6
Greaseproofness, g	0,60	0,52	0,50	0,18	3,2	0,12	0,12	4,6	8,6

In order to evaluate the effectiveness of the developed composition there were samples of paper with the same technology, according to the analogue with the known composition (patent number 34385 Ukraine, IPC 021N19/00, appl. 30.06.1999, publ. 15.05.2003) to provide greaseproofness to a fibrous material which

contains, wt. %: polyvinyl alcohol 7,0-10,0, glycerol 3,0-4,3; stabilizing additive 0,35-2,5, water - the rest up to 100%. We also know that as a stabilizing additive alkali metal salts are used.

This additive stabilizes the viscosity of the solution for some time, so the paper has sufficient greaseproofness after the application of the composition which is to cover the surface of the paper after a certain period (not immediately after obtaining composition). This additive does not affect the level of paper's greaseproofness, but can lead to increased corrosion of equipment and to reduced adhesion (connection) of a formed greaseproof film to a fibrous material. Greaseproofness index of paper coated with the known composition is uneven width of the paper, because cellulose fiber does not absorb evenly its components during application of the composition on the surface of the paper base. Moreover, greaseproofness of such material is not stable after starting to use because of multiple kinks, especially during manufacturing of package and packaging a variety of products, including food into it. By using such paper the greaseproof film is destroyed in places of kinks where the paper loses tightness and usually greaseproofness. Besides, paper coated with the abovementioned composition does not have sufficient mechanical strength, namely, according to the relative elongation indicator while stretching it in the crosswise direction, which leads to tearing of paper while using it appropriately on the packaging equipment.

The analysis of the research results presented in the table shows that the solution applied to the surface of the paper base reduces the rate of greaseproofness that, depending on the mass of the coated solution and the mass fraction of each component in it is within 0.18 - 0, 60 mg (for outgoing samples without cutting greaseproofness rate is 40 - 60 mg depending on the weight of the paper with the area of 1 m², airtightness and density).

Coating solution of the developed composition influences such paper indicator as airtightness, which decreases with increasing of mass fraction of the solution applied.

Airtightness is an indirect characteristic of greaseproofness parameters, density and structure closeness of the obtained packing paper and decreases with application of the developed composition onto its surface.

It should also be noted that in accordance with Standard 1760 "Imitation Parchment. Technical Requirements" for imitation parchment - material used for packaging food and lining containers for it, greaseproofness rate is 8-28 mg depending on the brand and application.

Processing paper with aqueous composition in order to increase greaseproofness also contributes to its mechanical strength, which can be proved by the results of changing the rate of relative elongation of paper during stretching. The solution of such composition coated on paper promotes the growth of the relative elongation of paper up to a tearing in the crosswise direction and exceeds the level for analogue and paper base without processing 1.6 and 2.3 times respectively.

Designed packaging material based on paper and environmentally friendly and safe for human health components coated on its surface, does not contain harmful contaminants, does not change the taste of food and does not cause mutual migration of material and product components to promote effective and safe protection of products through a high complex of barrier properties, meeting the requirements that apply to packaging of foods.

The results of the studies also show that the use of the composition for greaseproofness containing less than 0.1 wt. % of polyvinyl alcohol and less than 0.03 wt. % of glycerol is not rational as greaseproofness of a fibrous material does not reach the required level. At the same time it is also irrational to use the composition for greaseproofness containing more than 33.0 wt. % of polyvinyl alcohol and more than 10.9 wt. % of glycerol as costs for production of paper rise, and the level of greaseproofness indicator increases slightly.

Thus the results of the research showed the feasibility of obtaining greaseproof paper using the developed composition, which is a stable system of polymer-polymer, i.e. due to formation of the solution, which is compatible with cellulose and for that

reason provides for achieving high consumer, operational and hygienic properties of packing material.

The results of a more detailed study of the obtained packing paper properties and their change under the influence of various factors - temperature and double bends, and sphere of application will be published in the following issues of the magazine.

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Tyricheva E.A.

**UNIVERSAL ALGORITHM OF FORMING OF THE LISTS OF
STUDENT'S GROUPS ON SPECIFIC CRITERIA**

*Kharkov National Automobile and Highway University,
Kharkov, Petrovskogo, 25, 61002*

The article describes the author's personal experience of algorithmic processes of forming of groups of learners (schoolchildren, university entrants, students), information about that was preliminary added to the computer database.

Keywords: relational database, group of students, examination, testing, algorithm, program.

Introduction. Creating groups is the necessary and obligatory stage for the developer of informational system of the university or other educational institutions [1]. For example, it is necessary in the recruitment of students to the preparatory

department, during the entrance exam, with the formation of groups in various areas of study courses.

In each case, the developer uses as input the pre-created array of information on students, to be included in the groups that were formed. Array of information organized in a database, and meets the requirements for the organization of any relational database (RDB) [2].

Algorithm, a description of which is presented below, was developed by the author of this article and for many years was used for the automated formation of groups of university students entering to the budget form of full-time training.

Criterion for selection of students in the group can be simple or complex.

In the first case, the selection can be conducted, for example, by "entrants this specialty".

Complex criterion provides concatenation of the simple criteria, such as "entrants this specialty" + "entrants with benefits".

Consider the integrated scheme of the algorithm by the example of the formation of groups of students for the entrance exams.

Set the "filter" in the handbook of specialties on all full-time specialties of university. Program will show on-screen menu, which lists all of the selected specialties. "Exit" button allows you to complete the program and correctly go out of the process. Choice any specialty from the menu starts process for the formation of groups of students of this specialty.

Open RDB all entrants of university. Set the "filter" for all records of entrants for the specialty. The screen displays the number of such students. The user of system must select and enter the amount of groups that create.

Name of the group is defined as an abbreviation of specialty plus group's index number. Number of people in each group is determined by the user in the process of dialogue with the system. Further the work of the program goes in the cycle for each group separately.

Of RDB of students consistently choose the records that match the specified criteria, and formed an array of data of each student.

The array is sorted by last name in alphabetical order. A text file is formed for later printing.

In RDB of entrants in the field "Number of group" for each student enter a group name.

In the above algorithm integrated scheme involved the following arrays of information.

1) Reference book of the faculties of university *spr_fak.dbf* that contains information about all faculties.

2) Reference book of the specialties of university *spr_spec.dbf*, which shows the data for each training specialty.

3) Integrated university RDB *karta.dbf* of all entrants, who come to university this year. Formed during the period of receiving the documents, meets the requirements of the curriculum and the work program for the discipline, as well as the requirements for the organization of any RDB [2].

Structure (the set of fields) RDB *karta.dbf* can be following: *No personal file of university entrant; Personal data of entrant ...; Faculty; Specialty; Additional fields... .*

The first field ("*No personal file of university entrant*") is the primary cursor of record RDB *karta.dbf*. The value to this field is assigned when submitting documents to the university.

Further fields "*Personal data of entrant ...*" go. The number of these fields and their contents when filling determine by the requirements of the university's departments. "*Additional fields...*" RDB *karta.dbf* are intended for programs of processing exam results and automatically be filled in the execution of these programs.

The algorithm can be implemented in any of the high-level languages. The author used for programming language Visual FoxPro.

Conclusion. The universality of this algorithm is that it can be used to generate a list of groups as in the recruitment of students to the preparatory department, and in

the conduct of entrance examinations, and the formation of groups in various areas of study courses.

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Nyrkov A.P., Sokolov S.S.

NP-hard tasks: from the theory to practice

*Federal State Financed Educational Institution of Higher Professional Education
“Admiral Makarov State University of Maritime and Inland Shipping”*

Introduction

NP-hard tasks as a class of mathematical tasks make broad applied sense: from a way choice, before arrangement of objects.

The main ways of distribution of a wide demand of rational solutions of this tasks class the dictated world tendencies of transition from industrial society to the information. As confirmation that in the transport sphere is served "By strategy of development of transport till 2030": "Improvement of the market of transport services, ensuring their availability, volume and quality are connected with development of transport equipment, technologies and information support of transport services".

All main problems in the transport sphere often arise because of a lack of time and resources. In turn shortage arises because of irrational planning. "The freight traffics connecting large industrialists with consumers, actually are planned by nobody

and don't cope" - was repeatedly declared at various levels of the power in the Russian Federation.

The main transport process sites which first of all need automation, mechanisms of warehousing of freight and communication between various stages of a cargo transportation are. In the first case developers face unresolved at present the scientific problem which is belonging to the class of the NP-hard: cargo planning for placement of three-dimensional objects. This problem costs for all sphere of warehousing of freight, however, it is more actual for transport branch with introduction of the accounting of additional measurements, such, as weight, a tilt angle, etc. in case of warehousing on transport objects (vessels of different types of swimming).

Problem definition of placement of freight for creation of algorithmic providing

The cutting packing problem (C&P) draws attention of scientific researchers and production workers. This problem is understood as a wide class of the tasks allowing various applied sense and interpretation. The general for this tasks class is existence of two groups of objects. Between elements of these groups compliance is established and estimated. For the first time the qualitative typology in the field of cutting packing is carried out in 1990 by the German scientist of H.Dykhoff. It is accepted in world practice and is used when studying models and methods of the solution of problems of cutting packing.

A variety of models is defined first of all by a geometry factor. Problems of linear (one-dimensional), rectangular (two-dimensional) and parallelepiped (three-dimensional) cutting packing differ. Guillotine cutting and packing are distinguished from these tasks. Not Sting problems, that is placement of details of a difficult geometrical form in the set areas are especially allocated. For them into the forefront information problems of a task of figures, the account and providing from not crossing, codings and others act. Problems of C&P are typical representatives of NP-hard problems and the general approaches are applied to their decision (including not Sting problems): exact methods, simple heuristics and metaheuristics. In view of not polynomial complexity of exact algorithms, authors of many works pay considerable attention to approximate methods and эвристикам.

Applied problems of rational three-dimensional placement of a material of the set volume and form in the set $[1,2,3]$ space follow from an optimizing task "about a satchel" (a problem of a cargo planning - a problem of a placing of freight), become more actual in connection with development of production and industrial infrastructure. Such tasks are financially very various and are very often ambiguous in methods and approaches of their decision.

As it is noted work, combinatory properties of three-dimensional problems of cutting, such, as:

planning of cutting of a tree trunk on timber taking into account its profile as truncated cone or even the truncated parabola;

volume placement of production in a warehouse or in the transport;

and so on;

- in a general view don't give up hopes of their decision unlike the considered separately applied tasks possessing very expressed specifics.

Subjects in these tasks, most often, - cylinders (rolls) or parallelepipeds (packs, blocks, piles). Objects of cutting: the internal space of warehouses, cars, containers, holds – also are parallelepipeds or their combinations. The quantity of types of subjects in such tasks or so isn't enough that allows reasonable search of effective plans, or is very great that allows, considering measurement errors, dispersion of the linear sizes and reasonable admissions at implementation of the plan, to find not exact, but approached, based on heuristic reasonings, the decision. The scheme of loading or warehousing copes the dispatcher and shouldn't be too difficult that also simplifies a task, reducing a choice of plans of cutting.

The concept of the criterion of efficiency (CE) imposes additional restrictions on this or that parameter (or group of parameters) an optimizing task. Rationalization task, being a subtask optimizing, also has to have CE which will be defined and is in direct dependence on statements of the problem. CE can connect with a material expense in natural or value terms, quantities of the found subjects (preparations of details) or the total income from their realization, their measure, a share of losses of a material, etc. Irrespective of a choice of indicators, CE, as a rule, is linear function of quantity of the

spent objects and the received subjects of cutting. Though coefficients of proportionality of this function can have the various nature (volume, economic indicators, dual estimates of other task).

The Criterion of Efficiency (CE) in optimizing and rationalization problems of cutting and configuration

В некоторых задачах КЭ (зависимый от способов размещения) определяется не только количественно, но и качественно. К примеру, полотно бумаги может иметь «пятна пониженного качества», пригодные для выкраивания лишь части продукции, а качество пиломатериала – определяться положением центра ствола дерева. Примером может служить также размещение продукции на складе, где необходимо оставлять коридоры для проезда погрузчиков и другой складской техники.

In some problems of CE (dependent on ways of placement) is defined not only quantitatively, but also it is qualitative. For example, the cloth of paper can have "spots of the lowered quality", suitable for cutting out only parts of production, and quality of timber – to be defined by position of the center of a tree trunk. Also production placement in a warehouse where it is necessary to leave corridors for journey of loaders and other warehouse equipment can be an example.

The main maintenance of a task can be added with a number of requirements:

- interaction and interrelation of the main technologies of cutting-komplektovki [6];
- the specific requirements connected with placement of objects, the laying caused by more difficult mechanisms, centerings, rigidity of placement;
- conditions of consecutive realization of process of cutting-komplektovki, for example, requirements to forms of the remains of fabric and sequence of use of fabric for cutting, the requirement to sequence of filling of the bunker and possibility of granting additional space that is connected with specifics of cargo works;
- completeness of subjects, i.e. proportionality of volumes of their production adjusted for available stocks;
- mass character and quantitative assessment of subjects of cutting-komplektovki;

- observance of a certain framework/borders of loss of material/space when cutting / комплектровки;

- the accounting of quality, cost and other parameters connected with selection of production most favorable to production/placement (i.e. prime production) [7].

Additional conditions differently influence by sight mathematical model, complexity of algorithm and labor input of the solution of a problem of cutting. In certain cases the quantity of versions of the solution of a task becomes less more simply, sometimes, significantly changing algorithm, he manages to be "adapted" for the solution of the modified task. However more often additional restrictions complicate the solution of a task [4,5].

Let's return to a problem of a комплектровка (freight placement) which according to the contents is the return in relation to cutting operation. The purpose of a problem of cutting – search of the plan providing the greatest income, problems of a комплектровка, on the contrary, - minimization of the expenses connected with a комплектровка.

Обозначения и базовая модель комплектровки аналогичны модели выбора плана раскроя материалов. К примеру, можно определить план комплектровки объекта μ как совокупность образов предметов комплектровки $M_{j_s}^{\eta_s}, s \in S$, покрывающих фигуру объекта комплектровки μ :

Designations and basic model of a комплектровка are similar to model of a choice of the plan of cutting of materials. For example, it is possible to define the plan of a комплектровка of object μ as set of images of subjects of the комплектровка $M_{j_s}^{\eta_s}, s \in S$ covering a figure of object of a комплектровка μ :

$$\mu \subset \bigcup_{s \in S} M_{j_s}^{\eta_s} . \quad (1)$$

These images completely fill object, therefore value:

$$V = \sum_{s \in S} (M_{j_s}^{\eta_s} - \mu) \geq 0, \quad (2)$$

- let's call the size of losses. The share of losses and density of a комплектровка

are entered similar to a problem of cutting [8,9].

Thus, the rationalization problem of a komplektovka isn't always reduced to minimization (a problem of the first type) or maximizing (a problem of the second type) sizes V . It can have a number of the additional restrictions entered at definition of KE and considered far not least. While the common optimizing problem belongs rather to theoretical area of mathematics and combination theory, its projection to empirical area of data is the rationalization task into which as input parameters enter such as cost, the weight, a gabaritnost and many others, raising dimension. The solution of the last task consists first of all in application of the algorithms reducing its dimension, by means of decomposition.

Conclusions

Questions of the class np-full problems solution in modern science are actual and closely interfaced to the solution of practical tasks, as problems of effective placement of freight which are solved for a long time. However, despite a large number of approaches to the decision, placement methods, these tasks up to the end didn't find enough optimum answers and demand continuation of researches.

In work the algorithmic model developed by a group of authors which can be adapted further under concrete transport was considered, considering additional criteria and restrictions. Already at a present stage of existence the model showed the adequacy on numerous empirical data.

The algorithmic providing described in work, belongs to area of "scientific creativity" and never will allow to speak about an absolute optimum in received results (and can't in a type of an inequality of the classes NP and P). In a place with that, it gives sufficient data at the exit for achievement of a local optimum that fully satisfies practical requirements.

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Lvovich I.Ya., Preobrazhensky A.P., Kulneva E.Yu.

THE PROBLEMS OF INVESTIGATION OF COMPUTER NETS

Voronezh institute of high technologies

Introduction

Currently, we can see a great increase of information flows, and it is quite difficult to imagine a strong relationship between banks, industrial enterprises, as well as various

institutions without modern computers and computer networks. We can match the development of the network infrastructure, which lies at the heart of today's enterprises [1].

During the increasing the complexity of the applications used on the network there is an increase in bandwidth requirements, reliability, and security of the network, its effective management, and, where possible, reducing the cost of use.

That is, the purpose of paper is to examine approaches to the estimation of characteristics of the computer network and the efficiency of routing algorithms.

According to the purpose of the paper we needed to solve the following problems:

- carrying out the analysis of the construction and topology of local area networks (LAN);
- developing an algorithm for estimation of the of cost LAN;
- considering the estimation algorithm of download channels with taking in to consideration of performance parts and bandwidth.
- creation of software on the base of developed algorithms.

1. The estimation of the cost of computer network

1.1 General structure of the developed subsystem

In Fig. 1 there is a system information module for estimation of cost of local area network (LAN).

"Main window" is intended for the organization of user interaction with a computer software tool, which contains the basic functions of management.

"User" is for input of information and querying the database (DB), if you want to view the existing information in the database, or to the power calculation, which calculates the cost of the planned reception, according to the parameters set by the user.

"Database" keeps all the necessary information, the database structure and composition will be discussed below. In the database it is also possible to enter the information about hardware.

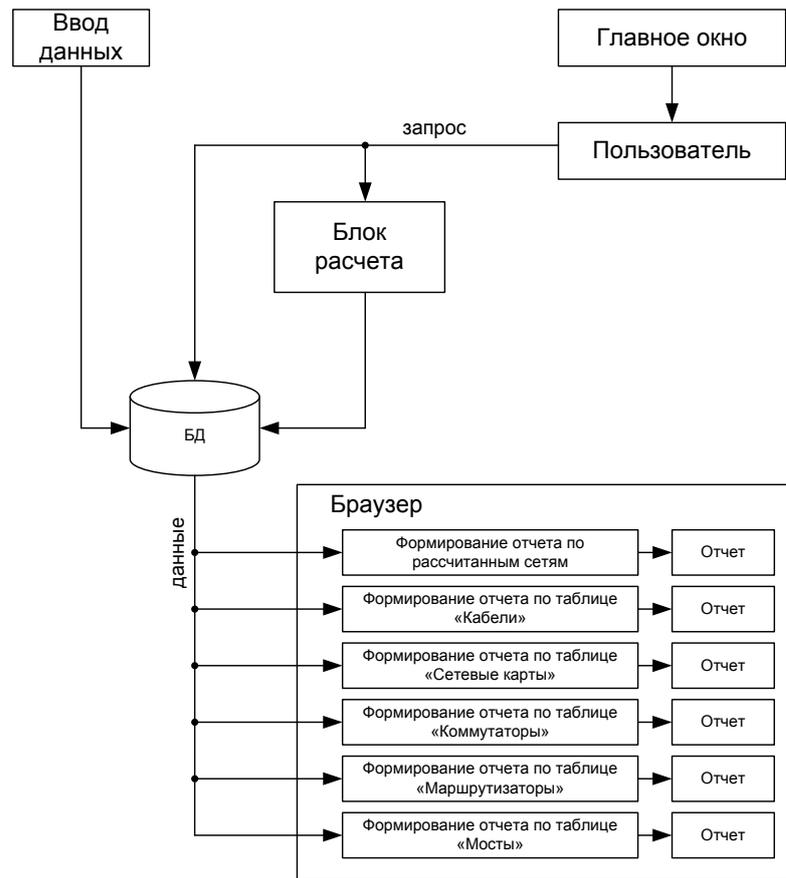


Fig. 1. The information model for estimation of cost of LAN

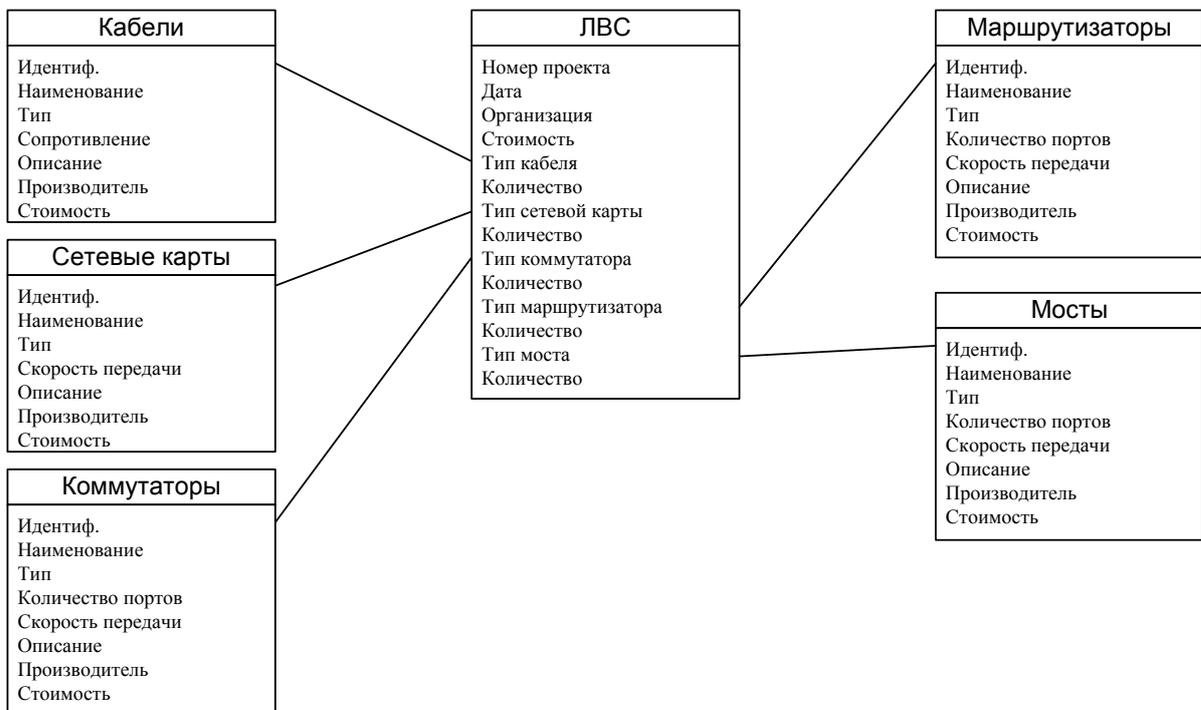


Fig. 2. The database structure

Based on user queries various reports can be generated that are displayed in the browser.

The structure of the database, which provides data storage in a retrieval system calculate the cost of a local area network, has 6 tables (Figure 2):

1. "LAN" 2. "Cables" 3. "Network adapters" 4. "Switches" 5. "Router" 6. "Bridges."

The table "LAN" is basic, because it is used to store information on calculated network includes the following fields (see Table 1):

- "Project ID" - a unique value, which determines the developed project networks;
- "Date" - is the date of development;
- "Organization" - contains information about the name of the contracting authority of the project;
- "Cost" - used to store the value of the developed project;
- "Cable Type" - used to store the type of cable used;
- "No." - the number of cables used in the design of the network;
- "Type network card" - used to store the type of network cards;
- "No." - the number of network cards used in the design of the network;
- "Switch Type" - contains information about using either the switch;
- "No." - the number of switches used in the network design;
- "Type Up" - are used to store the type used by the router;
- "No." - the number of routers used in the design of the network;
- "Type bridge" - used to store the type of bridges;
- "No." - the number of bridges used in the design of the network.

Table 1 - The table "LAN"

Field Name	Data Type
Project Number	Text
Date Date / Time Date	Date / Time
organization	Text
cost	Money
Cable Type	Text
Number of cables	Number
Type of network card	Text
Number of network cards	Number
Switch Type	Text
Number of switches	Number
Type of router	Text
Number of routers	Number
Type of bridge	Text
Number of bridges	Number

To store information about the types of cables that can be used in the design of a table of the "cable", which includes the following fields (Table 2):

Table 2 - Table "Cables"

Field Name	Data Type
Identification. (Unic)	Text
name of cable	Text
Type	Text
resistance	Numeric
Description	Text
Manufacturer	Text
Cost	Money

- "Identification." - A unique value that identifies the position in the database;
- "Name" - the name of the cable;
- "Type" - contains information about the appropriate cable;
- "Resistance" - defines the characteristics (impedance) cable;
- "Description" - outlines the cable used, indicating the core of its parameters;
- "Producer" - contains information on the manufacturer cables;
- "Cost" - specifies the cost of the cable.

To store information about network cards that can be used in the design of a table of "Network adapters", which includes the following fields (see Table 3):

- "Identification." - A unique value that identifies the position in the database;
- "Name" - the name of the network card;
- "Type" - contains information about the corresponding network card;
- "Transfer rate" - defines the speed at which data can be transmitted;
- "Description" - contains a brief description of the network card, indicating the main parameters;
- "Manufacturer" - contains information about the network card manufacturer;
- "Cost" - specifies the cost of the network card.

Table 3 - Table "Network card"

Field Name	Data Type
Identification. (Unic)	Text
name of network card	Text
Type	Text
Transfer rate	Numeric
Description	Text
Manufacturer	Text
Cost	Money

To store information about the switch, which may be used in the design of a table of "Switch", which includes the following fields(see Table 4):

- "Identification." - A unique value that identifies the position in the database;
- "Name" - the name of the switch;
- "Type" - contains the relevant information about the switch;
- "Number of ports" - stores information on the number of ports for connecting computers;
- "Transfer rate" - defines the speed at which data can be transmitted;
- "Description" - contains a brief description of the switch, indicating the main parameters;
- "Producer" - contains information on the manufacturer switch;
- "Cost" - specifies the cost of the switch.

Table 4 - Table 'Switches'

Field Name	Data Type
Identification. (Unic)	Text
Name of switch	Text
Type	Text
Number of Ports	Number
Transfer rate	Numeric
Description	Text
Manufacturer	Text
Cost	Money

To handle the routers that can be used in the design of a table of "router", which includes the following fields (see Table 5):

- "Identification." - A unique value that identifies the position in the database;
- "Name" - the name of the router;
- "Type" - contains the relevant information about the router;
- "Number of ports" - stores information on the number of ports for connecting computers;
- "Transfer rate" - defines the speed at which data can be transmitted;
- "Description" - outlines the router you use, specifying the basic parameters;
- "Producer" - contains information about the manufacturer of the router;
- "Cost" - specifies the cost of the router.

Table 5 - Table "router"

Field Name	Data Type
Identification. (Unic)	Text
name of router	Text
Type	Text
Number of Ports	Number
Transfer rate	Numeric
Description	Text
Manufacturer	Text
Cost	Money

To store information about bridges, which may be used in the design of the corresponding table is used, which includes the following fields (see Table 6):

Table 6 - Table "Bridges"

Field Name	Data Type
Identification. (Unic)	Text
Name of Bridge	Text
Type	Text
Number of Ports	Numeric
Transfer rate	Numeric
Description	Text
Manufacturer	Text
Cost	Money

- "Identification." - A unique value that identifies the position in the database;
- "Name" - the name of the bridge;
- "Type" - contains the relevant information about the bridge;
- "Number of ports" - stores information on the number of ports;
- "Transfer rate" - defines the speed at which data can be transmitted;
- "Description" - outlines the use of the bridge, showing the basic parameters;
- "Producer" - contains information on the manufacturer of the bridge;
- "Cost" - specifies the cost of the bridge.

1.2. The algorithm for calculation parameters and search the required equipment

To calculate the cost of a local area network, we use the correlation coefficients. As input parameters we use the following:

1.type of traffic (multimedia, messaging, etc.) [2]; 2.the number of rooms in which computers must be located 3. the number of computers in each room; 4.the number of servers 5. Existence of floors.

A block diagram of the calculation of the cost of a LAN is shown in Fig. 3. We use the following notation: $\vec{\alpha}_{BH}$ - vector, each of whose elements are the corresponding input parameters, $\vec{\alpha}_{II}$ - a vector containing the corresponding dependences in the database, \vec{k} - a vector containing the correlation coefficient [3, 4].

The output is the result of the equipment included in the projected LAN.

The algorithm of the calculation of the equipment:

1. Entry of the input parameters.
2. Calculating the correlation coefficients for each type of equipment;
3. The choice the most appropriate type of equipment, based on the principle of maximum correlation coefficient.
4. Displaying of results.

In the first step, the input parameters are set, which are then used to calculate the composition of the equipment.

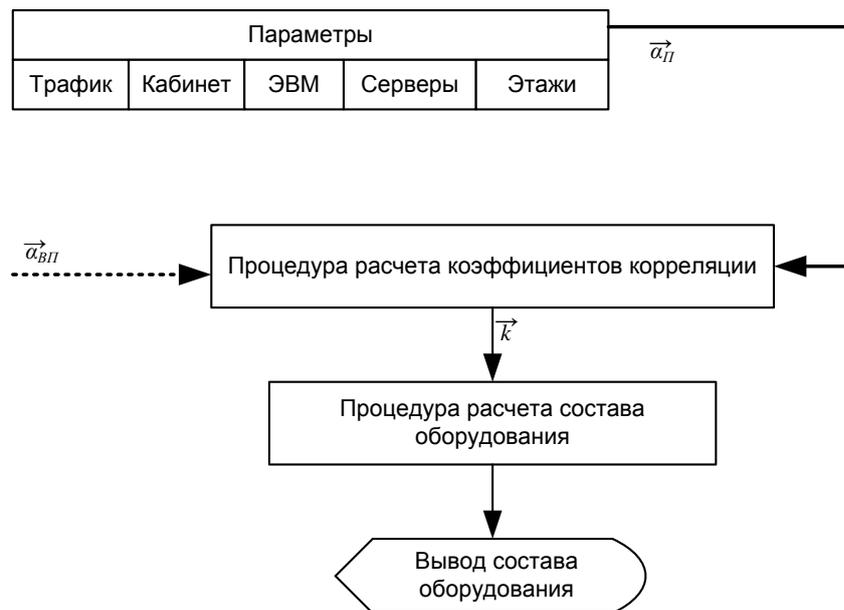


Fig. 3. A block diagram of the calculation of the equipment

The process of finding the necessary equipment is reduced to the following procedure for finding the maximum correlation coefficient.

$$\vec{k}_{N \max j} = \frac{\int_{S_1 S_2 \dots S_L} \vec{\alpha}_{N \max}(\eta_1, \eta_2 \dots \eta_L) \vec{\alpha}_{\hat{A}i}(\eta_1, \eta_2 \dots \eta_L) d\eta_1 d\eta_2 \dots d\eta_L}{\sqrt{\int_{S_1 S_2 \dots S_L} \vec{\alpha}_{N \max}(\eta_1, \eta_2 \dots \eta_L)^2 d\eta_1 d\eta_2 \dots d\eta_L \times \int_{S_1 S_2 \dots S_L} \vec{\alpha}_{\hat{A}i}(\eta_1, \eta_2 \dots \eta_L)^2 d\eta_1 d\eta_2 \dots d\eta_L}}, \quad (1)$$

where S_1, S_2, \dots, S_L - the range of parameters $(\eta_1, \eta_2, \dots, \eta_L)$.

For a vector of correlation coefficients using the standard procedures the maximal elements were founded, which correspond to the required number of telecommunications facilities, according to the input parameters.

1.3. Description of the developed software

To install the program designed to calculate the cost of a LAN to a computer we must copy a file folder where the program is stored on the hard drive.

To launch the program, you must run the executable «Program.exe».

After starting you will see the main window (Figure 4). The main form is divided into two areas: basic data for the design of LAN and LAN cost calculation results.

Also in the top of the form there are control buttons.

In order to calculate the cost of a LAN we must enter basic data for the design:

- Determine the type of traffic on the local network (depending on the desired speed), the number of personal computers in the same office, the number of servers in the network, the number of rooms, the size of the room (length, width and height), number of floors (for the case when the network is on several floors).

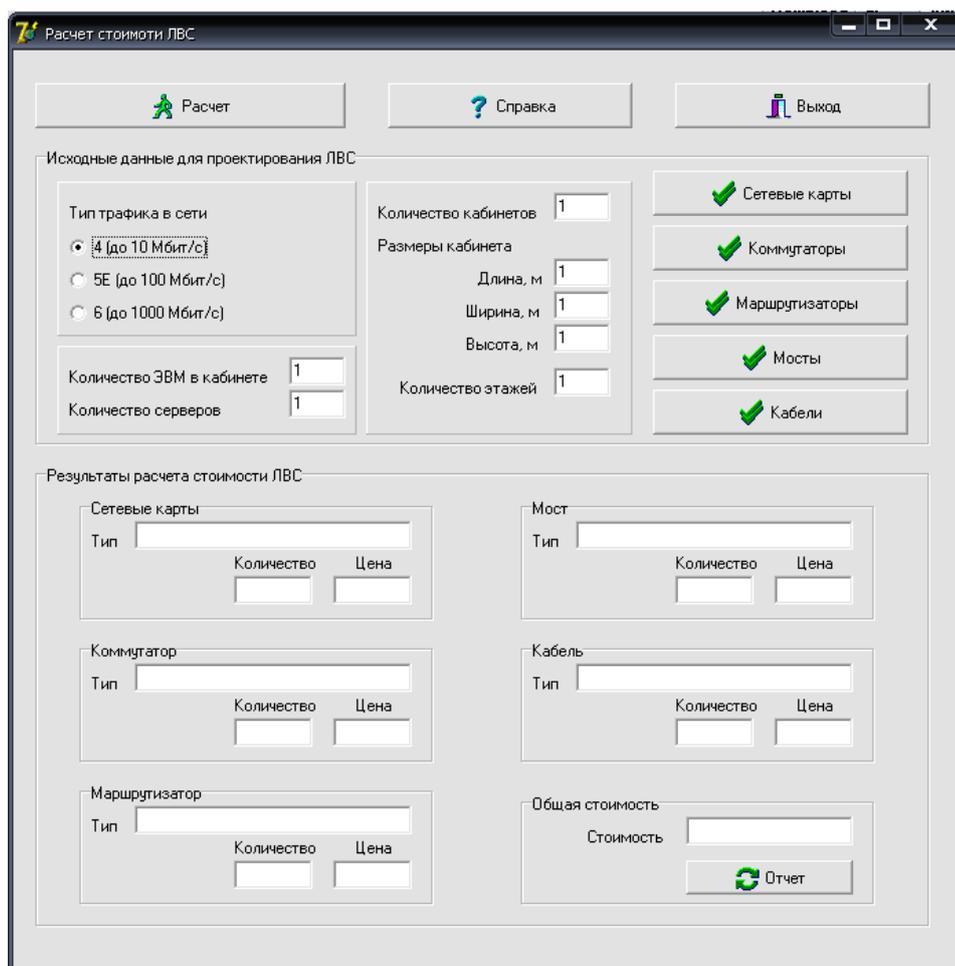


Fig. 4. - Main window

It is also possible to view or edit the table with your hardware for the design of LAN by clicking on the button:

network interface cards (Figure 5), switches (Fig. 6) Routers (Fig. 7); bridges (Fig. 8) Cables (Fig. 9).

Идентиф.	Наименование	Тип	Скорость, Мб/с	Описание	Производитель	Стоимость

Fig. 5. network cards

Идентиф.	Наименование	Тип	Кол-во портов	Скорость, Мб/с	Описание	Производитель	Стоимость

Fig. 6. Switches

Идентиф.	Наименование	Тип	Кол-во портов	Скорость, Мб/с	Описание	Производитель	Стоимость

Fig. 7. – Routers

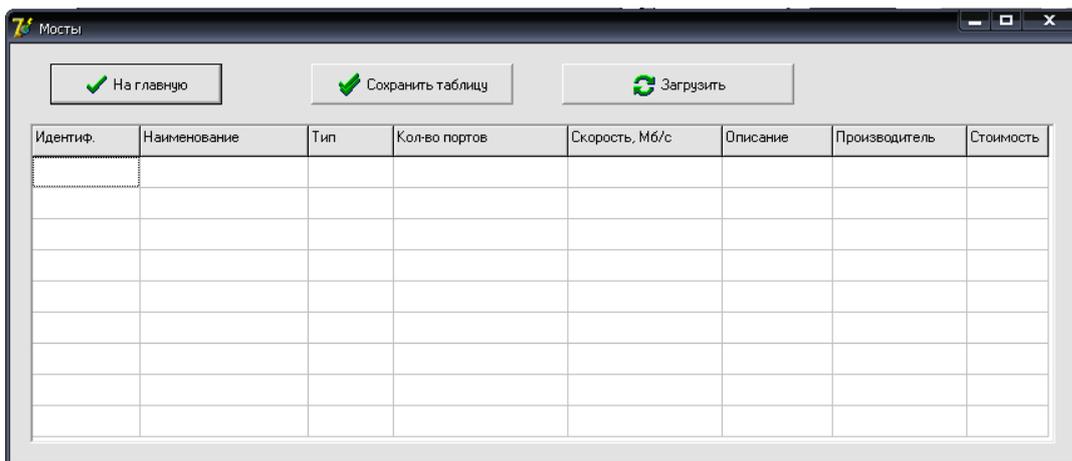


Fig. 8. Bridges

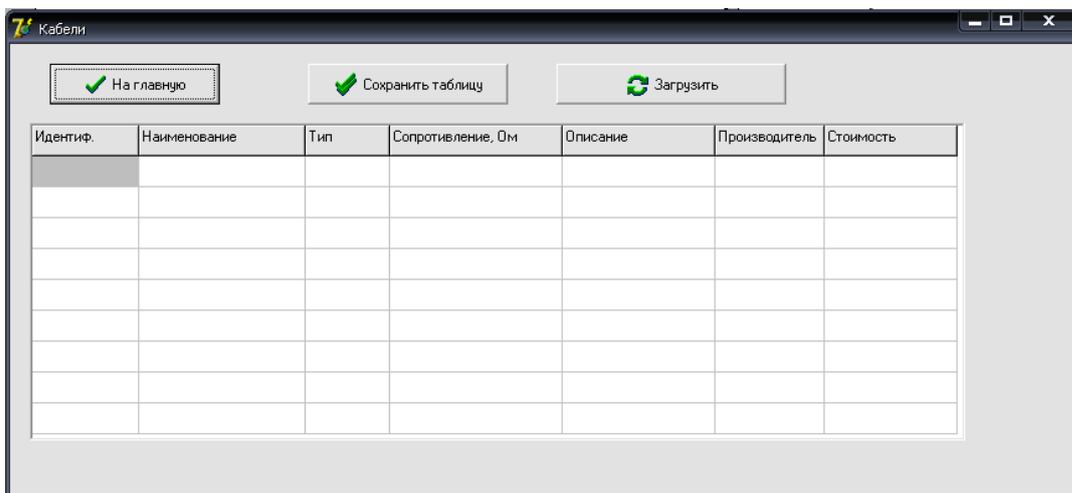


Fig. 9. Cables

In all forms, which displays information about the network equipment (Figure 5 - 9) you can edit the entries found in the table, as well as removing and adding. It is also possible to go to the main form by clicking on "Home."

After filling in all the required fields, if you specify the source data, you must push on the button "Calculation", which is on the top of the main form (Figure 4), and in accordance with the developed algorithm the program will calculate the cost of a local area network. The results of the calculation will be displayed in the bottom of the form, which includes the following fields: type of equipment used, the name of the equipment, number, total cost.

In Fig. 10 we can see the appearance of the report on the composition and price of the equipment.

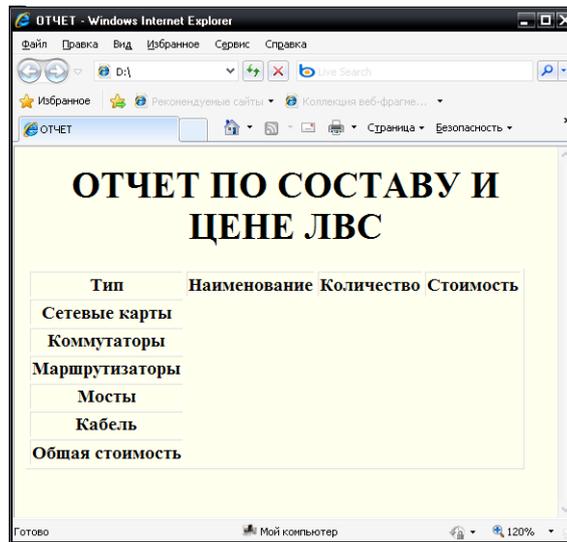


Fig. 10. Report on the result of engine design

1.4 Results of the system

In Fig. 11 we can see an example of calculating of the cost of the test LAN for 10 computers and one server located in different rooms.

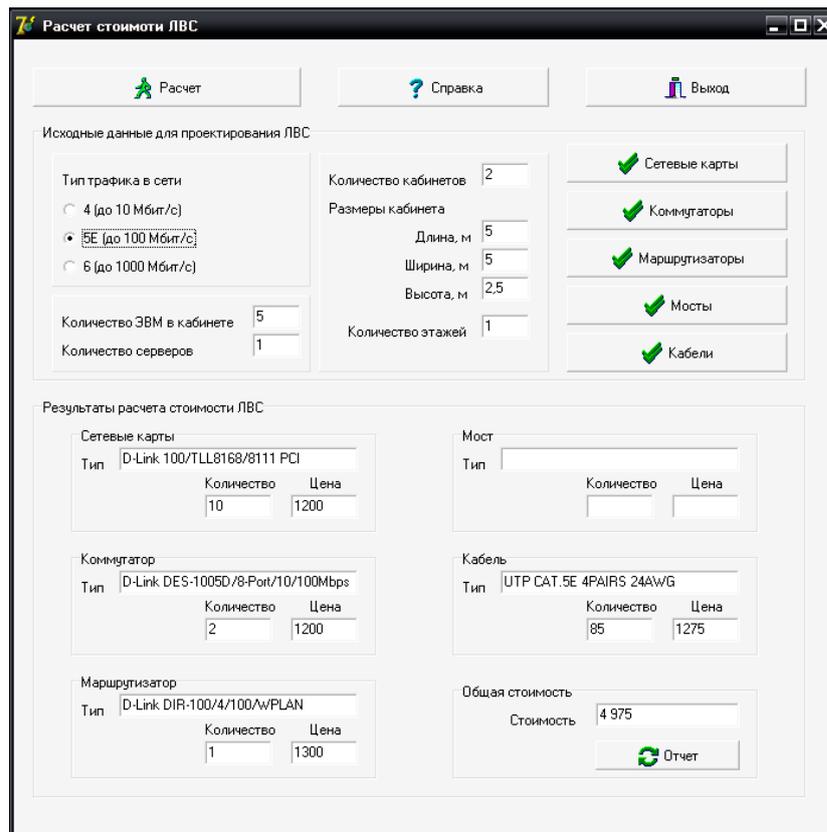
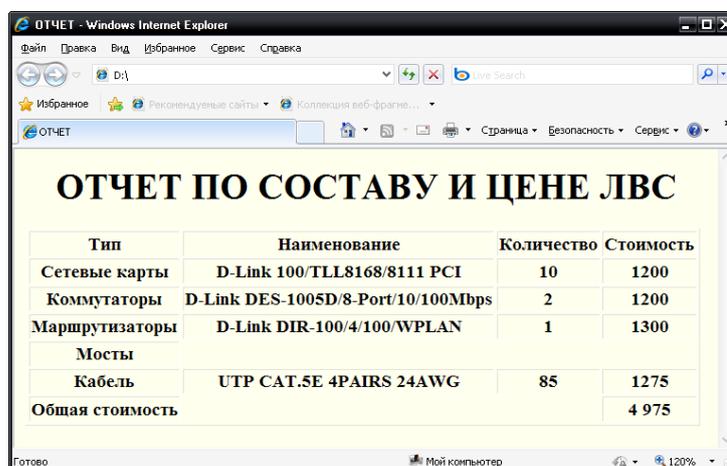


Fig. 11. A test example

According to the results it can be seen that for subnetting, you should use the switch to connect to the server - you need to use a router, a cable connection - twisted pair. In Fig. 12 shows the form of the report on the results of the calculation.



Тип	Наименование	Количество	Стоимость
Сетевые карты	D-Link 100/TLL8168/8111 PCI	10	1200
Коммутаторы	D-Link DES-100SD/8-Port/10/100Mbps	2	1200
Маршрутизаторы	D-Link DIR-100/4/100/WPLAN	1	1300
Мосты			
Кабель	UTP CAT.5E 4PAIRS 24AWG	85	1275
Общая стоимость			4975

Fig.12. Report on the result of calculation

2. Simulation and analysis of algorithms for routing in computer networks

2.1 Methods of modeling of local area networks

2.1.1 Mathematical simulation

Application of mathematical methods is determined by the need modeling LAN using appropriate mathematical approaches [5, 6]. We can apply various types of equations. In most cases, the use of such a method is considered in queuing theory, since packages in sets can be regarded as an application with the appropriate priority. In some cases methods diffuse approximation can be used, giving the opportunity to study the processes in networks with high load.

2.1.2 Simulation

Simulation modeling allows us to consider a greater number of situations in real computer networks, can be assessed the effect of various parameters on the characteristics of the systems [7, 8].

But, on the other hand, the cost of versatility is the complexity of the models, and the resource requirements of a computer (speed, memory).

2.1.3 Experimental Methods

In some cases it is possible to measure the characteristics of the network. To this end, the relevant hardware and software can be used [9].

In measurements using network analyzers, protocol analyzers, and other solutions can be used that let you watch and analyze network traffic based on the selection and network packets.

This may all statistics to be used to determine the base, as well as optimal performance. Some sniffers are able to give information about the protocol and is used to display the captured information.

Currently, there are some innovations in the design and implementation of various tools for measuring parameters of the LAN.

Based on these and properly prepared data are analyzed.

2.2 Mathematical simulation software of subsystem of networks

2.2.1 Formulation of the problem

It is necessary to develop an algorithm which allows the client to assess the distribution of the load on the server.

On Figure 13 there is given a block diagram of a computer network. It includes a server, which aims is providing certain services, routers connecting network nodes and subnets that are connected to the router of these subnets are requests to the server.

The aim is to assess the specific network flow in the communication between adjacent routers, depending on the number of users connected to each node, as well as the intensity of the traffic.

2.2.2 Parameters that affect the quality of information transfer

When we consider the characterization of the speed of a segment or a hardware device is not a separation by type of traffic, according to the program participants or type the information. In this case, viewing the total amount of data transmitted. On the other hand, there is practically important interest of detail in the network, which can be used to develop appropriate approaches management of computer networks [10].

Throughput describes the maximum possible processing speed of traffic, which is given by the standard technology of the network. On the other hand, the bandwidth

shows the maximum amount of data that can be transmitted over a network or a part of it at a time.



Fig. 13 - Block diagram of the network

Throughput is measured or in bits per second, or in packets per second.

Network bandwidth is determined by which physical transmission medium is used to solve problems. Communication media may include a cable or wireless technology. On the other hand, the capacity of affected transmission technology (eg, ATM or FastEthernet). Throughput can characterize it, what technologies are implemented in the network.

In contrast to the reaction times or speed traffic throughput is independent of the network load and has the specified value, depending on the used network technology.

The quality of the network depends on many parameters: the security, compatibility, reliability, manageability, performance and scalability. There are top of the parameters associated with the transfer of traffic - the maximum delay transmission and delay variation. It should be noted that in some cases there may be a weak dependence of the data transmitted from the transmission delays.

For example, it may be sending e-mail, send a job to print the document.

But in some cases, delays lead to much lower quality of information (audio or video).

The analysis shows that the technology Ethernet, for different physical layer standards, say the concept of the collision domain. It is each network segment. The bridge is the delimiter between the different collision domain.

2.3 Mathematical description of the algorithm for assessing the sustainability of switching nodes

We rely on a model of a data network, which contains N nodes, and (N-1) lines of communication. It is assumed that:

- All of the lines of communication is reliable;
- All lines of communication are noiseproof;
- Nodes have infinite memory;
- The processing of the nodes is very small, it can be ignored;
- The traffic on the network can be represented as a stream of messages that have the same priority, this thread has a Poisson distribution with mean γ_i [messages / sec] for messages that are sent over the communication channel.

Based on the foregoing as the objective function, we assume part of the network bandwidth, which consists of separate sections, measured in bytes / sec (2).

$$\sum_i x_i \rightarrow \max \quad (2)$$

where x_i [bytes / sec] - determines the bandwidth in i-th section of the net.

Constraints are the maximum throughput section (3), and the performance of the node in the network (4).

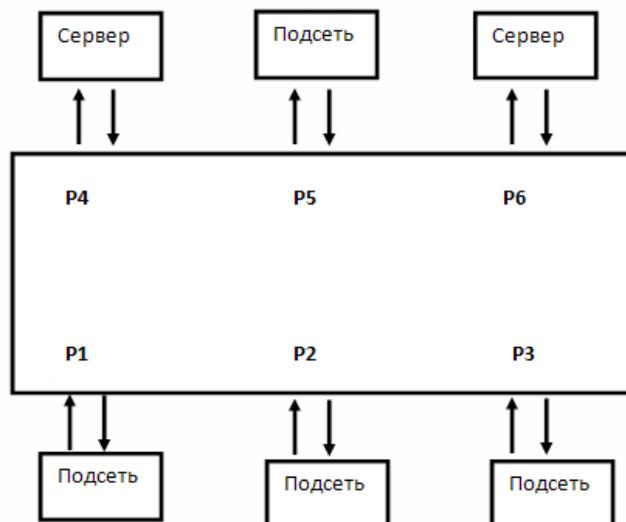


Fig. 14 – The distribution of traffic on the network uses switches

	1	2	3	4	5	6
1	0	P ₁₂				
2	P ₁₂	0	P ₁₂	P ₁₂	P ₁₂	P ₁₂
3	P ₁₂	P ₁₂	0	P ₁₂	P ₁₂	P ₁₂
4	P ₁₂	P ₁₂	P ₁₂	0	P ₁₂	P ₁₂
5	P ₁₂	P ₁₂	P ₁₂	P ₁₂	0	P ₁₂
6	P ₁₂	0				

Figure 15 - Matrix of average traffic intensity

$$\begin{cases} x_1 \cdot \sum_j N_j \cdot \gamma_j < d_1 \\ x_2 \cdot \sum_j N_j \cdot \gamma_j < d_2 \\ \dots \\ x_i \cdot \sum_j N_j \cdot \gamma_j < d_i \end{cases}, (3)$$

where N is the number of users in the switching node, γ - [messages / sec] received by the switching node of users, j - determines the number of users connected to the switching node.

$$\begin{cases} x_1 \cdot \sum_j N_j \cdot p_j < B_1 \\ x_2 \cdot \sum_j N_j \cdot p_j < B_2 \\ \dots \\ x_i \cdot \sum_j N_j \cdot p_j < B_i \end{cases}, (4)$$

where p - the intensity of traffic per user, B - the performance of a node.

To estimate the maximum value of the traffic that is transmitted over a computer network, you can use the simplex method to consider the performance of switching nodes.

The simplex method is a very versatile method for solving a linear system of equations or inequalities and linear functional [11].

The basic idea of the simplex method (in other words it is called the simplex method) for solving linear programming problem is the following [12]:

- the ability to determine basic plan, originally taken;
- selection criterion of the support program, which shows the ideal;

□ the ability to move on to the basic plan, which has nehudshy result.

The following is a simplex table that will be used by us (Table 7).

Table 7 - Simplex table.

C	B	L	C1	C2	...	Cm	Cm+1	...	Cm+k
			X1	X2	...	Xm	Xm+1	...	Xm+k
C1	X1	L1	1	0	:	0	q1,m+1	:	q1,m+k
C2	X2	L2	0	1	:	0	q2,m+1	:	q2,m+k
C3	X3	L3	0	0	:	0	q3,m+1	:	q3,m+k
:	:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:	:
Cm	Xm	Lm	0	0	:	0	qm,m+1	:	qm,m+k
	F=	F0	□□	□□	...	□m	□m+1	...	□m+k

The first column contains the coefficients in the objective function of the basis variables.

The second column is the basic variables.

The third column contains the constant terms.

The top row contains the coefficients of the objective function.

In the second row from the top contains the variables that are included in the objective function, as well as a system of constraints.

Ground field simplex method is a system of coefficients of the equation.

The last line contains information on how the plan is optimal or not.

The index gives the line of best plan:

1. When determining Fmin in the index line should be negative and zero rating.
2. When determining Fmax in the index line should be zero or positive

evaluation.

When we pass to the second iteration, the following happens:

We look for a key column and the key line.

The key column is the one that has the largest positive element of the index row in the search Fmin or lowest negative element in finding Fmax [13-15].

The key line is the one that has the least positive by dividing the elements of the column L to the appropriate members of the key column.

At the intersection of a row and a column is Allow.

Then there is a transition to iterations.

Iteration as follows:

1. Defines the basis of the key string, yielding a variable key column with its coefficient.
2. The filling of the newly introduced line basis, based on dividing the relevant elements of the selected row in the previous iteration Allow.
3. If the main line contains the zero element, the column in which the element to be transferred to the next iteration of the same.
4. If in the main column has a zero element, the row in which he was transferred without change in subsequent iterations.
5. The other elements are carried by the formula (5).

$$q_{i,j}^{(k+1)} = q_{i,j}^{(k)} - \frac{\Pi_p^{(k)} * q_{i,j}^{ключевая*} * \Pi_p^{(k)} * q_{i,j}^{ключевой}}{P^k} \quad (5)$$

2.3. The software development of subsystem for modeling of computer networks

To install the software to simulate and study routing algorithms in IP networks of various configurations to copy the program folder on the computer hard drive. To start the program, you need to go to the program folder and run the executable «MODEL.exe».

After starting the program on the screen will display the main window, shown in Fig. 16.

In this window (Figure 16) to set limits, which are - nodes and communication channels, and their parameters. In this case, the task of determining the traffic on sites, each site has a host (such as a router), and the communication channel. Once all the data will be entered, press the button "Next". The "Add", "Edit" and "Delete" are used to correct the information entered.

Also in the main window, there are buttons "Clear" - used to clear filled fields and "Exit" - to exit the program.

The next phase - input parameters of the objective function (Fig. 17). Here you must enter the number of sites. Parameters sections taken for "1."

"Back" button to return to the previous step.

Once areas have been added, you must click on "Next" and proceed to fill in the parameter table of nodes and channels shown in Figure 18.

After filling in the table (Figure 19), you must go to the next step by clicking on "Next".

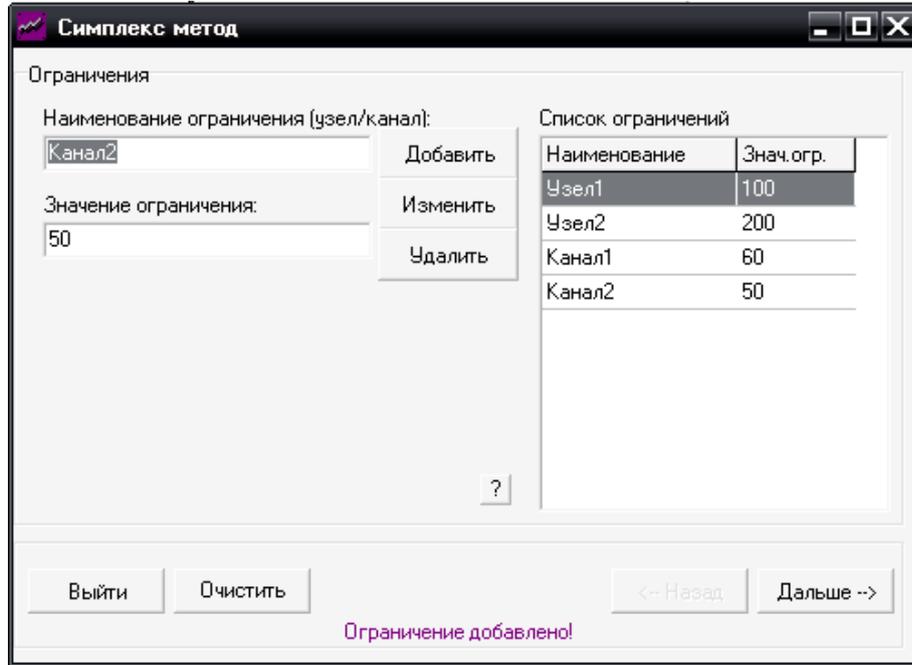


Fig. 16 - The main window

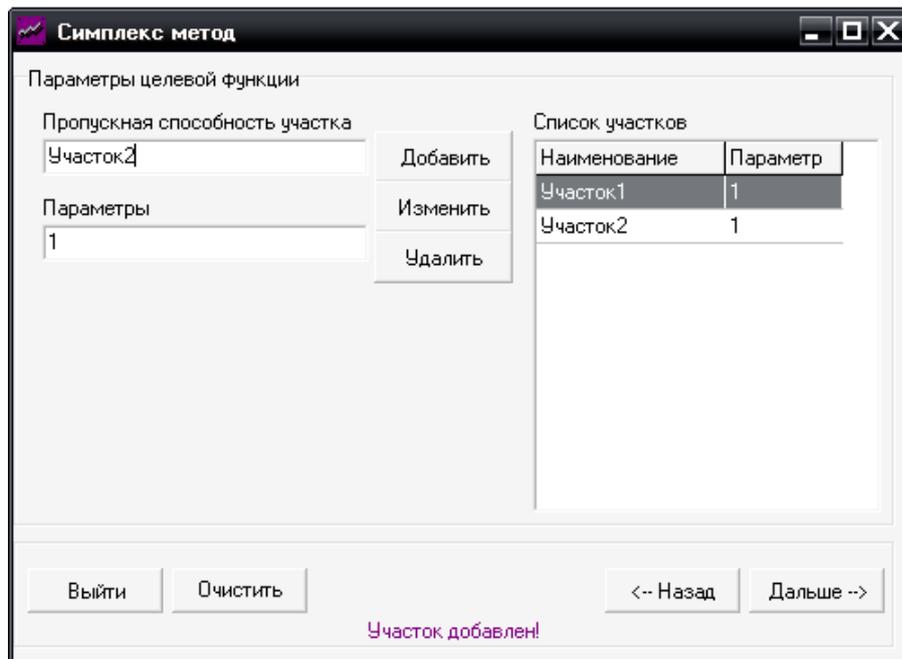


Figure 17. Setting the number of sites

Next you will see a table filled with simplex (Fig. 20), which is ready for settlement. This window contains the following controls:

- "Clear" - to clear the table;
- «Step-by-step» - settles the steps;
- "Decide" - to find the optimal solution;
- "A" - to show the answer in the form of a report.

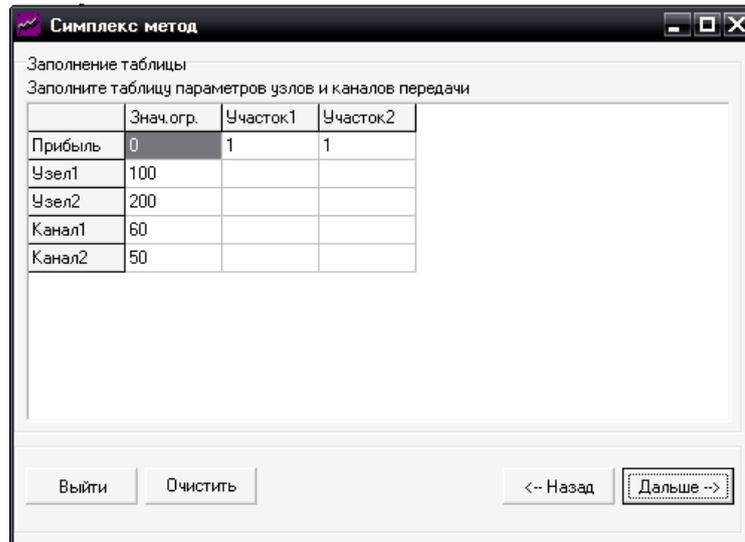


Fig. 18 Filling the parameter table of nodes and channels

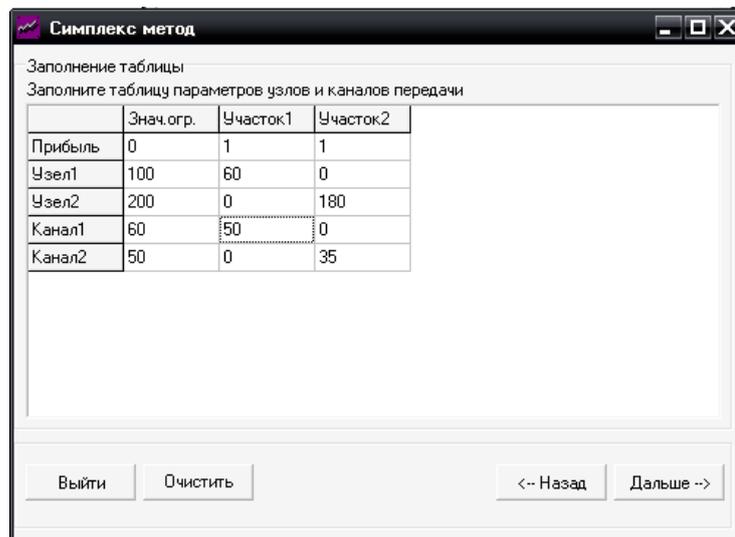


Fig.19 The completed table

If you click "solve" appears on the screen designed simplex table shown in Figure 21.

If you click "Reply", the decision will be formed as shown in Figure 22.

Симплекс метод

Поиск максимизации участков передачи

	Знач.огр.	Участок1	Участок2	Узел1	Узел2	Канал1	Ка
Прибыль	0	-1	-1	0	0	0	0
Узел1	100	60	0	1	0	0	0
Узел2	200	0	180	0	1	0	0
Канал1	60	50	0	0	0	1	0
Канал2	50	0	35	0	0	0	1

Выйти Очистить Step-by-step Решить <-- Назад <Ответ>

Fig. 20 completed the simplex table

Симплекс метод

Поиск максимизации участков передачи

	Знач.огр.	Участок1	Участок2	Узел1	Узел2	Канал1	Ка
Прибыль	2,311111111	0	0	0	0,005555555	0,02	0
Узел1	28	0	0	1	0	-1,2	0
Участок2	1,111111111	0	1	0	0,005555555	0	0
Участок1	1,2	1	0	0	0	0,02	0
Канал2	11,11111111	0	0	0	-0,194444444	0	1

Выйти Очистить Step-by-step **Решить** <-- Назад <Ответ>

Решение найдено!!!

Fig. 21 Decision in the table

Симплекс метод

Оптимальный план

Пропускная способность:
 Участок2 в объеме 1,1111111111111111 байт/с
 Участок1 в объеме 1,2 байт/с

Запас производительности:
 Узел1 в объеме 28
 Канал2 в объеме 11,1111111111112

Значение целевой функции равно 2,311111111111111

Выйти Очистить <-- Назад <Ответ>

Решение найдено!!!

Fig. 22 The decision in a report

From that shown in Fig. 22 of the report, you can see that the capacity of "Site 2" is equal to 1.11 bytes / s "Site 1" is 1.2 bytes / s. It also provides headroom for each parameter, in this case - for the "Node 1" headroom is 28, for "Channel 2" headroom is 11.1. Objective function value equal to 2.31. For a real system with similar characteristics, the results can be considered acceptable.

Conclusions.

Develop an information system model calculation of the cost of equipment. Justify the structure of the database to store information about the types of equipment used. The algorithm of the calculation of LAN equipment based on correlation analysis.

Formulation of the problem of modeling conducted research and routing algorithms in computer networks with different configurations.

A mathematical model for evaluating the capacity of the communication channels to the volume of traffic sent in switching nodes and capacity of switching nodes.

Developed software that implements the developed mathematical model, and which is a solution based on the simplex method. The description of the program and the interpretation of the results also shows the adequacy of the results.

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Shevchuk I.B., Vaskiv O.M.

**INFORMATION TECHNOLOGY OF MESOLEVEL: ESSENCE AND
FEATURES OF APPLICATION**

Lviv State Academy of Finance

Foreword. Trends development of modern information society predetermine reorientation of regional management and economic entities of regional economy on the application of information technology (IT) in their work. Using IT contributes significantly to the modernization of information and telecommunication systems in the region, reducing administrative costs, changes system of relationship between entities of regional economy, expanding access producers and the region's population to sources of information. Fundamentally changing opportunities of receiving, storing, disseminating information, increasing efficiency of economic contacts participants of regional markets.

Systematization of accumulated knowledge and foreign experience in the theory and practice application of modern information technologies in various field of activity engaged in such domestic and foreign scholars as O. Tomaszewski, G. Tsehelyk, M. Viter, V. Duduk [5] A. Shevchuk [9], P. Klimushyn, O. Orlov, A. Serenok [7], O. Gritsunov [1], M. Ozhevan, S. Hnatiuk, T. Isakova, D. Dubov [6] and others. However, in theirs scientific achievements not enough attention paid to the application of information technology to deepen regional research in practice regional management, spatial planning.

The general understanding of information technology (IT) - a purposeful organized totality of information processes using computer aids which provide high speed data processing, a quick search of information, dispersal data, access to sources of information regardless of their location. [4] According to the definition adopted by UNESCO, IT - a set of interrelated, scientific, technological, engineering disciplines that study the methods of effective labor organization of people employed processing

and storage of information, computer facilities and methods of organizing and interacting with people and production equipment, their practical applications and linked with all these social, economic and cultural issues. The main features of modern IT are a computer information processing, storing large amounts of information on storage media and transfer of information at any distance in the shortest time [3].

With the advent and widespread introduction of computers and peripheral equipment came era of computer information technology, which also got a name new, modern, paperless. Basic principles of the new information technology (NIT) - is integrity, flexibility and informativeness. It characterized by the following features [2, p.7-9]:

- work user in mode manipulation of data(not programming);
- complete information support at all stages of passing information based on an integrated database, which provides for a unified form of presentation, storage, retrieval, display, recovery and data protection;
- paperless process of processing of the document when only its final version is fixed on the paper, intermediate versions and required data recorded on the storage media, communicated to the user through a computer display screen;
- interactive (dialog) mode solving tasks which allows to users to actively influence the process;
- enable collective (group) collaboration for document preparation and execution of tasks on the basis of several personal computers combined means of communication;
- the possibility of adaptive reconstruction forms and ways of presenting information in the process of task solution.

Given that the concept of "information technology" (IT) spreads to all areas of human activity, because the information which transformed into data, knowledge, informational and software products, technological inventions - is an integral part of today [5], then advisable to consider information technology as an effective tool of providing progressive functioning of the economy of state as a whole and its regions.

In this context, when information technology should be understood as a set of methods, processes, and software and technical means combined into a process chain that provides collection, processing, storage and display of information in order to reduce the complexity of the processes of research development and operation of the regional economy under influence of different factors [9, p. 43-46], activation of its development, expansion fields of activity of regional policy, increase efficiency projects of regional socio-economic development, providing sustainability and integrity of public relations existing within different regions.

At the regional economy possible is the use of such types of information technologies as IT data processing, IT management, IT decision support and IT expert systems (Fig. 1). Thus, IT data processing designed to meet the challenges of socio-economic development of the region, for which are necessary input data and known algorithms and other standard procedures their processing. This technology is mainly applied at the level of employees of regional administrative apparatus for automate some routine operations constantly recurring administrative work.

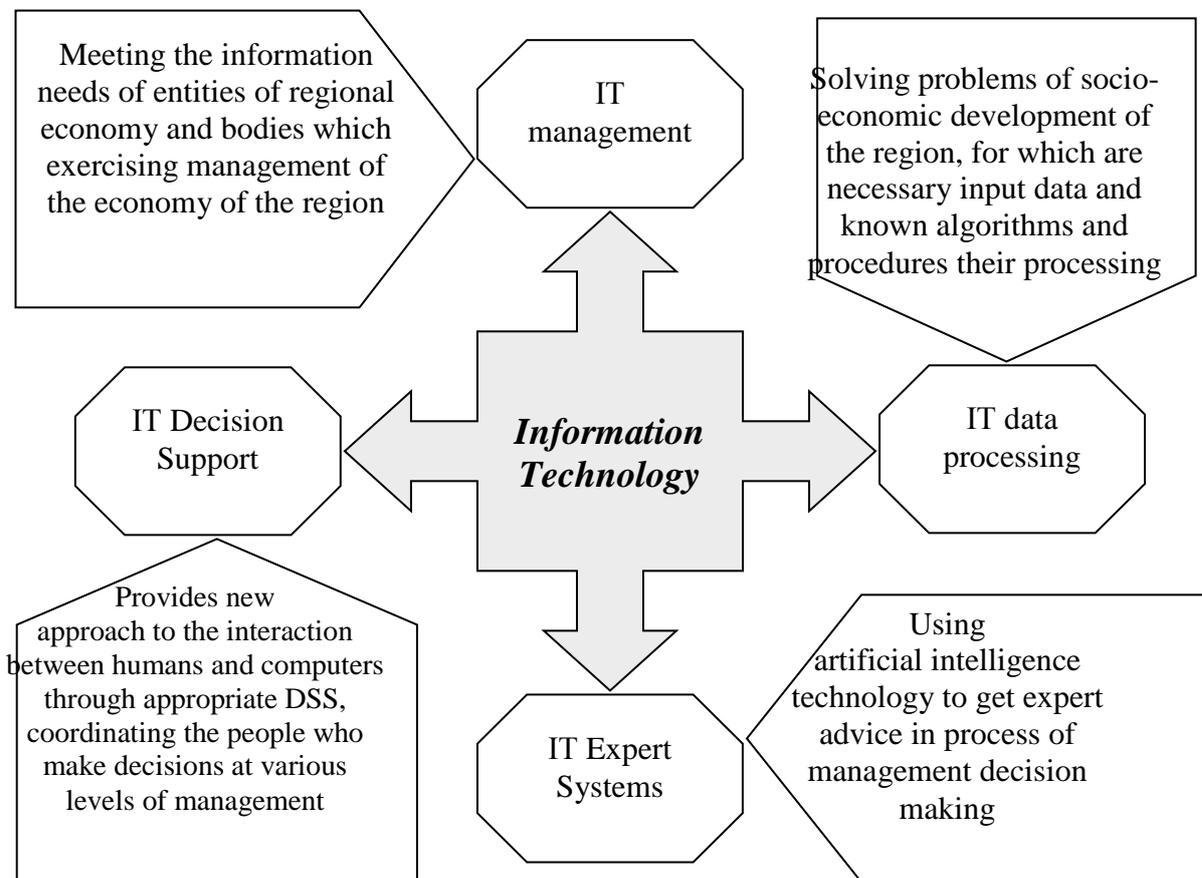


Fig. 1. Types of information technology regional economy

The goal of IT governance is to meet the information needs of any and all subjects of the regional economy, especially subjects that manage the regional economy and make decisions about its development and socio-economic growth of the region as a whole.

Information technology decision support provides a new approach to human interaction and computer through the appropriate decision support system (DSS) and in result are created a completely new information for decision making. Such IT can be used at any level of government region. In addition, management decisions which are made at different levels of management often must be coordinated. Functional purpose of this type of IT lies in coordinating individuals who make decisions as on the different levels of management, and on the same level.

Information technology of expert systems is based on the use of artificial intelligence. Expert systems allow professionals to get advice from experts on any issues on which they have accumulated knowledge. Technology of expert systems provides an opportunity to obtain output information not only the solution but also the necessary explanations.

Possible points of application of information technologies and areas of their influence in the regional economy include: information management in general, technical support, communication network, general and electronic computing means, methods and models, software and application packages.

Under the influence of IT usage significantly is changed the nature of regional research. At the same time is changed not only the nature of these processes, but also the corresponding organizational structure.

The process management of economic process at the regional level primarily is an information process that is associated with collection and processing of information. So information technology directly affect the efficiency of management, they change working conditions, including the management and involve information as a subject of work. In this context, the main purpose of the application of IT in regional governance is defined as receipt through processing primary information absolutely new, conducting its analysis and adoption on its basis of relevant decisions

to support and enhance socio-economic development of regions. General structure of IT as a means of organizing work on information processing in the regional management with its distribution on the basic procedure is shown in Fig. 2.

Information technologies have a number of properties that allows us to consider them as one of the most important catalysts socio-economic development of regions, which accelerates increase work of efficiency of the various sectors of the regional economy and economic growth, achieve specific goals of social development and also expansion participation of citizens in the political life of society and achieve qualitative level of management of regional development and territorial planning (Fig. 3).

Firstly, it is their ability to manage knowledge, including helping people in collecting, processing, storage and dissemination of knowledge. Knowledge management is crucial in the globalization challenges, where development often depends on the ability to rapidly acquire and effectively use knowledge and also quickly transfer them to state and local government, associates and others.

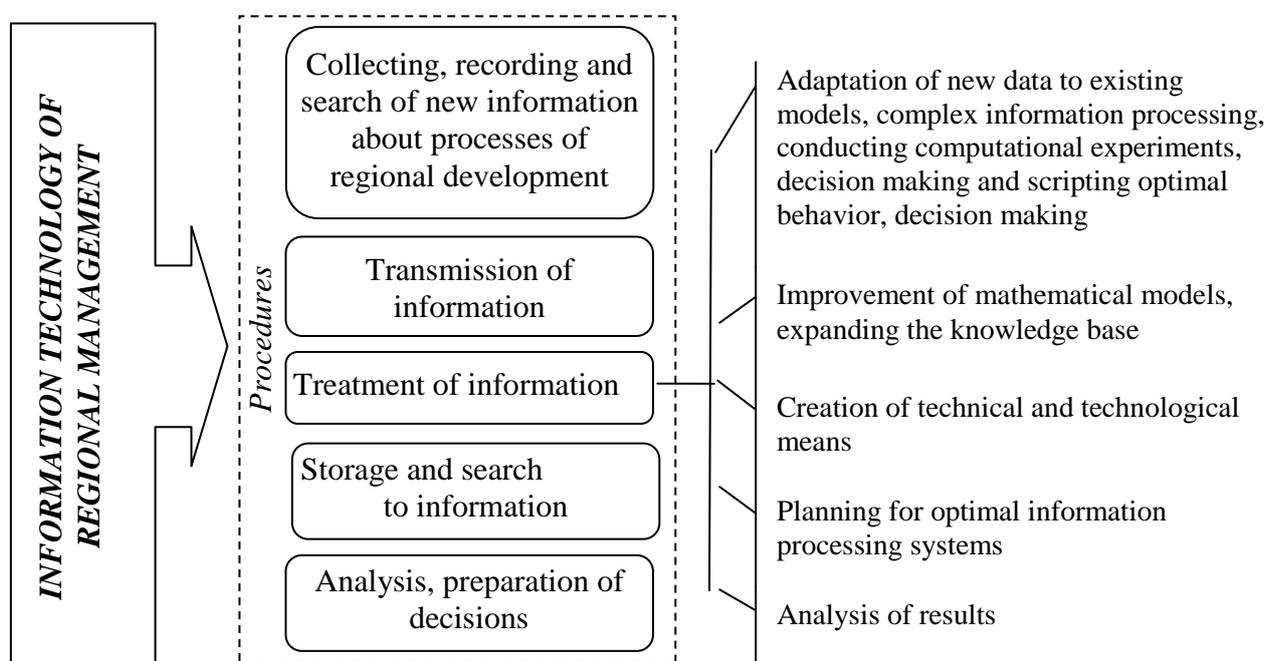


Fig. 2. Procedures information technology regional management

Secondly, IT can help businesses and organizations in undeveloped regions to compete more effectively with business entities in developed regions, and enter international markets.

Thirdly, information technology allow solve many non-economic problems by providing access to information. Internet is the integral part of the socio-economic development of regions and the country in general, as it provides both individual users and companies actually equal access to information, resources, distribution mechanisms and potential customers.

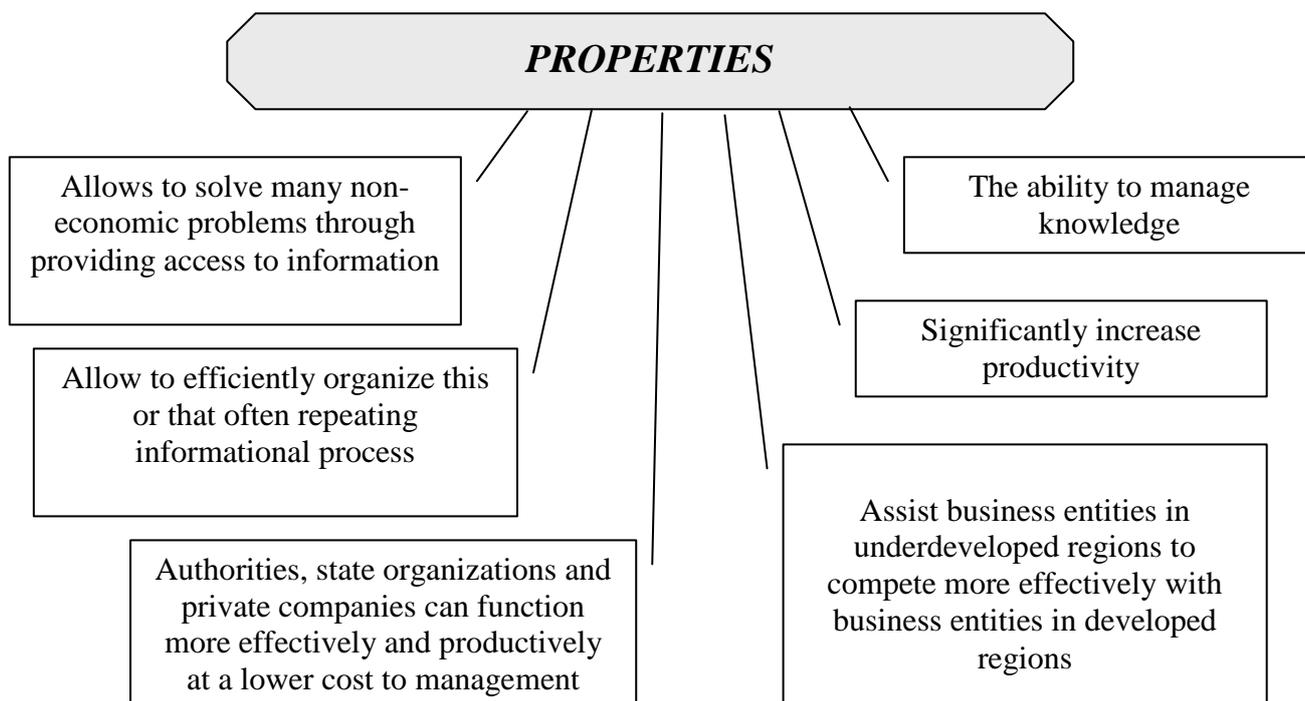


Fig. 3. Options IT as a catalysts of socio-economic development

Fourthly, by using IT, governments at various territorial levels, state organizations and private companies can operate more effectively and productively at a lower cost management as the economy of the region, the basic units of life in the region, and production in market conditions etc.

Fifthly, they significantly increase productivity of work. Thus, according to the results of a study conducted by organizations Stockholm School of Economics (SSE Russia) and SSE Ring Research with supported by Microsoft, about 50% of gross value added in some sectors of the Russian economy (finance, telecommunications, retail, electricity and food industry) are created resulting from the use of IT. Active

use of ICT creates additional competitive advantage for companies and within sectors, because there is a direct correlation between the level of integrated IT development companies and their productivity [8].

Sixthly, IT as a concentrated expression of scientific knowledge and practical experience enables rational way to organize this or that often repeating informational process with significant savings in the cost of labor, energy of human and material resources necessary for its implementation.

Application of Information Technology in the regional economy primarily aims:

- switching to electronic forms of document circulation between companies, between companies and regulatory authorities, between state authorities of different levels;
- construction of a rational structure of information sharing inside each business entity in the region;
- structuring and ordering information concerning regional socio-economic development;
- improving information support regional management;
- ensuring access to information for users of any part of the region;
- control and management of socio-economic processes in the region;
- improving the business environment in the region and strengthening inter-regional relations;
- development of informative space of region;
- formation of information culture managers, students, the population of rural and urban settlements of the region, etc.;
- increasing the efficiency and quality process of management decision making at all levels hierarchy of management region, business entities;
- activization of cultural and cognitive activities about the region through information and cognitive portals;
- deepening interregional informational linkages and enhancing cooperation between regions;

- to promote more free placement productions without compulsory binding to major cities;

- transformation of economy of resources in the knowledge economy as a prerequisite for sustainable regional development. In addition, the development of the knowledge economy improves global competitiveness of production by the country and its individual regions. It is determined by the intensity of development its three components: innovation, education, and information and communication technology.

Modern IT in information-economic environment must perform such functions as technical means automation of process research and management of regional development, means of change key resources development, means of remote informational communication, means of mobile work with information in various forms, means of support research approaches to region as to market, complicated territorial and social system, etc.

Conclusions. The importance and significant role of information technology in development all areas of the regional economy is undeniable. Because their application provides increase efficiency governance at all levels in the state and private sectors of the regional economy, promotes expansion interaction between government, local government and citizens through free and rapid access to information. IT help make important economic decisions and directly participate in process of effective management of innovation, business, entrepreneurship and functional activities in the region. They allow you to calculate and predict the results of socio-economic development in regions and on this basis they make the right management decisions to address problems of regional economy and prospects of development.

So strategic importance of IT for the development of regional economy and socio-economic development of regions in general is made conditional to the fact that they allow effectively use information resources to solve regional problems, optimize and automate information processes in the regional management and ultimately serve important elements of more complex technologies of providing of information interaction between people and organizations, authorities.

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J11307-223

Zavistovskaya T.A., Kovshov E.E.

**AUTOMATING THE PROCESS OF THE TEXT MESSAGES
FORMATION BY PROCESSING THE SEQUENCE OF DIGITAL IMAGES
FACE OPERATOR UNDER A STRONG NOISE CONDITIONS**

MSTU "STANKIN"

Currently, hardware and software systems used for creating, receiving, processing, storage, transmission and delivery of messages that are the main means of communication and communication of people. Modern means of mass communication have contributed to the rapid development of this research area in applied computer science, as a human-computer interaction, the purpose of which is to improve the interface between the computer and the user [1]. The use of human-computer interfaces to create a text message is especially important and economically justified in the context of developing information and communication technology and communication systems.

Existing methods and means of preparing text messages generated by human voice, fail to achieve the desired quality, sufficient to produce a text document. The accuracy of the speech recognition systems based only on audio processing, sharply reduced the distortion of sound information noise and interference of various nature. Support system for human-computer interaction, based on the analysis of changes in the nasolabial muscles of the face, is invariant with respect to extraneous sound effects, which certainly is an advantage compared to the speech recognition system. Computer processing of the sequence of digital images (video) to a person in real-time allowing a text message [2].

Computer interface of a new generation of so-called "silent interface access" will enable the operator to transmit information "silently", that is, without uttering any sound. Visual system input will simplify and automate the speech input, without the use of any speech recognizer, which in turn saves time resources to spend before the transfer of the channel of communication and audio processing module of the

expert system of the speech signal. The advantages of such a "silent" mode of communication can include a high degree of reliability in the transmission of private and confidential information.

In speech recognition, for the development and improvement of interface between man and computer, more and more significant role is played by the input system of visual information. Thus, *the object of the study* is to automate the process of forming text messages through formalizing procedures lipreading speech operator system for computer vision.

The subject of the study are models and software tools for the automatic detection of the lip contour geometry on a sequence of digital images of the face of the operator for further development of text messaging to improve human-computer interaction based on «open source» making.

Purpose – to create a software system to support human-computer interaction (HCI, from the English. Human-Computer Interaction), detecting change in lip respectively and recording the resulting phoneme vizemu as text information. In reviewing the status of the problem was the analysis of existing software development and hardware and software using motion information nasolabial muscles. The paper presents the concept of an information system that can simplify and facilitate speech input information in an acoustic zashumlenonosti. Support system for human-computer interaction, which is based on the detection of changes in the lip, the appropriate definition of the phoneme vowel, is invariant with respect to extraneous sound effects. Such a system will find its use for the preparation of a text message in a chemical, radiation pollution, excessive heat, open combat, when the likelihood of distortion of sound when it is transferred via voice is maximum. The presence of strong acoustic noise and interference in the acoustic path dramatically reduces the reliability of the recognition of the speech signal.

The proposed information system is a software that detects the change in the muscles of the mouth of the circle corresponding to a specific phoneme - vizemu and writes it in the form of textual information. In an object-relational database stores the visible image corresponding phonemes (sounds), together with their characteristic

descriptors. Descriptors are the angles formed by segments of the geometric model of the face or a mask, put on the face of the operator. Software application that works with a video camera (webcam), monitors changes in lip movements on a sequence of digital images, comparing the information with the database. As a result of translating the movement of the lips at the system output will be written to a text message - text to speech, commands, orders or order. Visual perception of speech is written in ASCII-text file and can be transmitted through existing technologies such as these, as wireless pico-network or Wi-Fi.

The main way of extracting data from the video of the speech is to analyze the movements of the lips or lip reading [3]. The main source of input data for the task is to find the characteristic points or areas, including recognition of the lip contour. For this goal has been chosen method of active contour, allowing the identification of a human face on the image and select the set of points characterizing features [4]. Of all the selected feature points and connected in such a way that they form the corners (descriptors) is uniquely determined by the change of muscle lips [5, 6]. The geometric model was constructed on the basis of work in the field of recognition of emotions created by renowned scientists P. Ekman and W. Frizenom – "The emotional system of coding facial movements" (SKLID) [7]. Based on the geometric model of the human face were identified those descriptors that uniquely define the muscles of the mouth change the conversation.

Currently implemented version of a functioning software application (Figure 1), automatically allocate lips on the face and mouth defining descriptors, which are the angles made between the characteristic points.

The application of this method to the human face is implemented using open source solutions STASM 3.0, which uses the computer vision library of open source - OpenCV. In this work, OpenCV version V2.2.0 was used to visualize the geometric model, image processing, and select the lips. Functionality of the library is also used in STASM 3.0 [8] to identify the person in the image of Viola-Jones method using Haar cascades[9].

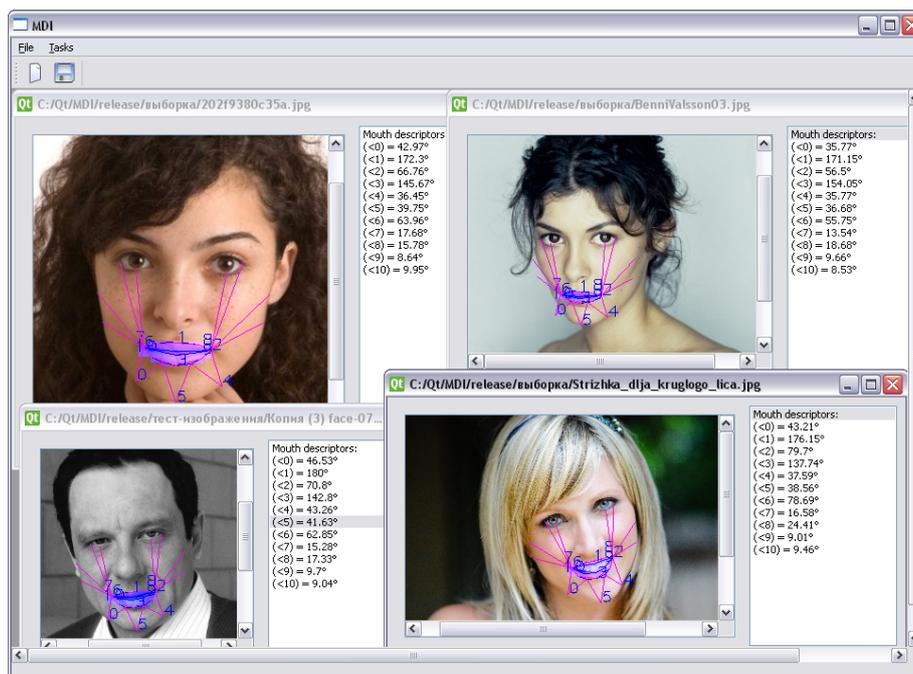


Fig.1 Application user's interface (fragment)

In the course of the research, including – in the implementation of application software has been used set of development tools Qt SDK v2010.05 for Windows XP (open source), which includes a class library version 4.7.0 (libraries version 4.7.0) [10, 11], Qt development tools and development environment for editing, compiling and debugging – Qt Creator IDE version 2.0.1.

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J11307-224

Batenkina O.V.

CREATING INTELLIGENT SEARCH SYSTEM AND MAKING DESIGN DECISIONS ENGINEERING AND DESIGN DESTINATION

Omsk State Technical University

The rapid development of information and communication technologies contributed to the creation of new methods and structures to radically restructure the production process properties. Currently, the world market high technology industry products clearly observed three major trends [1]:

- 1) increasing complexity of products,
- 2) improvement of resource products,
- 3) increasing competition in the market and the development of cooperation

between members of life cycle (LC) products.

To achieve an adequate level of interaction of industrial automation systems it is required creation of a single information medium not only for individual companies, but also within the union of companies (fig.1).

Single information space provides due to unification, both the form and content of information on specific products at different stages of their life cycle.

The ultimate aim of production is not only automatically product life cycle processes, but the real reduction of time and cost of the entire chain: development of design - product development - manufacturing products.

Achievement of this goal is possible in three main areas:

- 1) acceleration and reduce the cost of product design;
- 2) acceleration and reduce the cost of manufacturing the product;

3) acceleration and reduce the cost of promoting products on the market and its operation.

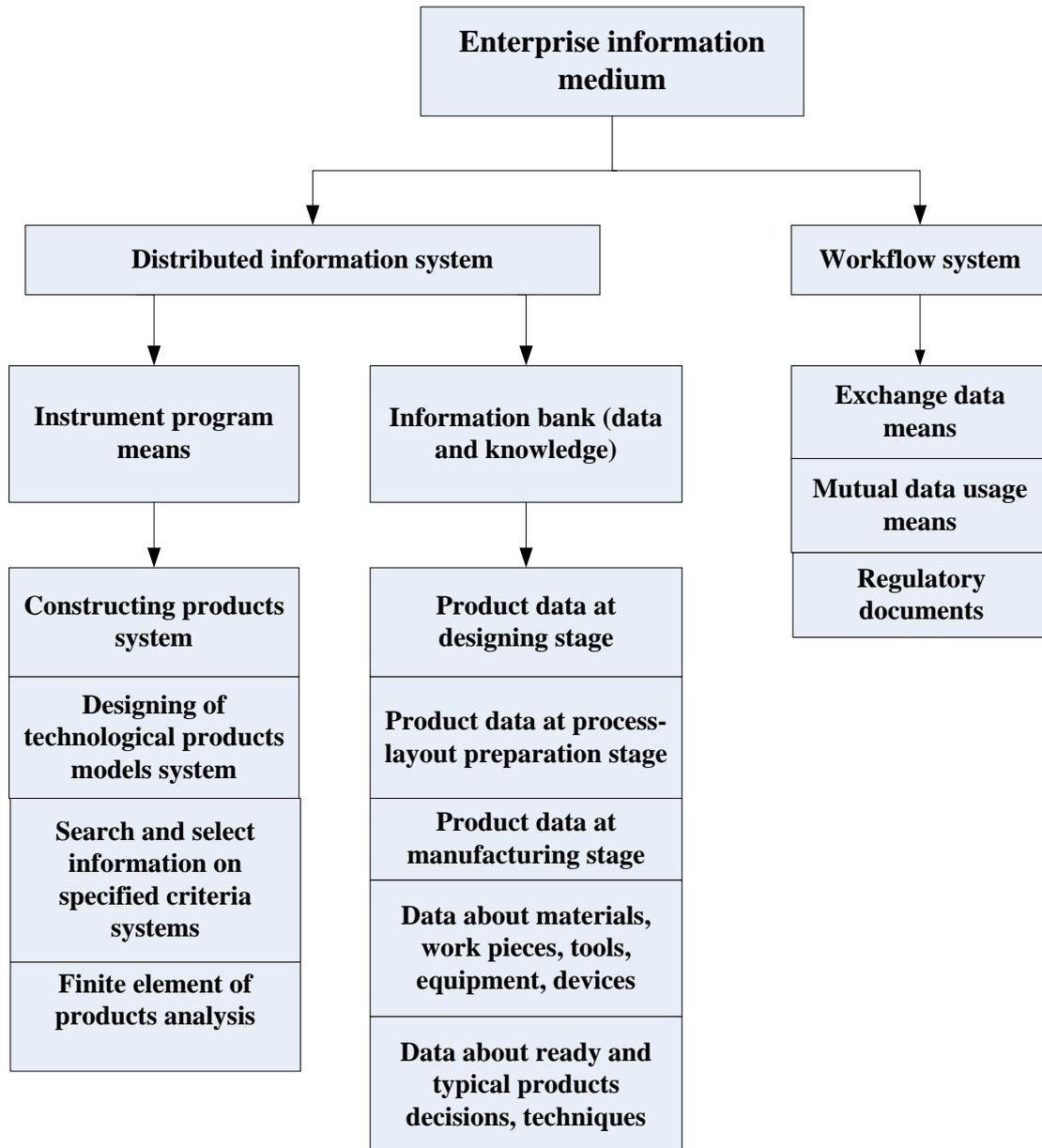


Fig. 1. Block diagram of the enterprise information environment

Shortening the design at all stages of the life cycle of the newly developed equipment is by far the most important task. One of the ways to solve this problem is the creation and development of automation systems design (CAD). [2]

Typically, CAD is designed for the design of complex objects. Complex object is the product of design or construction, which is characterized by the following features [3]:

- it consists of large number of elements (construction details and assemblies);
- it is characterized by conflicting requirements for quality;
- it is characterized by underdeveloped of formal relationships to its quality of decision-making, or the lack of unambiguous criteria for evaluation of these decisions;
- it has a set of properties that defines not only the properties of the elements, but also the nature of the interaction between the elements;
- it is marked with new technical solutions;
- it is intended for use in the multi-component system, or in changing (not entirely certain way) conditions;
- industrial equipment is manufactured involving a large number of enterprises.

Creating a design automation systems is an important task of the theoretical and practical aspects that will represent knowledge for structural and parametric synthesis in design and technological preparation of production.

Studies have shown that at the present time there are automated only simple formal, highly structured problems [4]. For complex, non-formalized, semi tasks such as selecting tooling and tool evaluation and selection based on analysis of viable options for the design decisions, in the best case, the system is only used in the dialogue regime.

The main obstacles to the creation of automation engineering and design destination now are:

- poor formalizing of some knowledge using algorithms;
- not all knowledge can be represented in a machine;
- partial or complete uncertainty of some knowledge or inquiries;
- for the application the most important objective (focus on general knowledge), and the subjectivity of the programs (focus on a specific organization).

The essence of automation engineering and design purpose is to search for and adoption of design solutions that fulfill future product demands placed on them. The quality of the design solutions obtained is directly related to the degree of automation

of the design process, especially in terms of increasing complexity and functional diversity of created system components.

Currently, the main trend in the direction of the development of automation systems is the development of cross-cutting CAD, but even their effectiveness remains inadequate accurate, since the best is only automated design stage design. Production planning in these CAD in society is not considered.

There are a lot of diverse information, participating in the pre-production process, it is heterogeneous, partially stored in electronic form, in part - on paper, in part - in memory of staff. To work with such information is necessary to understand its structure, that is, to know what kind of knowledge is available in the enterprise, to which categories and subject areas it is included, where and in what form is stored.

Considering the above, we can formulate the main problems of task searching and making design decisions [5]:

- compact representation of a set of options (alternatives);
- Selecting the method of searching for the optimal variant (short sorting options).

Technological preparation of production facilities are blank, main and auxiliary equipment (Fig. 2). Mold is to be exposed in the course of technological preparation of production directly exposed by metal cutting tools. Many pieces can give a justification for the selection process. There are differences between the blooms of profile rod, sheet metal stampings and sheet blank. Kind of stuff - it is one of the characteristics of the object, as well as between this parameter and the nature of the technological process there is some relationship [6].

TP design begins with the definition of a technological route processing, i.e. sequence of operating steps and identifying their characteristics. For the development of technology transition sequence it is necessary to identify the criteria for selecting solutions that take into account characteristics of the work piece and possible technological operations. Depending on the sequence of transitions it is determined by technological steps to accomplish the task. Technically, the route must be constantly present information about assistive devices for the implementation of each

technology transition. The most important of this information is data about the equipment, auxiliary tools and instruments, they are determined by the basic equipment in accordance with the parameters of the work surface.

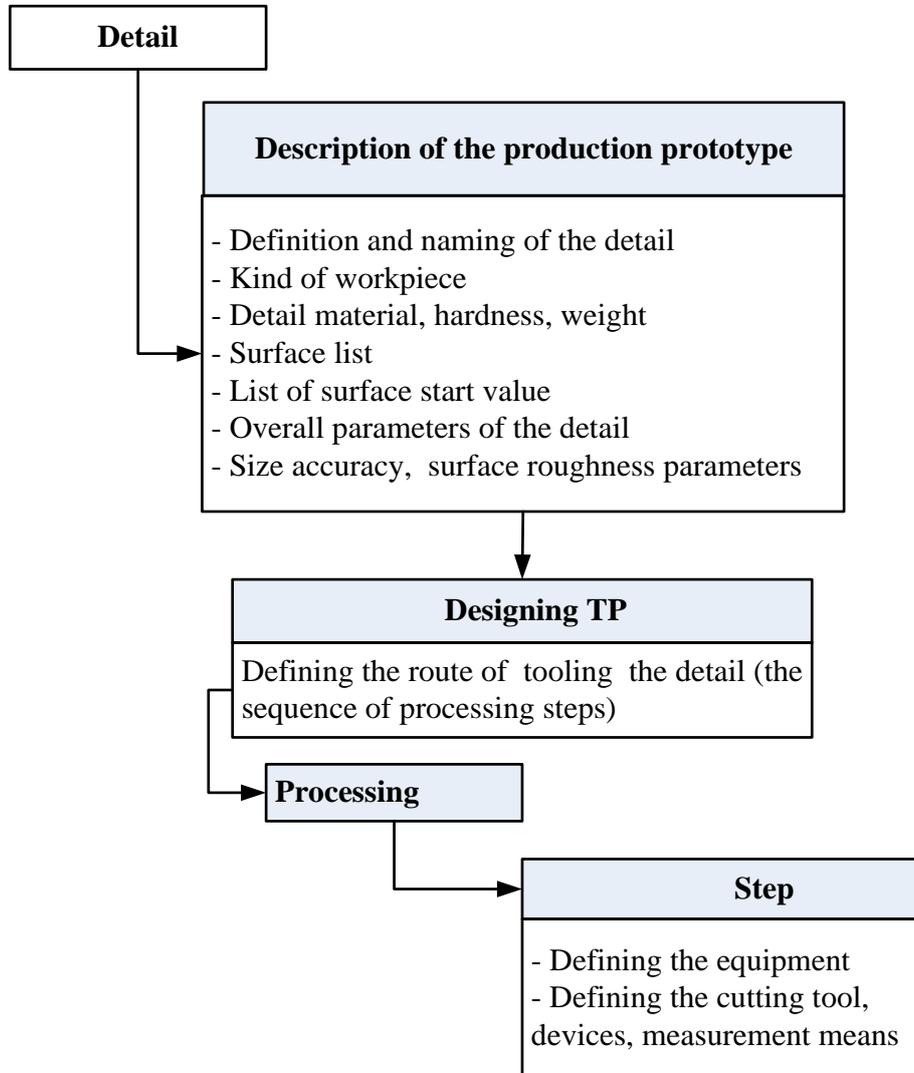


Fig. 2. Integrated scheme of interaction of information in computer-aided design of technical process (TP)

Thus, each type of treatment corresponds to a certain type of instrument, the use of which is impossible without a tool and means of measurement. Thus the type of treatment and the tools (tooling and equipment) are greatly influenced by the size of parts. Information about the material parts are also one of the criteria of the design process, along with the requirements for tools and machines. Optimal design for all

stages of process design is to achieve high quality of design in general and the effectiveness of the production process.

Here is given the integrated scheme of interaction of information in automated design of TP (Fig. 3).

All known modern computer-aided design TP implements the following methods of the design process:

- method of re-use of existing single TP (analog method);
- method of standard solutions;
- multi-step synthesis method;
- method of dialog design.

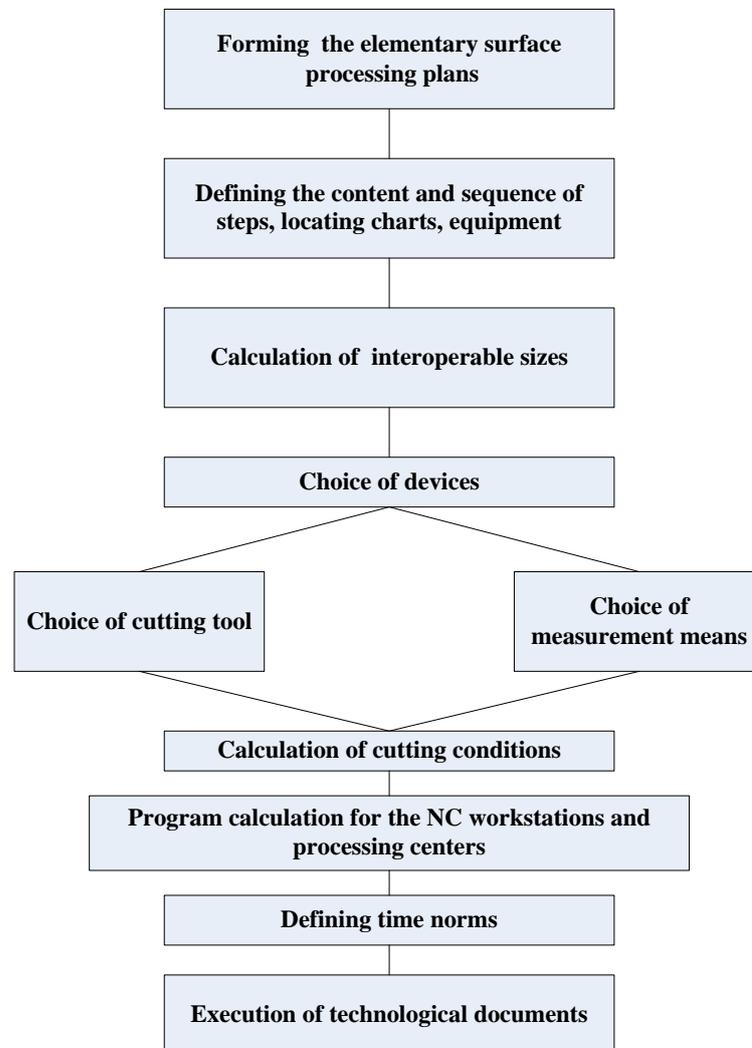


Fig. 3. TP design stages of machining

But whichever design method has not been used in CAD TA the problem of automating the search process tooling and tools, as well as decision-making still requires further research. From the words of firms virtually all CAD developers have ample opportunity TP implementation process of finding the required information in an existing database, which usually contains information about the technological equipment and tools, a set of state standards that are used in a specific area of design. Systems have the capacity to connect enterprise database. However, even after the databases have their design there is a problem of automated information search. Therefore, selection of equipment is made in the dialogue regime, with the high-quality solution greatly depending on the quality of decision-makers.

The complexity of the automation process of search and selection is also in the variety of existing enterprise equipment and tools, and can not be used for general inquiries database management system (DBMS) used in CAD TP in the search process. Database-aided design TP contains only information about the geometry and shape of objects, i.e. it contains data, not the knowledge of a specialist. The facts in the databases of CAD systems are passive in nature: either they have it or not. Database does not have "creative" opportunities, inherent knowledge bases that contain rules of inference of new knowledge, i.e. have the ability to self-learning and the accumulation of new information, and the ability to update the accumulated information.

In this regard, it is evident that the use of CAD fundamentally new approaches to the development and improvement is related, first of all, with using the principles and methods of Artificial Intelligence, the field of knowledge representation and mechanisms of project design.

The variety of geometric shapes blanks and machined parts, reflected in the geometric description of the object, makes hard knowledge representation and subsequent automation of technological design. One way of solving this problem is the classification of items.

Now in modern automated process design it is used standard method of classification of products, details of which are divided into the greatest possible

number of groups united by common technological problems arising in the manufacture [3]: shafts, bushings, wheels (solid of revolution), the eccentric part (such as crankshafts) crosses; levers; plates; rack - elbows, beams, gears, cams shaped, lead screws and worms, small fasteners. Each class is divided into groups of parts, sub-groups and types. Typical piece together is a set of parts with the same plan (route) operations carried out on a homogeneous equipment using the same type of tools and instruments.

This classification of parts and components for the ever-expanding range of products is yet another obstacle to the creation of automation engineering and design purposes.

The relevant classification of parts of the components is important for the designer. However, during the pre-production process fair representation of their products is to be. Product models used in existing modern systems are geometric, while as for the design process it is required a conceptual model.

Conceptual model of the product is based on the concept of design and technological elements (DEE), the simplest examples of which are shown in Fig. 4 [6].

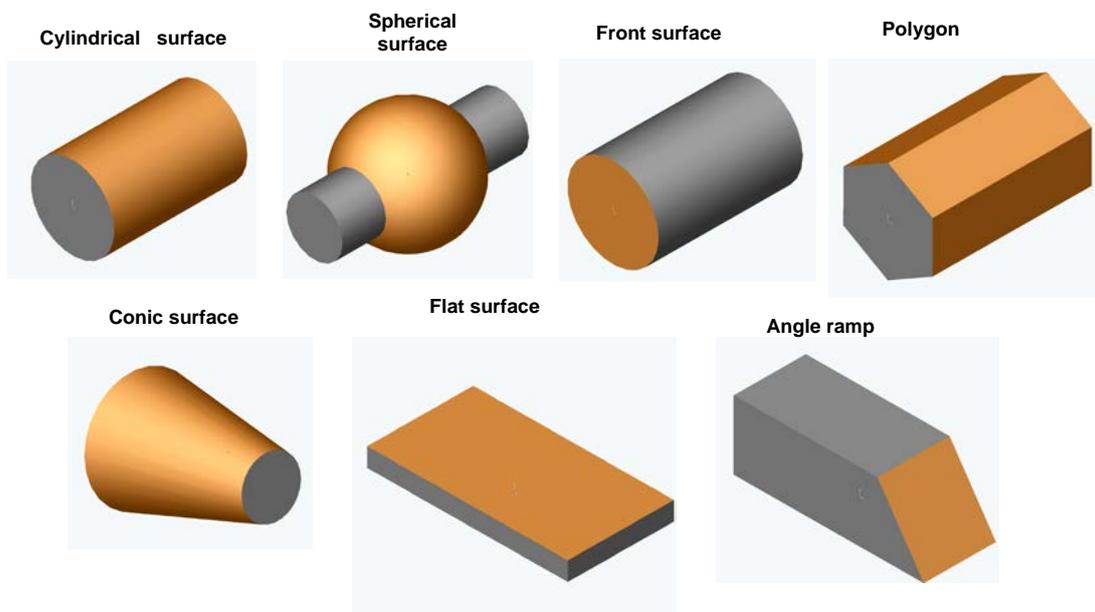


Fig. 4. Examples of design and technological elements

At the same time as the main element that describes the design of an object - a detail, it is proposed to use the design-engineering element (DEE), which is defined as:

$$DEE = EC + TP,$$

where EC - a unit of information on the element construction in terms of technology, which includes: the type of item parameters of the element, the geometry of the element;

TP - a unit of information that contains data about the treatment of one of the component, which includes: the type of transition, transition settings.

An element on the one hand is the design, as does the details of the design specific function, for example, provides basing parts in assemblies, or the parts of adjacent parts. On the other hand it has one or more of its manufacturing process flows generated from a set of transitions.

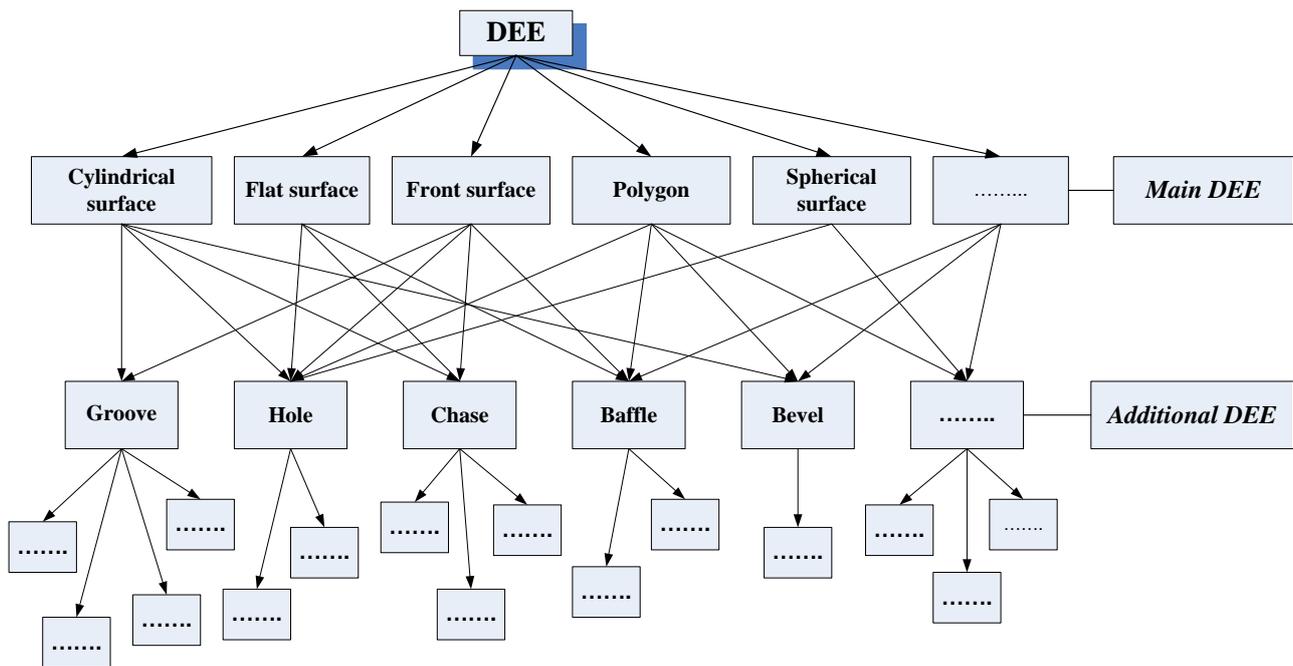


Fig. 5. The hierarchical structure of the representation of design and technological elements

Thus, any member may be represented by a set DEE with a hierarchical structure consisting of elements of complex levels, major and minor (Fig. 5). Some of the complex are axially symmetrical, prismatic elements and openings. Such a set of defined basic types of machining are operations details. Additional elements (boning,

slots, grooves, chamfers, etc.) are located in the main, as to their processing can begin only after the preliminary formation of the basic elements.

Most evident knowledge about objects technological preparation of production and their values can be represented as a tree, which is a convenient structure for storing information.

Each automation object refers to a certain category of DEE. Here we follow the rule: the object is attached to the bottom of the categories to which it belongs. Thus, the construction of the object tree can be seen as the process of successive transformations (partitions): originally a tree of objects, consisting of a single category, which are attached to all the objects. When branching in this category all the objects or part (depending on the completeness of the partition) go to the categories of the lower level. Lower-level categories are disjoint sets of objects, the amount of which is all space objects, or a subset of it (if the partition into any place was incomplete). The structure of the tree illustrates the relationships that are established between the objects in the knowledge base automation system (Fig. 6).

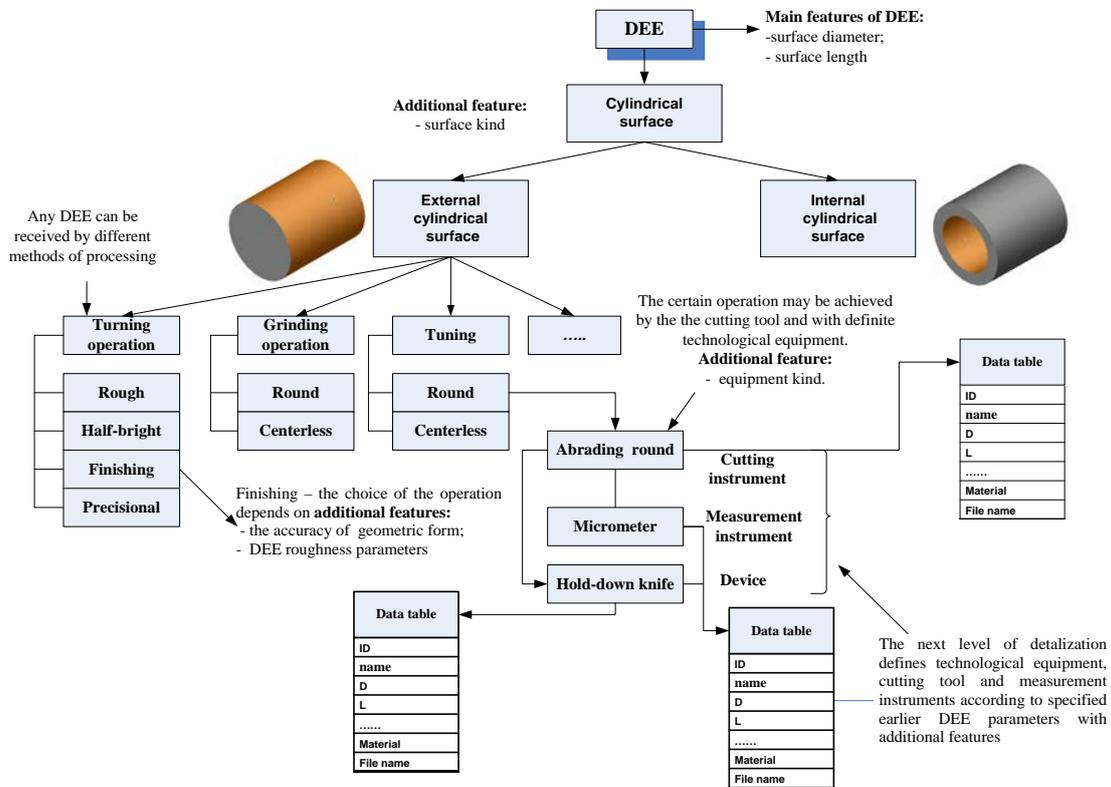


Fig. 6. A graphical representation of the tree of knowledge

Since each edge of the tree connects the top two types of feature and feature value. [7] Each of these features coupled with their values. In turn, any value of the underlying trait may create one or more other features of the next level, and a corresponding display on the tree, which extends to the lower levels.

Between elements of the sets is a one- one correspondence. Thus, the category can be defined either as the collection of values of a certain set of characteristics (category on the set of attribute values), or as a set of elements of the set, giving the region the two values of attributes (category on the set of objects).

In the case where the object tree becomes long and hard to define, it is divided into sections. This allows a set of objects partitioned into a number of subsets, each of them develops its object tree search system and decision engineering and design purposes.

This method of classification of objects of design and technological destination not only allows the specific and complex structure to represent the native form of the data, but also takes into account the knowledge of experts from the enterprise to design TA. The information is presented in a simple and user-friendly way, which allows to automate the search process and makes decisions on the given parameters.

The main purpose of the system is to provide information to users involved in the development and adoption of specific solutions in the computer-aided design, creating new projects with the accumulated knowledge base in the system and the knowledge available to the designer. The knowledge base of the system contains information reflecting the pattern of the subject area and to predict and derive new facts.

The model is determined by a description of the elements (entities), of which it is built, including relationships, and a set of descriptions of the properties and behavior of these elements.

In the description of the information involved in the design of TP it is better to use a production model for the description of knowledge, which is presented in the form of specific facts and rules. Facts are of the form "Attributes - Object - value."

Rules are represented as: "IF A - THEN S» (phenomenon - reaction) where A is condition; S is an action.

The action S is executed, if A is true. As a condition of A it can be either a fact or a few facts A₁, ..., A_n, combining logical operation "AND": A₁ "And" A₂ "I" ... "And". Rules in the knowledge base are used to represent the heuristic knowledge, i.e. informal rules of the arguments are produced by technology specialists based on the experience of its activities.

In order to convert the tree of knowledge in the rules, it is necessary to take into account the structure of the rules consisting of two parts [8].

Part of the "IF" can include several conditions that are linked together by logical operators "AND", "OR" and "NOT." Part of the "THEN" rule becomes operative only if all the conditions are true in the conditional part. In both parts of the tree corresponding to the rules is associated with each vertex and vertex solutions inference (Fig. 4). The condition part of the solution contains all the vertices in the path to the logical conclusion that each vertex of the solutions on the way to the conclusions, this is one condition of the "if." The conclusion is part of the "THEN" rule.

Table 1

Table variables names

Name of variable	Terms	Peak (s)
EXTERNAL	Is the DEE surface of the "cylindrical surface" male?	2
OPERATION	Is the DEE processing method "outer cylindrical surface" rough?	5,6,7,8,9
RA	"What kind of DEE surface roughness R should ensure Turning?"	11,12,13,14
POSITION	What method of treatment can be applied?	3,6,7,8,9,12, 13,14

All vertices contain variables that have unique names. Using variables instead of the full streamlining and writing rules. List of variable names, text that they replace, and the number of vertices for example (Fig. 5) are shown in Table. 1.

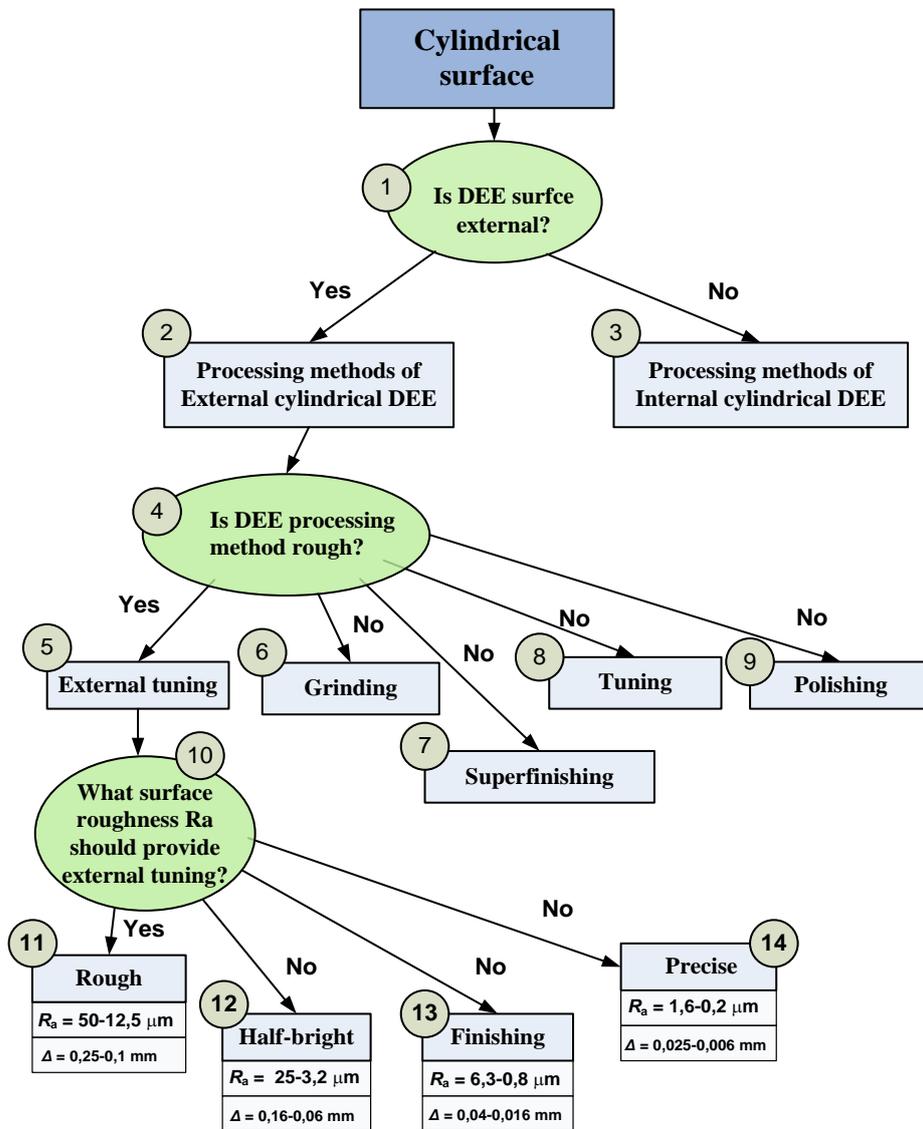


Fig. 5. The transformation of the tree into a rule

Check this reasoning begins with O and a decision tree can be seen in the opposite direction. Employing this way, the names of the variables (Table 1), you can create a rule:

IF EXTERNAL = YES AND OPERATION = YES AND R > = 40
THEN POSITION = Rough

Using these principles, it will continue to develop the database. Table. 2 contains all the rules for the decision tree shown in Fig. 6. Non rules are arbitrary and are only for identification needs.

Rules match all paths leading to the possible objectives of the decision tree.

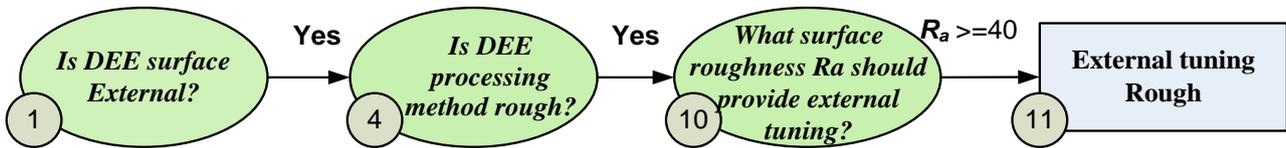


Fig. 6. The way to solve

Table 2 IF-THEN rules

Rule	Way
10 IF EXTERNAL = NO, THEN POSITION = NO	1,3
20 IF EXTERNAL = YES, THEN OPERATION = YES	1,2
30 IF EXTERNAL = YES AND OPERATION = YES, THEN POSITION = EXTERNAL TUNING	1,2,4,5
40 IF RA >=40, THEN POSITION = ROUGH	5,10,11

Thus, using a production model for the representation of knowledge about the objects of design, it was possible to take into account such factors as:

- uniformity of views, which leads to a simplification of the control mechanism of logical deduction and knowledge management;
- ease of interpretation - the "transparent" structure of production rules facilitates meaningful understanding;
- naturalness - knowledge in the form of "what to do and when," are natural from the point of view of common sense.

From the tree it can be seen that each production rule is an independent element of knowledge (local source of knowledge), and the individual production rules are related to each other only through the stream of data that they process.

Research results have shown that the description of details in the design of TP as a combination of design and technology elements can provide knowledge that previously did not respond to the formalization and algorithmic, in the form of production rules.

Thus, the use of this technique allows the description of the elements to provide the automation of technological preparation of production as a system based on knowledge, but also contributes to the adaptive capacity of technology to change the design of facilities, the nomenclature of used items, technical support, which, in essence, should greatly improve the mobility of CAD.

When designing the system it was used the concept of "rapid prototype". The essence of this concept is that it creates the theoretical prototype of intelligent search system and making design decisions, which holds the common methodology for designing the system. This method is the most effective in connection as the system should take into account the specialty and domain design of a certain enterprise application.

The process of creating a "rapid prototype" of search and making design decisions consists of the following steps [8]:

1. Advance preparation: data collection and study of scientific concepts underlying the study area of concern, the class definition of tasks (sub-tasks), data, criteria, aspects of the experience of experts, the selection of key parameters and their types, their range of measurement equation, setting the target criteria determining the quality of the design solutions generated.

2. Identification of cause-and-effect relationship between the parameters and target criteria, providing the essential links between the parameters explicitly, the formation of knowledge bases, which are reflection of the experience of experts in this area of concern, the development of design models, etc.

3. Setting design models on their task by adapting databased evolutionary methods and training.

4. Choice from an alternative set of possible on the basis of the customer requirements by constructing a decision rule based on machine learning methods.

5. Analysis and evaluation of options generated by modeling techniques and the use of statistical methods for processing the results of experiments.

6. Computer analysis of the best draft version of the design and modification of the variation of the NTA in order to improve its characteristics.

7. The preferred option decision based on the evaluation of conformity of the decisions given the objectives and constraints.

To develop an information system design model is presented in Fig. 7.

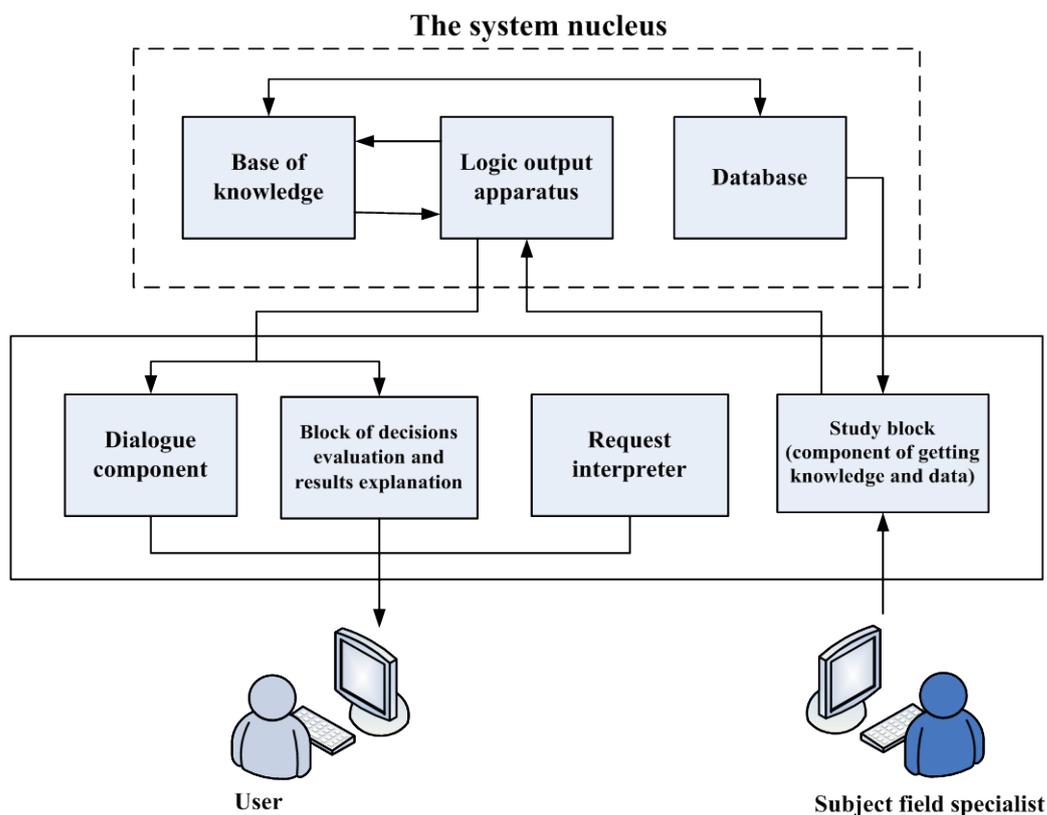


Fig. 7. The information model of the system

Requests Interpreter (Fig. 7) is program of the components of the system, implementing a process of reasoning based on the database and the working set. It performs two functions:

- First, the view of the evidence of the working set and the rules of the database and adding (if possible) to the working set of new facts;
- Secondly, the definition of the order review and application of the rules.

This subsystem controls the process of finding relevant information, the user saves the information of the results and asks him the information when applying for

another rule in the working set if data is not enough. Operation of the system is a sequence of steps, each of which is selected from the database for a rule of the form :

"If A, then B" that applies to the current contents of the working set of the system.

Finding the desired objects in general, it is appropriate to be regarded as a two-step process. In the first phase, corresponding to the selection process for associative connectives, a pre-selection is made in the database of several options for the desired objects. In the second stage by performing a comparison of options with descriptions of the options is the final choice of search objects.

Using this approach, knowledge representation, the formation of the regulations for the task of decision-making based on multivariate analysis is reduced to solving a parametric optimization and allows you to:

- Generate possible design solutions;
- To assess the options and choose the best;
- Ensure constant exchange of information between their decisions and help to coordinate group decisions;
- To model the decisions (if possible);
- To assess compliance with the implementation of design solutions.

The results of the research is:

- A method of classification of objects of automation engineering and design purposes, based on the representation of the product as a set of engineering design and technological elements (TEF), each of which has one or more methods of treatment with the appropriate cutting tools, industrial equipment and measuring instruments;

- Theoretical prototype in the form of a system based on knowledge, has the ability to self-learning and the accumulation of new information and the ability to update the collected information, and not as a database management system (DBMS) used in modern CAD systems;

- The method of knowledge representation in the information system as a set of rules of heuristic knowledge (heuristics), i.e. informal rules of the arguments produced by an expert on the experience of its activities;

Creation intelligent search and decision-making project engineering and design will allow for:

1) improving the system design, including the systematization of the design process;

2) integrated automation mentally formal, non-creative functions specialist in the design process;

3) development of simulation models for native playback of human activity, its ability to make design decisions, in full or in part the uncertainty of the situation.

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J11307-225

Ipatov Y.A., Krevetsky A.V.

**HARDWARE-SOFTWARE COMPLEX FOR LOCALIZATION
OF THE TEXTURE TRANSITIONS ON THE WOOD IMAGES WITH
CELLULAR STRUCTURE**

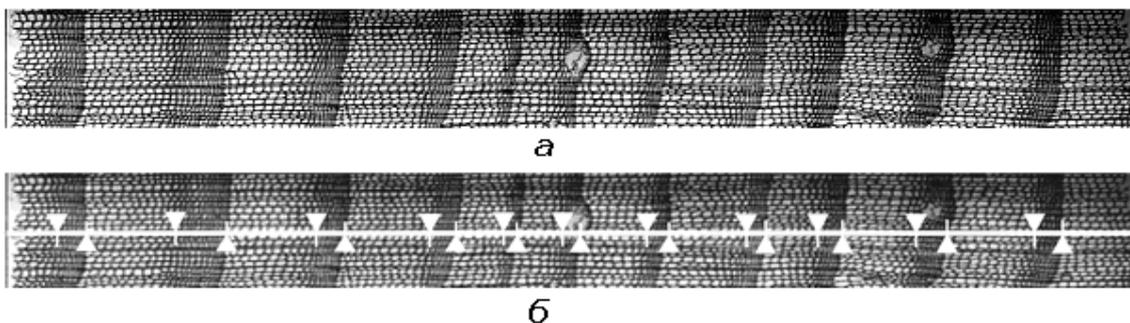
Volga state technological University, Yoshkar-Ola

Introduction

Modern approaches for assessing the dynamics of soil fertility in forest taxation measuring work are based on the measurement and detection parameters boundaries early wood and late in the cross-sectional images of tree trunks [1,2]. To date, the timber industry, these tasks are manual methods derived slices analyzed by experts using the calibration lines and the microscope. Become necessary set of statistics to substantiate the results of studies ticks and the possibility of widespread use. In such a situation is urgent solution to the problems of objectivity measurements, as well as providing a given level of accuracy, while reducing the overall complexity of the measurements and the economic efficiency of research.

In this paper we present one solution to this problem by automating the image analysis of wood cross sections, formed monochrome television transmitters (Fig.1, a). Registration, such a class of images for subsequent automated processing can be carried out on the basis of hardware and software, including mating microscope, camera and television transmitting computing device. Research results of image data, should be the characteristics of spatial areas for early and late wood - the coordinates

of the boundaries between regions of different textures, their width, the growth dynamic width. Figure.1,*a* shows that the image areas differ texturally, middle brightness, geometry and scale checked texture. Examining some of the texture areas can be observed wood heterogeneity in the form of resin ducts. The internal structure of the homogeneous regions is checked with significant brightness variation along individual cells. Spatial location and dimensions of borders between textures are not strictly regular, every image contains additive luminance noise level and light level different parts of the image may differ.



**Fig. 1. Example image of wood saw cut: a - original image,
b - result of texture boundaries detection**

Thus, the problem for microscopic images processing of transverse wood slices can be supplied as a problem of detecting boundaries for early and late wood in non-uniform statistical background under the influence of confounding factors.

Statistical studies of wood slices images class

For synthesis of algorithms for detecting boundaries of early and late wood is necessary to know the geometric and statistical image characteristics of these areas. From the brightness histogram of digital black-and-white wood slices images should be that they are not distinct modes corresponding to the bright areas and dark areas in the early late wood. Therefore, the direct use of well-known segmentation methods for different brightness areas with global threshold [3, 4] to highlight the borders is not possible.

Partial histogram (Fig. 2) selected manually of relevant areas suggest that the main variance of brightness along the border due to the cellular structure of the

specimen. Granularity can be a high confidence level approximated model additive noise. The minimum width of the bands texture is known and identify as τ .

Verification the hypothesis of normal noise distribution by Pearson criterion has not been confirmed, so Pearson curves was used to find law of distribution for this random variable [5]. In general, the differential equation is given by Pearson:

$$\frac{1}{w} \frac{dw}{dz} = \frac{z - M}{b_0 z^2 + b_1 z + b_2}, \quad (1)$$

where the coefficients

$$\begin{aligned} b_0 &= \frac{2\mu_2\mu_4 - 3\mu_3^2 - 6\mu_2^3}{2(5\mu_2\mu_4 - 6\mu_3^2 - 9\mu_2^3)}; \\ b_1 &= -M = \frac{(\mu_4 + 3\mu_2^2)\mu_3}{2(5\mu_2\mu_4 - 6\mu_3^2 - 9\mu_2^3)}; \\ b_2 &= \frac{(4\mu_2\mu_4 - 3\mu_3^2)\mu_2}{2(5\mu_2\mu_4 - 6\mu_3^2 - 9\mu_2^3)}. \end{aligned} \quad (2)$$

are determined by the sample values of the central moments $\mu_1 = 0$, $\mu_2 = 133$, $\mu_3 = -43$, $\mu_4 = 55677$ [6].

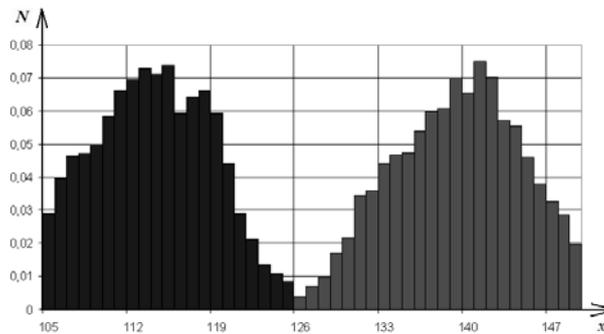


Fig. 2. Luminance histogram of individual sections of the early and late wood

In the case of complex roots $b_0 z^2 + b_1 z + b_2 = 0$: $z_1 = \alpha + ai$, $z_2 = \alpha - ai$ the distribution of the random variable x describes:

$$w(z) = w_0 \left(1 + \frac{(z - \alpha)^2}{a^2} \right)^{-m} e^{-v \cdot \arctg \frac{z - \alpha}{a}}, \quad (3)$$

where $\alpha = \frac{\mu_3(r+2)}{4\mu_2}$, $a = \frac{\sqrt{\mu_2}}{4} \sqrt{16(-r-1) - \beta_1(-r-2)^2}$, $m = -\frac{1}{2}(r-2)$,

$v = \frac{\mu_3 r(2-r)}{4\mu_2 a}$, $w_0 = \frac{n}{aF(-r, v)}$, $r = 2 - \frac{1}{b_0}$, and $F(\bullet, \bullet)$ – Pearson function

$$F(-r, v) = \frac{1}{a} \int_{-\infty}^{\infty} \left(1 + \frac{t^2}{a^2}\right)^{-m} e^{-v \cdot \text{arctg} \frac{t}{a}} dt, \tag{4}$$

where the integral evaluates the Pearson function for the given parameters $-r, v$.

Analysis of observed image histograms leads to the following conclusions. Average brightness researched areas is different. Uneven lighting along the border areas of early and late wood image areas is small compared to non-uniformity over the area of the frame and can be considered statistically homogeneous in brightness. Since the deviation from the mean vector boundaries of slope by more than two dimension of magnitude smaller than the length, the boundaries of areas considered as parallel and their curvilinear can be later neglect.

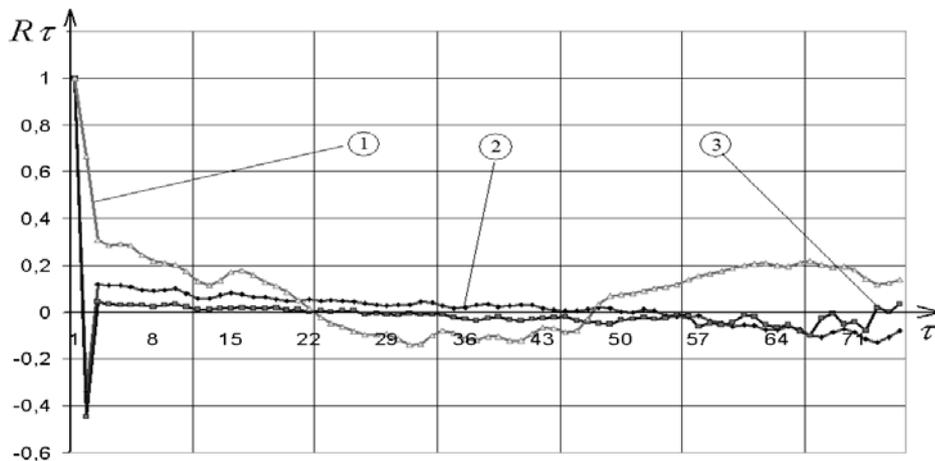


Fig. 3. ACF for the resulting slice brightness (1) mixed, (2) early and (3) late wood

Correlation intervals of brightness samples in these areas are approximately equal to one pixel (Fig. 3), both along the horizontal and the vertical axis, that is statistically independent and can be approximated by a model of white noise.

Mathematical model of images with periodic banding cell textures

Figure 4 shows the line of the image micro-slices high resolution and brightness

samples plotted on this segment. Statistical analysis shows that the spectral characteristics of the two regions textures are different. Three-dimensional representation of brightness samples $I(x, y)$, where x, y – spatial coordinates of the image, shows Fig. 5, which is also visually confirm the estimates.

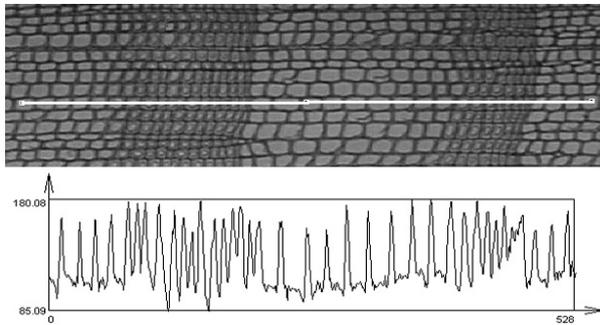


Fig. 4. The brightness distribution along a given line in the image of the mikro-slice sample

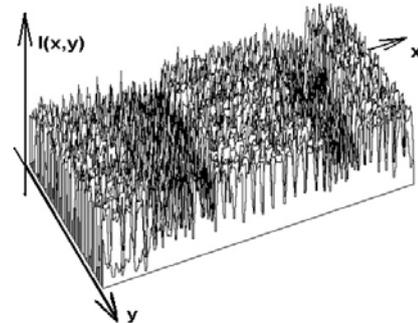


Fig. 5. Evaluation samples background brightness for these pictures

Early wood textures are periodic changes in the brightness of pulses corresponding to the larger size of cells, with frequency $\omega_R(x) = \omega_1 \pm \Delta\omega_1(x)$, where ω_1 – average rate for this form region, and $\Delta\omega_1(x)$ – random component of the frequency, randomly distributed with zero mean and variance σ_1 . Similarly, late wood textures are periodic changes of brightness pulses, corresponding to the smaller size of the cells, with frequency $\omega_P(x) = \omega_2 \pm \Delta\omega_2(x)$, where ω_2 – average rate for this form region, and $\Delta\omega_2(x)$ – random component of the frequency, randomly distributed with zero mean and variance σ_2 . In this case $\omega_R < \omega_P$. Noticeable difference between brightness pulse ratio: larger pulse ratio are early wood.

The analysis for fine structure of the images class lane textures results give rise to the following mathematical model of the observed frame: $\mathbf{z} = \mathbf{s} + \mathbf{n}$, where $\mathbf{z} = \{z_{yx}\}_{x=0, X-1, y=0, Y-1} = \{z_{yx}\}_{YX}$ – sample matrix of the observed image, $\mathbf{s} = \{s_{yx}\}_{YX}$ – reference image, $\mathbf{n} = \{n_{yx}\}_{YX}$ – noise component of the image; x, y – space coordinates; X, Y – image width and height, respectively.

For highly detailed scale images of objects used $s_{xy} = s_x^1 = f(x, \tau_1, \tau_2, T_1, T_2, N_1, N_2, A)$, parameters of which are shown in Fig. 6.

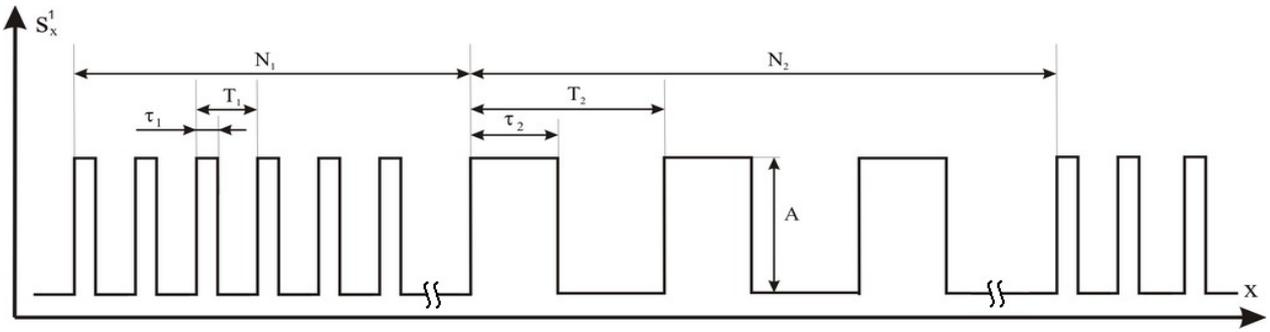


Fig. 6. Model of the fine structure of the slice brightness s_x^1 periodic lane texture along line direction of image frame

For images with less detail when pixel dimensions are comparable to the size of cells T_1 and T_2 , cell structure is eroded so that the model of the reference line is simplified (Fig. 7) :

$$s_{xy} = s_x^{(2)} = f(x, Z_1, Z_2, N_1, N_2) \quad s_{xy} = s_x^2 = f(x, Z_1, Z_2, N_1, N_2),$$

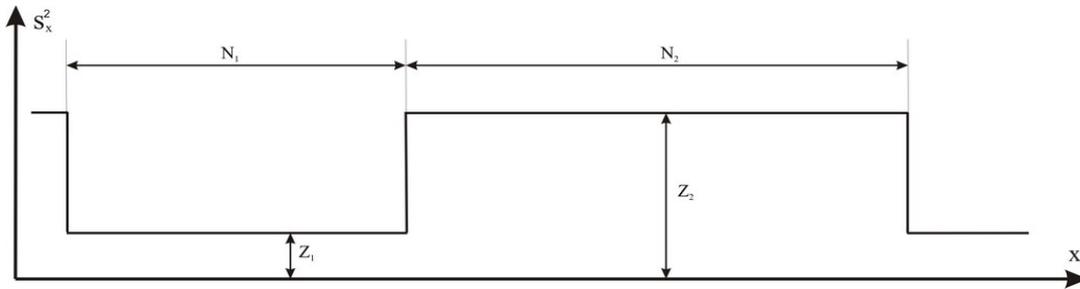


Fig. 7. Line model low resolution images $s_x^{(2)}$ with periodic lane texture where z_1, z_2 – average brightness levels of two textures.

Given the independence of brightness samples joint conditional probability density for the observed image is given by

$$w(\mathbf{z}|x_0) = \prod_{x=0}^{X-1} \prod_{y=0}^{Y-1} w\{z_{yx}|x_0\} = \prod_{x=0}^{X-1} \prod_{y=0}^{Y-1} w\{z_{yx} - s_{x-x_0}\}, \quad (5)$$

where conditional probability density of brightness samples $w\{z_{yx}|x_0\} = w\{z_{yx} - s_{x-x_0}\}$ corresponds to the Pearson distribution, x_0 – horizontal displacement of the boundary between two textures lane.

Synthesis algorithm based localization boundaries matched filtering

For the registered image \mathbf{z} conditional probability density (5) can be viewed as the likelihood function

$$w(\mathbf{z}, x_0) = \prod_{x=0}^{X-1} \prod_{y=0}^{Y-1} \left\{ w_0 \left(1 + (z_{yx} - \alpha)^2 / a^2 \right)^{-m} \exp(-v \cdot \arctg((z_{yx} - \alpha)/a)) \right\} x_0 \quad (6)$$

unknown parameter x_0 , the value is required to estimate. In the observation of deterministic signal in white noise in the optimal Bayesian sense is a device based on the matched filter, forming a monotonic transformation of the likelihood function, and the maximum selection unit [7]. After substitution of the expression (6) coefficients specific to the class of images, logarithm $w(\mathbf{z}, x_0)$, linear transformations and rejects of small in absolute value terms, we obtain an approximate expression for the minimal sufficient statistics:

$$g_{x_0} = \sum_{y=0}^{Y-1} \sum_{x=0}^{X-1} z_{yx} s_{y(x-x_0)} = \sum_{x=0}^{X-1} s_{x-x_0} \sum_{y=0}^{Y-1} z_{yx} \quad (7)$$

From the structure of (7), that an optimal algorithm for the localization of boundaries between banding textures allows the average brightness samples along the border, forming a one-dimensional signal g_{x_0} (Fig. 8, a), and then find the estimated value

$$\hat{x}_0 = \arg \max_{x_0} w(\mathbf{z}, x_0) \approx \arg \max_{x_0} (g_{x_0}) \quad (8)$$

Since the maximum corresponding to the boundaries lane texture can be somewhat, their search is performed by the vanishing of the first derivative (the first difference) and a negative value of the second derivative (the second difference) g_{x_0} .

So in Fig. 8 and Fig. chart 9 shows g_{x_0} for model and real data.

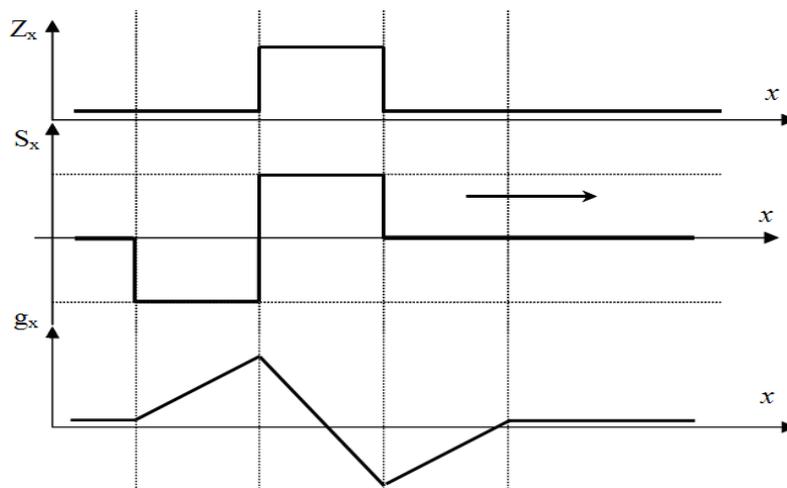


Fig. 8. a — model pulse intensity $s_x^{(2)}$, b — waveform, which matched impulse response filter, c — response of the filter to model the pulse intensity.

Technology training preparation (wood micro-slices Fig. 4) often not provides strong vertical orientation of detected edges in the image. Studies filter response (8) shows (Fig. 9, b), that with decrease of error angle φ_0 model and the observed image variance σ_g^2 of the sample increases (Fig. 10).

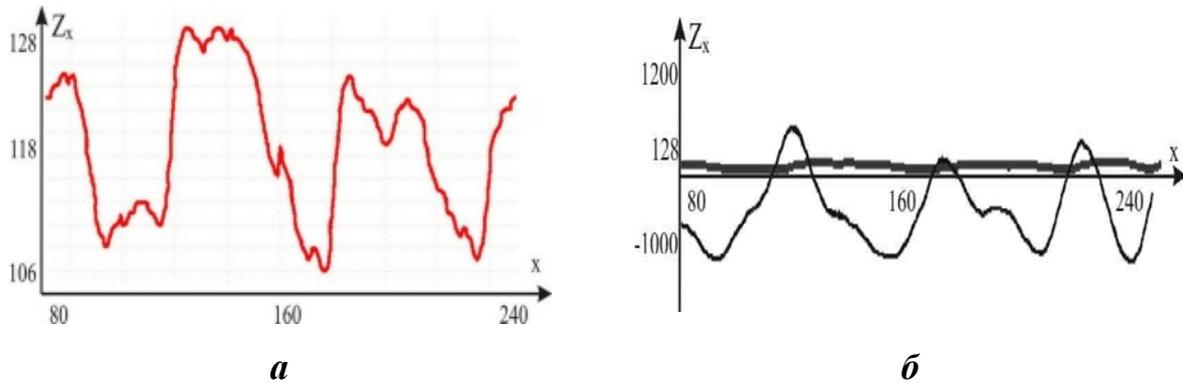
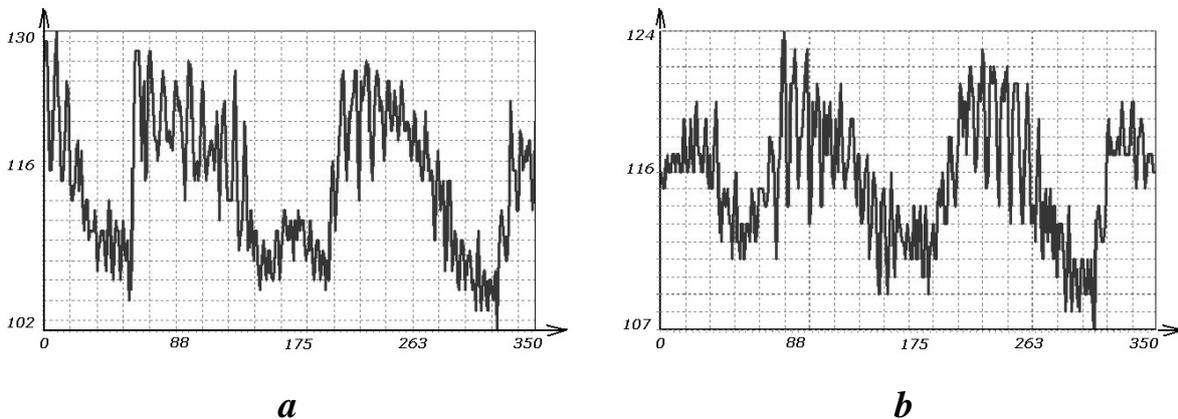


Fig. 9. a — vertical distribution of average brightness, b — chart g_x for real image.

Thus, the value of dispersion can serve as a criterion for the angular orientation of the image.



**Fig. 10. Graphics average brightness of the vertical frame:
a – for the image with vertical textures;
b – for the image, rotated at some angle φ_i**

In each i step image z rotated by an angle $\varphi_i = \Delta\varphi \cdot i, i = 0, 1, 2, \dots$. Here is the response of the filter $g(\varphi_i)$ corresponding to the current rotation and its samples variance $\sigma_g^2(\varphi_i)$. In the output value of the filter after completing all the steps taken:

$$g_{x_0}(\hat{\varphi}_0), \quad \hat{\varphi}_0 = \arg \max_{\varphi_i} (\sigma_g^2(\varphi_i)) \quad (9)$$

Thus, when an unknown angular orientation for lane texture image this algorithm are the lane boundary detection textures reduced to the angular orientation of the

preliminary assessment and the subsequent implementation of evaluation algorithm s_0 , as in the case with a known angular orientation of the observed image. The unknown φ_0 for the image with a resolution of 2100x450 the complexity of this algorithm is 23,000 million elementary operations of addition/multiplication, which is a modern CPU Intel Core 2 Quad 2,8 GHz support decision in 2 seconds.

Hardware-software complex for the analysis of micro-slice wood images

To automate the analysis of area parameters for early and late wood in the research process was developed hardware and software package BioImage, implements the algorithm obtained. To eliminate errors in the automatic analysis of the complex provides the ability to manually correct the results of the detection and measurement of the edge coordinates the domain.

The results of the hardware and software system are represented as markers detected feature points in the image of the investigated wood slices (Fig. 1, б), as well as information about the width of annual rings.

To bind the origin of localization limits to the scale of of the investigated slice in the complex has a mode calibration television recording system To reduce the computational complexity in the software implementation of the considered algorithm function s_x model brightness distribution along the line image frame replaced by the model

$$s_x = \begin{cases} 1, & \text{if } x \in [0; \tau] \\ -1, & \text{if } x \in [\tau; 2 \cdot \tau] \\ 0, & \text{in other cases} \end{cases}, \quad (10)$$

This allows for a single loop find front (by maximum g_{x_0}), and cut (by minimum g_{x_0}) texture transition between areas of early and late wood, and multiplication operation when filtering by the formula (10) is replaced by the sign change operation.

Fig. 11 displayed the program structure of the complex, which has a modular architecture.

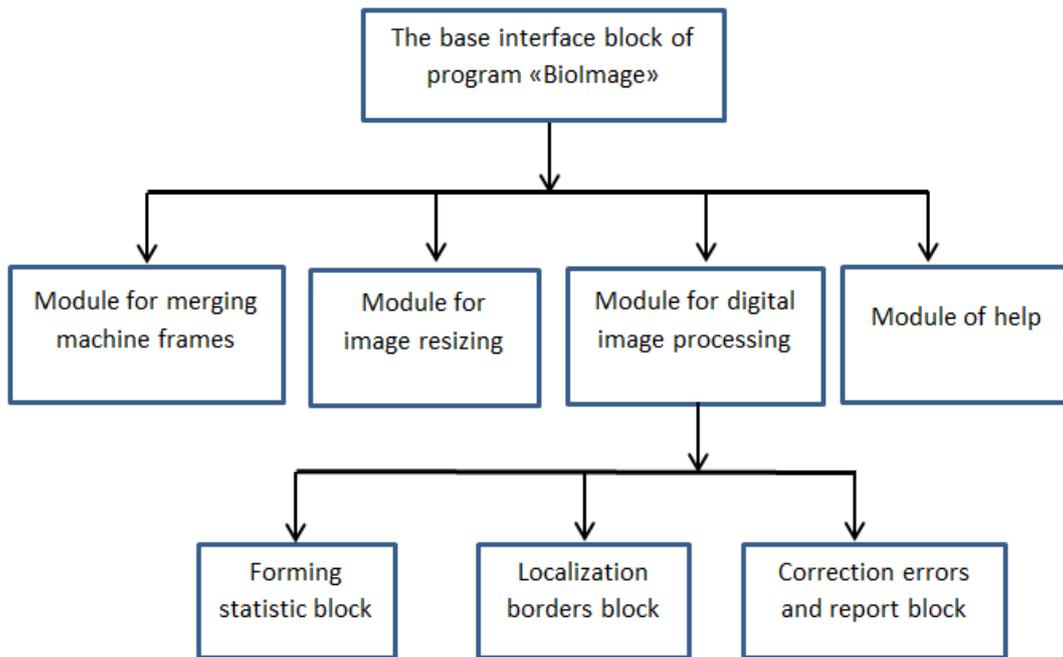


Fig. 11. The software structure of the complex

Software and hardware system provides for manual correction of anomalous errors (Fig. 1,b) and generate a report in a text report with numerical data on the width of each type of wood for the year.

Synthesis algorithm localization boundaries based on wavelet transform

Classical Fourier analysis of signals does not practically significant results on the separation of the different textures spectra and defining their boundaries due to the fact that the basis functions of the expansion here are undamped harmonic. As is known from the literature [8-11], the most suitable for the localization of the features, for instance in the form of radio signals [12], multi-scale analysis based on wavelet decomposition.

From the earlier model detailed image (Fig. 6) the fine structure of the signal should be, that it corresponds to the sequence of pulses brightness with periodically varying frequency and pulse ratio. Moments of these parameters continuously violates regularity following brightness samples. To solve similar problems in the field of radio, television, and digital imaging has recently become a popular use of wavelet analysis.

Analysis of the literature on wavelet expansions shows [9, 11] that, up to date there is no universal and stringent selection criteria of these functions. Therefore, to

solve the problem in this work used a selection of the best from 12 nabolee known and included in the package MATLAB wavelets (Daubechies, Haar, Gauss, and others). The criterion used in selecting the maximum probability of correct detection of boundaries between textures. As a result, the base for texture boundary detection algorithm was chosen Haar wavelet (Fig. 12).

At the core of the algorithm is a direct wavelet transform signal $s_i(x) = s(x, y_i)$, where i - line number in the frame:

$$C_i(a, b) = \int_R s_i(x) a^{-1/2} \psi\left(\frac{x-b}{a}\right) dx, \quad (11)$$

where a and b – parameters of wavelet $\psi\left(\frac{x-b}{a}\right)$, sets the scaling and offset axis x respectively.

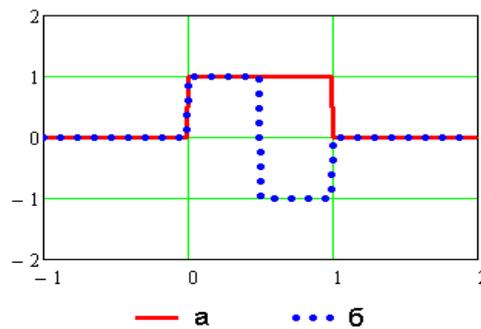


Fig. 12. Haar wavelet: a – scaling function, b – mother wavelet

Quasiperiodic boundary detection algorithm textures reduced to the next steps:

1) compensation for uneven lighting and unknown angular orientation of the image types.

2) lines selection $s_i(x)$ with the variance of brightness σ_i , exceeding the average brightness of the frame variance $\bar{\sigma}$. This selection is necessary because some lines fall in the region between the rows of cells, which violated the adopted brightness model of pulses distribution;

3) direct use of the wavelet transform (11) to each of the one-dimensional signal $s_i(x)$, $i = 1, \dots, i_{\max}$. Fig. 13 shows the values of the coefficients of the wavelet decomposition in the plane (b, a) .

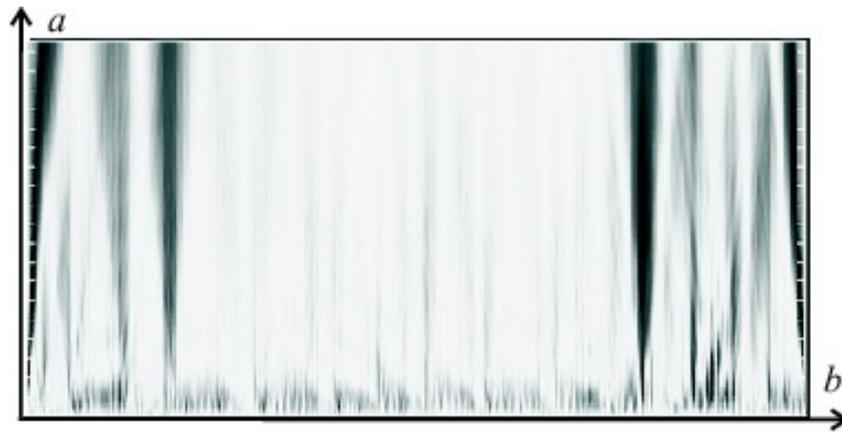


Fig. 13. Wavelet spectrogram of the signal

Dark areas of the spectrogram corresponds to a larger value of the coefficient. Located at the bottom of the spectrogram coefficients with small parameter a . They give a detailed picture of regularities in $s_i(x)$. Top - with large coefficients a , give a picture of regularities in a coarsened $s_i(x)$. Pure harmonic signals corresponding to light horizontal stripes where the modulus of a wavelet coefficient is large. Local features (violations of regularity) are responsible dark vertical stripes that go from the point where the feature is found;

4) average values of the coefficients for the wavelet transform along the scale axis of the spectrogram:

$$Q_i(b) = \frac{1}{A} \sum_{a=0}^{A-1} C_i(a,b), \quad (12)$$

where A – the maximum dimension of the scale for wavelet transform, b – offset equivalent spatial coordinate x . This takes into account a feature of the wavelet decomposition about the detailed and rough picture signal. Fig. 14 shows the averaged wavelet spectrogram (13) for a single line of the image. Here, local extremes correspond to the borders of textures.

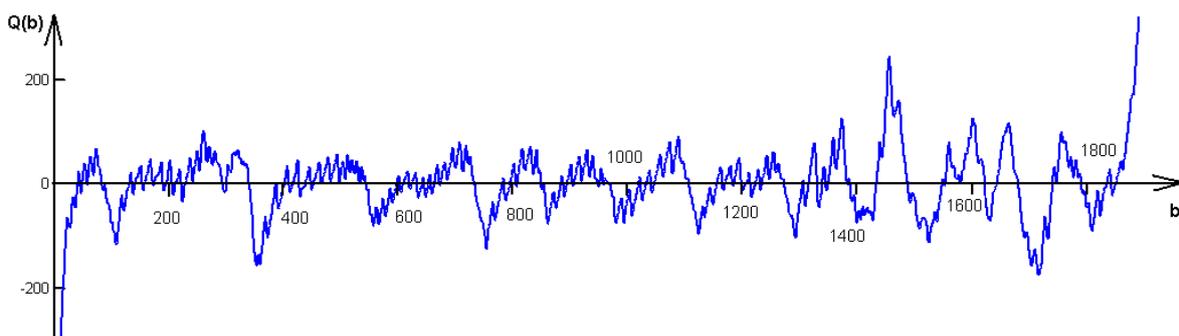


Fig. 14. Averaged wavelet spectrogram of a row in image

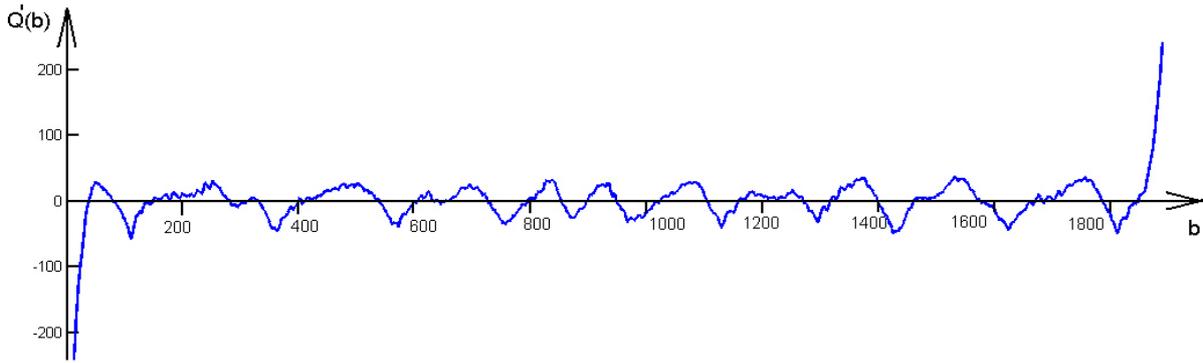


Fig. 15. Averaged wavelet spectrogram over the entire image

5) average of all $Q_i(b)$ over the entire image for K lines, selected in the second step:

$$Q'(b) = \frac{1}{K} \sum_{i=0}^{K-1} Q_i(b), \quad (13)$$

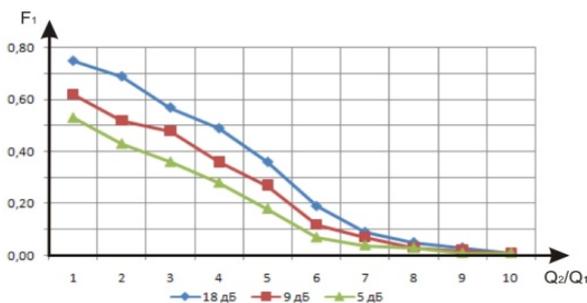
This takes into account all the local features of each image line for the observed frame. Fig. 15 shows the averaged wavelet spectrogram on selected lines.

6) spatial localization of average spectrogram extrema vanishing first derivative (first difference) and the minimum negative value of the second derivative (the second difference) $Q'(b)$. Example display texture boundary detection results shown in Fig. 1,b.

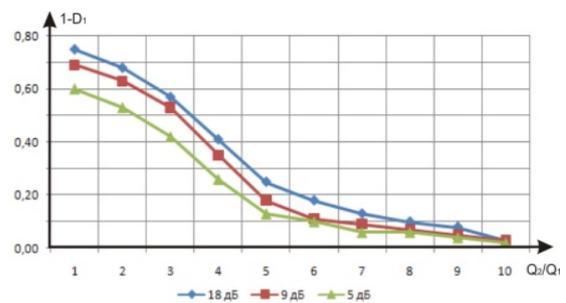
Analysis of localization characteristics algorithm for periodic lane texture

In order to know the quality of the algorithm for the localization of texture boundaries is necessary to analyze the effectiveness of its work on the basis of statistical data.

Accepted model s_x^1 for the brightness slice of the fine structure obtained following the detection characteristics of Fig. 16.



a



b

Fig. 16. Boundaries of textures at different ratios of the modeled signal pulse ratio s_x^1 : *a* – possibility of errors for the first kind, *b* - probability of error for the second kind.

Detection performance for real image types of localization algorithms boundaries between banding textures preparations cellular structure of wood on the basis period by quasi-periodic matched filtering strip texture shown in Fig. 17.

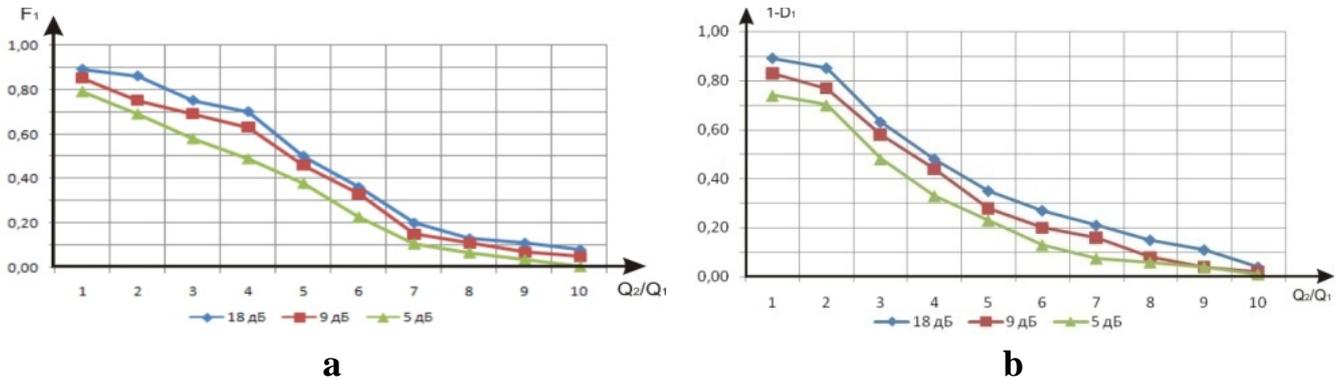


Fig. 17. Boundaries of textures at different correspondence pulse ratio for real images based on matched filtering: *a* – possibility of errors for the first kind, δ - probability of error for the second kind.

Comparative analysis of the characteristics in Fig. 16 and Fig. 17 shows that the discovery options on real images are correlated with the theoretical model, so we can make a conclusion about the adequacy of the math model for periodic lane texture cut image and their counterparts.

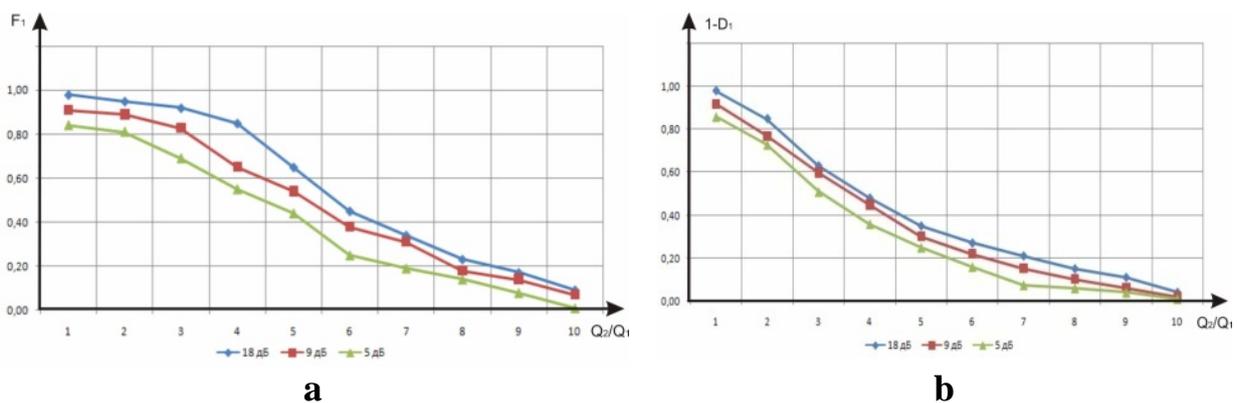


Fig. 18. Texture boundary detection characteristics at different correspondence pulse ratio for real images based on wavelet transform: *a* – possibility of errors for the first kind, *b* - probability of error for the second kind.

Comparative analysis of the curves in Fig. 16 and Fig. 17 shows that the algorithms based on matched filtering with a period quasiperiodic strip textures

compared with wavelet transform are on average 49% less than the error of the first kind and 19% less than the error of the second kind.

As characteristics of the performance for algorithm we assume dependence of the average statistical error σ_{x_0} determine the position of the boundaries by luminance noise level σ .

To obtain characteristics was a statistical experiment. In the image was applied normal noise with zero mean and variance of a certain value, which increases linearly. Table 1 shows the measurement data for the σ_{x_0} empirical, calculated on a real image (Fig. 1 b) and σ_{x_0} theoretical, obtained on the basis of the ideal pulse intensity (Fig. 8 a).

Table 1

σ luminance noise	1	2	3	4	5	6	7	8	9
σ_{x_0} empirical	0,07	0,13	0,15	0,25	0,29	0,41	0,53	0,58	0,62
σ_{x_0} theoretical	0,05	0,10	0,15	0,21	0,26	0,31	0,36	0,42	0,47

Now we find the confidence intervals for the normal population, for each pair of values from general sample. They are as follows:

$$S^2 \frac{n-1}{\chi_2^2} \leq \sigma^2 \leq S^2 \frac{n-1}{\chi_1^2}, \tag{14}$$

where, n – amount of sampling, S – standard deviation of the sample, σ - the standard deviation of entire assembly and χ - the distribution of the degrees of freedom (table value).

For the probability - 95 %, in which the value of $\chi^2 = 18,493$ and degree of freedom $m = 30$, calculated values of confidence intervals for the general put the sample in Table 2.

Table 2

σ luminance noise	1	2	3	4	5	6	7	8	9
Upper bound	0,12	0,21	0,26	0,42	0,48	0,68	0,83	0,91	0,98
Lower bound	0,02	0,05	0,04	0,08	0,1	0,14	0,23	0,25	0,26

As a result of the statistical analysis we build a graph of the average statistical error σ_{x_0} of determining the position of the boundaries by noise luminance level σ considering confidence intervals (Fig. 19).

Determine the position of the error variance x_0 for the maximum count practically significant range of signal-to-noise ratio $q^2 = \|\mathbf{s}\|^2 \sigma^{-2} \gg 1$ determined by the second derivative of the autocorrelation function $d(x_0) = \sum s_x s_{x-x_0}$ in the region of maximum: $\sigma_{\hat{x}_0}^2 = -[q^2 d''(x_0)]^{-1}$ [7]. For the example given in this class of images corresponds to an error in Fig. 19.

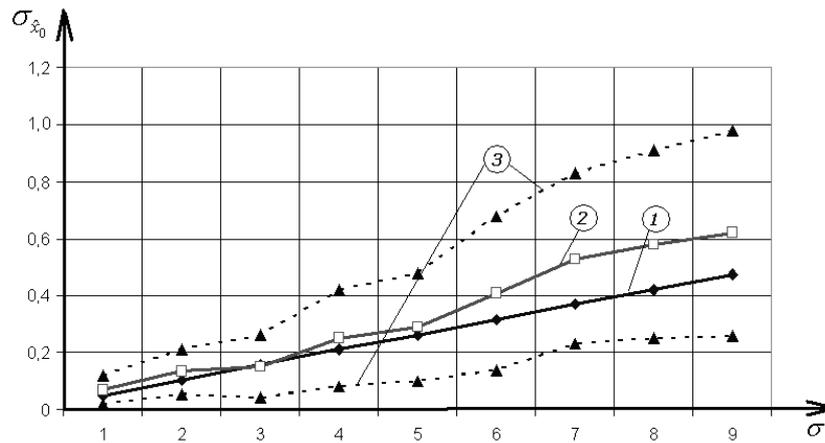


Fig. 19. Accuracy of detecting the boundary between different regions of the noise degree texture image: 1 - theoretical, 2 - empirical and 3 - confidence intervals

The graph shows that the theoretical and empirical measurement error values x_0 are within the confidence interval for a significance level of 0.05. Along the abscissa axis MSE luminance noise σ , and the vertical axis – MSE measurement position of the boundaries in terms of pixel for explore digital image.

Estimate the timing of the different processors Intel x86 architecture [13]. Since each processor knows such a characteristic as MIPS [14] (million instructions per second), is the integer calculations, it is easy to calculate the time characteristics. Characteristics of the algorithm and the dependence on the type of CPU time are shown in Table 3.

Analysis of the temporal characteristics of synthesized algorithms, shows that the average time of a complex algorithm on modern processors is less than 0.5

seconds. These results confirm the high computational efficiency of the developed algorithms, and point to the possibility of their use in mobile platforms.

Table 3

Processor type	MIPS per second	Speed of the algorithm, seconds
Intel Pentium I 90 MHz	180	0,640
Intel Pentium III 750 MHz	1900	0,061
Intel Pentium M 1,7 GHz	5500	0,021
Intel Core 2 Quad 2,8 GHz	50000	0,002

Conclusion

Created algorithms and hardware-software package to automate image analysis of cross wood slice accurately detect texture boundaries, which is several times higher than existing manual methods.

Using a quasi-optimal algorithm can more than double win in complexity, compared to the optimal algorithm with negligible board exactly.

The running time for a single television frame image on a modern CPU Intel Core i5 is less than one second, which is several orders shorter than the manual methods. The developed system provides documentation of image analysis that allows you to create a text report in popular formats and save the settings in the database.

Hardware and software package provides an analysis of the boundaries for texture area images with high accuracy and it is therefore proposed to use in forest taxation industry. The complex was tested on samples obtained by scientists of the Volga State Technological University, and applied in research and teaching.

The developed algorithms have the certificate of official registration for computer programs by the Federal Service for Intellectual Property, Patents and Trademarks of the Russian Federation № 2007610624 «BioImage Tree v.1.0» from 08.03.2007 year.

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Pachurin G.V., Vlasov V.A.

DURABILITY OF STAMPED METAL IN THE AIR AND CORROSIVE ENVIRONMENT

Nizhny Novgorod State Technical University n.a. R.E. Alekseev

The task of ensuring working capacity and longevity of details of technical devices in different operating conditions in solutions priorities for resource conservation, cost of raw materials is very important. It includes the need for optimization of the production processes.

The most common cause of destruction of parts and machines is corrosion fatigue when operating in air and in a corrosive environment. The process of fatigue fracture of materials depends on their nature, technological processing and cyclic loading conditions.

Metals and alloys subjected to different modes of thermal, mechanical and plastic processing are widely used in industry. The different types and modes of bulk plastic deformation are the most common of these.

The issue of durability under cyclic loading in air pre-deformed metallic materials and its increase by optimizing the process conditions of plastic processing is highlighted in the literature in detail prediction. However, systematic theoretical and experimental study of the influence the corrosive environment on the fatigue behavior of deformed metals and alloys in different structural states are virtually absent.

It is not only important to develop a progressive process of manufacturing of a plastic part by forming to engineer technologist, but also to take into account all the factors that influence their corrosion durability during their subsequent operation. However, it is difficult to predict without experimental corrosion-fatigue behavior of extruded material in most cases.

The experimental technique

We used [1] a comprehensive methodology for conducting experiments. It included mechanical tests under static and cyclic loading, the study of the initial microstructure and its changes on the surface of samples for fatigue using optical and electron microscopes to study the kinetics of the fracture process, measuring the deflection of the current samples, the samples exposed fractographic analysis and other methods.

Metals and alloys of different classes in different structural states used in automotive, mechanical engineering and aerospace industries and processed at the request were investigated. Cylindrical specimens pre-deformed at room temperature by stretch, and flat samples by precipitation at different rates to different degrees, mainly in the range of uniform strain at a rate of $2 \cdot 10^{-3}$ to 10^2 s^{-1} . Fatigue flat samples were tested on a specially designed two-stage set [2], and cylindrical ones were tested on drive МПП-8 converted for cargo loading and equipped with fazosinhronizator and an optical microscope with stroboscopic illumination [3]. For testing in a corrosive environment of cylindrical samples the camera was designed [4]. Accessories for fatigue and corrosion-fatigue tests on a two-stage sample set were specially designed and manufactured [5].

The obtained results

According to the results of static stretching it is found that the tensile strength and yield strength increase and the values of indicators ductility decreases with increasing degree of deformation, especially at low stacking fault energy (e.d.u.) material, which is related to changes in the structural state of it in the process deformation [6]. It was found that pre-mixed hardening effects on the cyclic corrosion and cyclic durability of materials [7-10]. For example, preliminary deformation of the annealed copper M1 increases to 25% in longevity in the air at 3,6 times ($\sigma_a = 100 \text{ MPa}$). Stretching up to 25% of samples of hardened steels and vysokootpuschennyh 40X, 20X13 and 14H17N2 increases cyclic durability respectively 7.9 ($\sigma_a = 200 \text{ MPa}$), 2.7 and 1.8 ($\sigma_a = 380 \text{ MPa}$). Life of the air decreases monotonically respectively by 3.2% in M1 ($\sigma_a = 140 \text{ MPa}$) and 28.8% in

the Л63 ($\sigma_a = 170$ МПа) with increasing strain drawn copper M1 from 0 to 13% and Л63 drawn 0 to 25%. There is a "failure" cycle life respectively by 1.9, 10.2 and 5.0 times ($\sigma_a = 380$ МПа) for small degrees of plastic deformation (up to 5%) in samples of cold rolled steel 12X18N10T and hardened steels vysokootpuschennyh 14H17N2 and 20X13. The increase in strain rate of 25% with $1.1 \cdot 10^{-3} \text{ s}^{-1}$ to $5.6 \cdot 10^{-3} \text{ s}^{-1}$ promotes high-cycle life ($\sigma_a = 300$ МПа) hardened steels vysokootpuschennyh 14H17N2 and 20X13 in 2.0 times; a further increase in the strain rate to $2.8 \cdot 10^{-2} \text{ s}^{-1}$ significantly reduces their life (1.07 and 1.21 times, respectively). Preliminary deformation of 16% of welded joints of annealed steel 12Kh18N10T increases longevity of 12.3 times ($\sigma_a = 280$ МПа). Subsequent change in the degree of stretching to 25% increases in life at the same voltage of only 1.3 times.

Corrosion durability of structural materials undeformed is lower (up to 2.0 times) life in the air and also is determined by the amplitude of the applied voltage, the lower the amplitude, the stronger the effect of the medium. In this case, plastic deformation tends to raise (up to 3 times) corrosion-resistance to fatigue failure of the studied materials in comparison to their undeformed state [7, 11,12].

It is observed a monotonic decrease in cycle life in the air, which is increasing at low amplitude loading as the degree of pre-precipitation is hardened to 29% and is naturally aged aluminum alloy Д19АТ. So life falls by 3.2 times at $\sigma_a = 300$ МПа and 4.3 times at $\sigma_a = 200$ МПа after a draft of up to 29%. Corrosion fatigue resistance of the alloy is reduced to a greater extent at high (3 times at $\sigma_a = 300$ МПа) than at low (2.6 times at $\sigma_a = 200$ МПа) voltage amplitude with the degree of cold working up to 29%.

Cold-rolled steel 08кп in air has limited endurance limit based on 10^6 cycles at 1.9 and 1.7 times which is higher than that of hot-rolled steel 07ГЦЮФТ and 08ГЦЮТ respectively. Corrosive environment reduces the limited endurance limit (base 10^5 cycles) of 1.8 and 1.6 times that of steel 07ГЦЮФТ and 08ГЦЮТ against steel 08кп respectively. Sediment up to 29% reduces in fatigue resistance in air up to 1.3 times that of steel and increases in 08кп 08ГЦЮТ steels (up to 1.1 times) and 07ГЦЮФТ (up to 1.36 times). However, steel 08кп shows more stable and superior

parameters of fatigue fracture resistance than steels 07ГCЮФТ and 08ГCЮТ. Limited endurance limit for steel 08кп (base 10^5 cycles) is higher in 1.34 and 1.11 times than that of steel and 07ГCЮФТ 08ГCЮТ respectively in a corrosive environment after precipitation 29%.

The discussion of results

Analysis of the structural failure rate during fatigue of heat-treated and deformed structural materials in air and in a corrosive environment showed that the process of destruction of metallic materials under cyclic loading has three main stages: nucleation macrocracks, their growth and rapid dolomite, essentially related to the composition material and structure, depending on the thermal pre-treatment or plastic, and the test conditions (eg, environment, and the amplitude).

Average speed of fatigue macrocrack, such as copper M1 is 3.64 m / cycle ($\sigma_a = 280$ МПа), and in brass Л63 ($\sigma_a = 300$ МПа) is only 1.53 m / cycle, which supports the view that the duration of the material increases with the crack, and the rate of spread is reduced in materials with low e.d.u. all things being equal.

The nature of fatigue failure of the material also the magnitude of up e.d.u. to some extent: in brass and copper samples (0.007 and 0.070 e.d.u. J/m², respectively) destruction predominantly intergranular, in samples, for example, aluminum B95пчТ2 (e.d.u. ~ 0,200 J/m²) fatigue crack spreads mainly through the body grain. The period before the origin of the fatigue cracks in the alloy B95пчТ2 is more, and the rate of development is significantly less than that of annealed copper and brass.

Prestrain samples hinders the development of the process of fatigue and increases durability, which is due to increase in the period of crack initiation and decrease the speed of its spread. Corrosive environments causes multifocal nature of the occurrence and development of corrosion-fatigue failure giving rise to various types of corrosion damage. However, changing the current deflection curves of samples under cyclic loading in a 3% aqueous solution of NaCl has qualitatively the same character as in testing the air despite the significant features of the process. This is so that the determining factor of quality data about the current state of materials

during cyclic loading of the parameter changes to the current trough is reducing the effective cross section of the sample along with the mechanisms of hardening-softening.

Thus, the analysis of experimental data indicates that the curves changing the current trough, coupled with metallographic, fractographic and other methods of studying the kinetics of fatigue failure, a very important integral characteristic of the processes occurring during fatigue and corrosion-fatigue loading of structural materials.

Electron microscopic studies show [7,10], that steel 08кп has a structure of ferrite with some pearlite ductile fracture occurs on the mechanism, the degree of preliminary plastic deformation has almost no effect on the process of fatigue failure. 07ГЦЮФТ steel and are 08ГЦЮТ have carbide inclusions that hinder the movement of dislocations in the material. This leads to some increase of strength properties under static loading and cycle life in the preliminary draft. However, carbide inclusions negatively impact on the parameters of ductility and resistance to fatigue failure being a source of secondary cracks. In the process of fatigue cracks that originated from carbide inclusions, initiate these materials longitudinal cracking which causes lower values of limited fatigue strength compared to steel 08КП, independently of the mode of technological processing.

Theoretical study of the issue showed [13] that the sensitivity of the deformed structural materials for cyclic durability in corrosive environments, all other things being equal, can be evaluated with the value of the exponent A hardening under static loading: $\sigma_i = \sigma_0 \cdot \varepsilon_i^n$, where σ_i - actual current flow stress of the material, МПа; ε_i - true current strain; σ_0 - a constant equal to the flow stress at $\varepsilon_i = 1$, МПа; n - exponent of strain hardening. At the same time lowering the exponent A must comply with the growing resistance of corrosion-fatigue failure as a result of technological uniform prior deformation of the material in stamping.

Experimental data support this conclusion. The dependence of the relative change of durability previously plastically deformed material in the environment of a 3% solution of sea salt in the water ($N_{\varepsilon c} / N_{\varepsilon}$, where N_{ε} and $N_{\varepsilon c}$ - cyclic life pre-

deformed materials respectively in air and in a corrosive environment) of the figure $A\epsilon$ hardening at static stretching is established [7.13]: processed foods, which leads to a decrease in rate A , causes a positive effect on corrosion resistance to fatigue failure of structural materials. This relationship allows to predict the feasibility of introducing a process of manufacturing parts of plastic deformation in order to improve their corrosion durability, which is enough to monitor its impact on the amount of strain hardening exponent under static loading.

The conclusions

1. Corrosive environment accelerates the nucleation of fatigue cracks and their subsequent development, which results in low-amplitude loading, a significant reduction of fatigue resistance of metallic materials. The sensitivity of the alloys in the initial undeformed state to the negative influence of corrosive environment on longevity increases with a decrease in the strain-hardening exponent under static loading.

2. Plastic deformation under static loading of uniform deformation, tends to raise the ratio of their corrosion durability to longevity in the air reducing the amount of structural hardening sensitive indicator of surface quality and uniformity of materials. This dependence allows to predict resistance to corrosion fatigue fracture of plastically deformed materials and to optimize processing technology to improve the performance properties of metal products, while reducing metal.

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Chinenkov S.V., Filippov A.A., Pachurin G.V.

RESOURCE-SAVING FORMATION OF STRUCTURE AND MECHANICAL PROPERTIES OF STUD DRIVING STEEL GRADE 38XA

Alekseev Nizhny Novgorod State Technical University

Ubiquitous environmental degradation and depletion of natural resources highlight the questions concerning the development of environmentally sound, resource-saving technologies of metal production with a concurrent enhancement of the same.

Based on the experimental findings, this study describes the method of producing calibrated rolled 38KhA grade steel for cold massive forming of automotive engine hardware without grinding any surface defects. Calibrated rolled 38XA grade steel, $d = 9.65$ mm produced using the suggested resource-saving and more environmentally friendly technology features good cold plastic deformation properties and leaves similar rolled products manufactured using actual technology behind in all respects.

State-of-the-art

A quite important link in development of environmentally friendly and resource-saving hardware production technologies is a structured approach to the preparation of graded rolled metal products that enables functional management of properties by means of changing the degree of particles dispersion, the number and morphology of phase components.

Today, the most widely-spread thermal operation of making rolled products of medium carbon and alloy steels preceding the stage of cold massive forming is batch or bell annealing to granular pearlite. The annealing time is up to 36 hours or more. But even following such long thermal exposure the structure of metal products may have some spots with traces of lamellar pearlite and sometimes feature non-uniform distribution of properties along the roll length.

The number of automotive industry hardware products is subject to exclusive standards for surface defects such as the depth of surface defects, decarburized layer presence and surface finish.

The existing technologies of heavy-duty hardware treatment prior to cold massive forming imply the exposure of hot-rolled steel to plastic deformation and removal of major surface defects by means of the expensive grinding operation.

Intolerable high mechanical characteristics $\sigma_{0.2}$ and σ_B result from heavy cold work hardening in the process of drawing and cutter grinding as well as an unsatisfactory microstructure which is inadmissible for cold massive forming of an automotive engine group bolts. Typically, surface defects (collar marks, silvers, decarburized layer etc.) of rolled products are removed by means of surface grinding. The surface grinding of rolled metal products, in addition to cold work hardening, results in other surface defects such as hardening of a surface layer accompanied with cracks in that layer (the hardened layer depth is within 0.15-0.3 mm). There may rough spiral cuts and cracks occur on the surface of rolled metal products. Improper alignment for grinding may result in a non-uniform peripheral stripping of calibrated rolled products with an inadmissibly excessive (above 0.1 mm) decarburized layer remaining on the surface. This technology of processing rolled products chips over 5.5% of metal. The most primal calculation expressed in monetary terms shows that grinding 1 ton of rolled metal products results in min. 55 kg of chipped metal per ton or the loss of 1650 roubles.

Below is the actual technology of processing 38XA grade rolled metal products for engine group bolts M10:

- initial condition: hot-rolled steel, $d = 12.0$ mm;
- bell blanket annealing to granular cementite at the temperature of 750°C (total annealing time is 28 hours);
- etching rolled metal products to complete removal of scale;
- drawing rolled metal products from $d = 12.0$ mm to $d = 11.0$ mm (reduction rate is 16.0%);

- recrystallization bell blanket annealing at the temperature of 670°C (total annealing time is 15 hours);
- etching rolled metal products to complete removal of scale;
- drawing rolled metal products from $d = 11.0$ mm to $d = 10.2$ mm (reduction rate is 14.0%);
- grinding calibrated rolled metal products from $d = 10.2$ mm to $d = 9.97$ mm;
- drawing rolled metal products from $d = 9.97$ mm to $d = 9.65$ mm (reduction rate is 6.0%);
- lubricating.

Prior to cold massive forming of hardware the produced rolled products must meet the requirements of GOST 10702-78 High-Grade Structural Cold-Pressing and Heading Carbon and Alloy Steel: $\sigma_B \geq 600.0$ MPa; hardness HB < 207; decarburized layer thickness < 0.05 mm; surface finish class should conform to group E GOST 14955-77, i.e. there are particular marks acceptable if their depth does not exceed the half of the limit diameter deviation; $\sigma_{0.2}$ is not specified in GOST 10702-78.

In the absolute majority of cases, calibrated rolled steel products, grade 38XA, produced using actual technology feature σ_B above 700 MPa ($\sigma_B = 75$ MPa) and unacceptable values of $\sigma_{0.2} > 640$ MPa ($\sigma_{0.2} = 660$ MPa) where the difference of $\sigma_{0.2}$ and σ_B on examination reaches 10-12 MPa. About 50% of checked rolled metal products feature hardness above the permissible value specified in GOST 10702-78, HB > 207. In most of the cases, the contraction ratio (Ψ) is less than 55%, i.e. below the permissible value. A portion of rolled metal products ($\approx 20\%$) features the decarburized layer thickness above 0.05 mm which exceeds the permissible value. The surface finish class of over 50% of calibrated of rolled metal products does not conform to GOST 14955-77. By microstructure only the half of rolled metal products conforms to the regulatory and technical documentation requirements after annealing to granular pearlite because of non-uniform heating of metal charge in the furnace cavity.

In order to avoid the abovementioned defects it is suggested to produce calibrated rolled 38XA grade steel products of the ready diameter of 9.65 mm from the initial hot-rolled steel diameter of 14.0 mm using the following flow diagram:

- HFC (high-frequency current) annealing of hot-rolled products at the temperature of 760-780°C;
- etching rolled metal products to complete removal of scale;
- drawing rolled metal products from $d = 14.0$ mm to $d = 12.5$ mm (reduction rate is 20.0%);
- HFC annealing of rolled metal products at the temperature of 760-780°C;
- etching rolled metal products to complete removal of scale;
- drawing rolled metal products from $d = 12.5$ mm to $d = 11.0$ mm (reduction rate is 22.0%);
- HFC annealing of rolled metal products at the temperature of 760-780°C;
- etching rolled metal products to complete removal of scale;
- drawing rolled metal products from $d = 11.0$ mm to $d = 9.65$ mm (reduction rate is 23%);
- HFC annealing of rolled metal products at the temperature of 760-780°C;
- etching rolled metal products to complete removal of scale;
- calibrating through a die, $d = 9.65$ mm (within the elastic deformation).

The total reduction ratio is 65%. The samples of hot-rolled 38XA steel products of 14.0 mm diameter and HFC-annealed samples were etched in a spirit of salt at the temperature of 63-67°C. HFC-annealing resulted in a thin oxidation deposit on the rolled steel surface that was removed in a spirit of salt in several seconds. In this case the time for using the acid solution required for etching rolled metal products significantly increases.

It was established that following the first HFC-annealing the microstructure of hot-rolled steel becomes finer and more uniform as compared to the microstructure of the initial hot-rolled steel.

Such change in the structural condition results in lower strength and higher plasticity, hardness characteristics: σ_B is decreased for 60-90 MPa; $\sigma_{0.2}$ is decreased for 40-70 MPa; Ψ (%) is increased for 54 to 69%; HB is decreased for 30-32 units.

Following the first HFC-annealing, rolled metal products become suitable for further drawing. The variation in the microstructure, mechanical characteristics and hardness of calibrated rolled 38XA steel products at various process flow stages showed that an increased number of HFC-anneals results in a significant post-drawing change in the microstructural condition. Sorbitic pearlite becomes finer and fine-granular pearlite occurs in the microstructure on the intermediate diameter of 11.0 mm after HFC-annealing.

After the third HFC-annealing a uniform microstructure consisting of fine-granular and dotted pearlite and uniformly distributed ferrite is formed on the final diameter of 9.65 mm. The hardness of calibrated rolled steel with such microstructure exceeds HB 194. The mechanical properties of calibrated rolled steel are changed resulting in lower strength and higher plasticity characteristics.

The triple drawing of rolled steel and the absence of scale after HFC-annealing results in significantly higher finish class of the calibrated rolled steel. It is by no means unimportant that these rolled metal products feature no ovality on the final dimension.

Calibrated rolled 38XA steel products produced using the suggested technology unlike those produced by actual technology feature much lower plastic resistance, higher plasticity and lower hardness. These metal products have no decarburized layer.

The strain capacity of such metal products is $\sigma_{0.2} / \sigma_B = 41/68 = 0.6$. The resulting rolled metal products are considered suitable for cold massive forming.

Conclusions

1. The article shows the flow diagram of production of calibrated rolled 38XA grade steel for cold massive forming of automotive engine hardware without grinding any surface defects.

2. Calibrated rolled 38XA grade steel, $d = 9.65$ mm produced using the suggested technology features good cold plastic deformation properties and leaves similar rolled steel manufactured using actual technology behind in all respects.

3. The suggested technology of production of calibrated rolled 38XA grade steel, $d = 9.65$ mm is environmentally friendly as compared to the existing technology. In this case there are no hazardous emissions common for batch or bell furnaces. Etching solutions are rarely refreshed since there is no heavy scale on HFC-annealed rolled metal products.

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Beskid P.P., Chernetsova E.A., Shishkin A.D.

AN ALGORITHM OF GEOINFORMATION SYSTEM DATABASE

REQUESTS NUMBER OPTIMIZATION

Russian State Hydrometeorology University

It is suggested that in a wireless monitoring system sensors receive Geoinformation System Database information from Control Spot Transceiver which has more power and memory volume than sensors. So we can use Control Spot Transceiver as a filter for request number reduction in the Communication Net and prevent their duplication for Communication Net workload decreasing and also decrease transmission band requirements.

An idea of the optimization algorithm of requests number for wireless monitoring system consists of the generalized request formation before sending requests of the same type to the geoinformation system database. So superfluous requests number of the same type to the database will be reduced. Ideally in the Communication Net only one request of the unique type of data has to exist.

For the development of the optimization algorithm of sensors request number for monitoring system database we take assumption that request object is number information which is characterized by changing values range and return period. We will name these sensors requests to Control Spot Simple Requests simple requests.

For each coming to Control Spot simple request we have to define value metric for decision acceptance to integrate this simple request with a generalized requests set. The algorithm of generalized requests set creation has to unite simple requests which execution result can be directly obtained from before coming simple requests execution results and prevent their sending to Communication Net.

Let us assume that in the wireless monitoring net sensors create K simple requests q_i . A simple request parameter q_i ($i = 1, \dots, K$) has changing value range $[l_i; h_i]$ and return period s_i .

Let us define request cost function as

$$V(q_i) = \frac{h_i - l_i}{s_i} = \frac{p_i}{s_i} . \quad (1)$$

If two simple requests q_1 and q_2 are integrated with a generalized request q' that for correctness maintaining in a generalized request all dates requested q_1 and q_2 has to be included with q' . And for getting results of simple requests q_1 and q_2 from generalized request q' result, they have to have the same return period. So return period of the generalized request q' has to be the Greatest Common Divisor (НОД) of the function (1).

As a union criteria of the two simple requests q_1 and q_2 in a generalized requests set let us define "goal" metric (B):

$$\begin{cases} B_{ij} = \frac{p_i}{s_i} + \frac{p_j}{s_j} - \frac{p_i \cup p_j}{НОД(s_i; s_j)} . \\ НОД(s_i; s_j) = s_i \parallel s_j \end{cases} \quad (2)$$

If the goal is less than null that simple requests q_i and q_j are not united in a generalized request but are putted separately in a generalized requests list as q'_i and q'_j . If the goal is more than null so simple requests q_i and q_j are united in the generalized request q' which is putted in the generalized requests list.

Let us consider a generalized request formation in this example:

It is suggested that three simple requests are created for data which have different sample size and return period:

q_1 : 380 < sample < 500, return period 4,

q_2 : 200 < sample < 400, return period 2,

q_3 : 250 < sample < 600, return period 4.

At entry simple requests q_1 and q_2 to the Control Spot we have to count the goal $B_{12} = \frac{500-380}{4} + \frac{400-200}{2} - \frac{500-200}{2} = 30 + 100 - 150 < 0$. The goal $B_{12} < 0$, so simple requests q_1 and q_2 can not be integrated and are putted separately in a generalized requests list as the generalized requests q_1' and q_2' .

At entry simple request q_3 to the Control Spot we have to count goals for integration with each request that was putted in the generalized requests list.

$$B_{13} = \frac{500-380}{4} + \frac{600-250}{4} - \frac{600-250}{4} = 30 + 87,5 - 87,5 > 0.$$

The goal $B_{13} > 0$ so the requests q_1' and q_3 can be integrated with the generalized request q_3' : 250 < sample < 600, return period 4, which is putted in a generalized request list.

Let us count the goal for requests q_3' and q_2' union:

$$B_{32'} = \frac{400-200}{2} + \frac{600-250}{4} - \frac{600-200}{2} = 100 + 87,5 - 200 < 0.$$

The goal $B_{32'} < 0$ so the requests q_3' and q_2' can not be integrated and are putted separately in the generalized requests list.

Since in the generalized requests list there can exist some requests that their integration verifying can request time. So we must develop a fast algorithm for generalized requests formation. The algorithm can save processing time by heightened request of memory volume in the formation device for saving all primary requests and goal values. If it is suggested that such resources exist at the Control Spot that the fast algorithm of generalized requests formation can work in such a scheme:

If at entry a simple request q_i to the Control Spot the generalizes requests list is empty that a simple request q_i is recorded in it as the generalized request q_i' . If at

entry a simple request q_i to the Control Spot the generalizes requests list is not empty that the generalized request Q_{int} with the greatest goal value B_{int} is looked in it. If after integration of a simple request q_i with the generalized request Q_{int} the value B_{int} does not increase that the simple request q_i is not integrated with this generalized request and there are an attempt to integrate this simple request with a generalized request that has a lower value of B_{int} .

Also we have to take into account that each generalized request has to have a limited formation time after which it has to be transmitted in the Net.

If during generalized request formation time any simple request q_i , integrated with it, is rejected, that any summand included with the goal is zeroed. In this case the generalized request Q_{int} return to its former state Q_{int_old} , in which it was before listing a simple request q_i in it. Let us assume that the generalized request Q_{int_old} represents a new set of generalized requests if the inequality is right:

$$\frac{|B_{Q_{int_old}} - B'_{Q_{int_old}}|}{B_{Q_{int_old}}} \leq \alpha, \quad (3)$$

where $B'_{Q_{int_old}}$ represents a goal at integration of requests from the updated generalized requests list with Q_{int_old} request; α - a threshold.

Otherwise we consider the set Q_{int_old} a simple request.

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Galkin VV, Pachurin VG, Pachurin GV, Derbenev AA

REGULAR VARIATION OF THE STRUCTURAL AND MECHANICAL PROPERTIES OF THE METAL IN A PRODUCT WITH WEDGE PROFILE, RECEIVE OPERATION ROLLING

Nizhny Novgorod State Technical University n.a. R.E. Alekseev

This paper sets forth a comprehensive study of the behavior of structural-mechanical properties across the volume of a rectangular spring plate grade wedge-rolled steel based on a strain degree.

The experimental techniques included: measuring curves of vertical lines applied to the rolled strip lateral surface (Hollenberg delineating method); structural-mechanical tests of the material specimens fabricated from the delineated regions of the rolled strip which were layer by layer cut into $\approx 1,5$ mm thick plates using the electric erosion machining method; evaluation of hardening/softening of the material by measuring its microhardness and dimensions of structural constituents on the specimen polished section at the rolling shutdown, and a mathematical modeling of the fine-element (FEM) rolling process using DEFORM software system.

We have defined the microstructure of the deformation centre in a rectangular strip wedge-rolled on a plate as exemplified by fabrication of a spring plate blank of 50KhGFA grade steel and have evaluated its service properties.

Improvement of the service life of engineering products while reducing the steel intensity of the same is the primary trend of resource saving technologies. Meanwhile many metal products are exposed to cyclic loads when in service. A behavior of metal materials in the specific products under alternate loads is determined by many factors. All of them affect the regularities of occurrence and propagation of fatigue cracks. For the purposes of discussion these factors may be subdivided into two categories.

The first category may include a specific geometry of a product, size, conditions and cyclicity of external loads. Due to the fact that the process of cracks occurrence and propagation is local this results in that the determinants of a fatigue rupture are not average characteristics of deformation and rupture resistance defined in static loading of plenty large enough specimens but the local characteristics and their combinations. The principle factors of the second category include the structure factor that is a function of the specific structure, phase composition, chemical composition and thermal treatment. In addition, this factor is affected by the previous plastic deformation in a cold or a hot state which may be concurrently combined with a thermal treatment. In this case any plate forming or die forging process may be associated with the unhomogeneity of deformation.

A plastic deformation affects the cyclic strength both at the micro-level where it changes the density and structure of crystal defects and the macro-level where due to the unhomogeneity of deformation residual macrostresses occur and remain in the volume of the blank being formed. Besides, any contact of a tool with the blank changes the nature of superficial fine irregularities and the condition of near-surface layers. It is known [1,2] that the impact of a homogeneous predeformation is ambiguous. For instance, a plastic deformation in the area of superficial deformations typically results in a higher cyclic strength of metal products. However hardening at degrees below or above the homogenous plastic deformation level may have an adverse effect on the fatigue strength. For instance, according to E. Schmidman and P. Emrich, 2% predeformation of Sk10 steel slightly reduces the fatigue limit while 10 and 22% predeformation increases such limit. This is proven with the data previously obtained by N.I. Chernyak who found that plastic deformations other than homogenous result in a lower fatigue strength of structural materials.

Recently the development of spring design tends to decrease the number of leaves to a single leaf. OAO GAZ designed and put into service automated lines for production of variable cross-section 50KhGFA steel plates for few-leaf springs used on GAZel vehicles [3,4] which ensured a reduction in their steel intensity as compared to traditional springs of regular cross-section plates.

While in service springs are exposed to cyclic loads both in the air and in a corrosive medium. There is a little information available in scientific and technical literature with respect to the evaluation of a fatigue strength of the specific products [2,5]. This is associated with the fact that studying the unhomogeneity of deformation in a specific engineering metal-forming was difficult until quite recently. Therefore a study of the structure and mechanical properties of fabricated spring plates is of great practical importance.

A spring plate fabrication technique includes piece blank (hot-rolled rectangular stock) induction heating and forming operations: central hole punching, wedge-rolling both blank ends with idlers (rolling speed is 200 mm/sec) and coiling. The cycle time is 17-19 seconds. Then the plate is heated, bended and heat-treated according to the factory technique (oil quenching and tempering) followed by shot peening of its surface.

The technology of the application of rectangular strip hot-rolled stock for fabrication of springs has a number of features: a blank is wedge-rolled in one operation which implies unhomogenous deformation across the rolled plate length; the production is automated which results in considerable post-deformation pauses and a possibility of recrystallization processes in metal; there are bar section blanks used which are supplied not for the purpose of processing.

It was found that while a cold-working process is associated with an increase in resistance to deformation (hardening or peening) proportionally to the deformation degree, a hot-working is accompanied with concurrent hardening and softening processes. In this case the recrystallization rate is a function of the deformation degree. Thus, the quicker the recrystallization (determined by an increase in plasticity indices and a decrease in strength properties) is, the higher deformation has preceded the instant of time in question. In other words, from physical point of view, the deformation localization development is associated with a considerable softening of metal. The measurement results showed that there was no drop in temperature and the rolling was carried out at a constant temperature. The analysis of yield and strength

limits showed an irregular softening both in the rolled strip thickness and cross-section at various shrinkage rates.

Strength properties: yield limit and ultimate rupture strength confirm the abovementioned nature of an irregularity of the strength variation across the hot-rolled blank length. In this respect some inconsistency of results can be explained by the fact that tensile test specimens were fabricated from hot-rolled metal sheets featuring irregular mechanical properties across the width as well as partially through the thickness. The highest degree of hardening at low deformations was achieved for the rolled sheet.

The resulting relations of mechanical properties indices across the hot-rolled plate length are comparable with the formed structure. The structure across the plate length consists of sorbite and ferrite. The metallographic analysis showed that the structure is consertal. The grain size varied in the range of numbers $5 \div 11$ (GOST 5639). The biggest grain size (number $5 \div 6$) corresponds to deformation degrees in the range between 4% and 10% or to the distance to the central hole in the range between 100 mm \div 200 mm. It is obvious that a deformation degree below 10% does not result in any intense development of recrystallization processes though strength properties are increased in such case. An increase in a recrystallized grain size can be objectively explained as it corresponds to the range of critical deformation degrees which typically correspond to a size of $8 \div 10\%$ [6]. At higher deformation degrees $\varepsilon \approx 20\%$ a hot-cold state occurs and partially persists when cooling. This is proven by an increase in strength with some decrease in plasticity.

The qualitative analysis of X-ray patterns showed that 50KhGFA steel, based on the processing type, contains the following phases: ferrite after hot-rolling, carbides in the form of cementite and alloy cementite. In addition to the abovementioned phases there is vanadium carbide precipitation taking places following quenching and tempering. It is found that changes in the fine structure which occurred during the material rolling did not disappear after the heat treatment. It is expressed in an increase in the mosaic block sizes and in the level of microstresses proportionally to the deformation degree. In the opinion of D.S

Kazarnovsky and his assistants the obtained data may be indicative of a reduction in the strength limit of heat-treated spring plate metal.

The fatigue test results generally qualitatively supported the deformed state data in terms of mechanical characteristics. Metal layers featuring a higher intensity of recrystallization processes and, consequently, better healing of structural defects occurred in deformation had a longer service life.

The data of calculation of percent elongation for two surfaces of the rolled strip (from the roller side and from the stationary plate mill (first direction)) obtained using Hollenberg delineating method confirmed the mechanical test results.

According to the specific areas distinguished by hardness there was the analysis of their microstructure conducted. The microstructure of rolled 50KhGFA steel strip consists of perlitic colonies and ferrite and features the irregularity expressed in sizes of the ferrite constituent of equiaxial shape essentially across the deformation centre. Elongated ferrite grains were detected only for the specific area of maximum 34...36 HRc which may be indicative of the absence of any recrystallization in this area.

Production tests conducted by OAO GAZ showed that spring plates fabricated using the automated lines conform to the requirements of design documents (GOST R 51585). The few-leaf springs of GAZel vehicles have successfully passed in-service tests as per OST 37.001.275 and conform to the requirements of GOST 12.1.012 and OST 31.001.291.

Conclusions

1. The locally deformed volume shape corresponds to the geometric model proposed by S.I. Gubkin where intense metal flow localization areas correspond to the maximum shear stress directions.

2. Due to a constant increase in the tool/roller-to-blank contact surface area in the wedge-rolling process the maximum shear stress direction from the contact area perimeter point is constantly changing along the roll stroke.

3. The deformation centre location changes with the draft increase: from the rolling beginning point to 20% draft point the deformation centre is displaced from

the rolled layers to the adjacent ones and then back to the rolled layers with further increase, particularly till 40%.

4. The comparison of the results of mathematical modeling of the fine-element (FEM) rolling process using DEFORM software system with the results of the evaluation of an irregularity of metal flow in the blank layers by the degree of deformation of the corresponding layers of rolled bolts and the amount of deflection of the same showed that the results are generally comparable and accurate.

5. Metal layers that featured a higher intensity of recrystallization processes and, consequently, better healing of structural defects occurred in deformation had a longer service life.

6. The strength properties are increased while plasticity properties are decreased along the hot-rolled blank length with an increase in the deformation degree when passing through the extreme point in the range of deformation degrees of 15÷20% based on metal layer.

7. The hardening degree obtained in the hot-rolling process partially remains unchanged after the final heat treatment where the nature of the deformation degree dependence between strength properties and plasticity properties of the rolled blank metal and heat-treated blank metal is the same.

8. Structural tests of hot-rolled and raw metal are indicative of various conditions for the formation of a hot-deformed structure and its effect on the final mechanical properties of the spring plate.

9. Performance characteristics of the front few-leaf springs as compared to multileaf springs did not deteriorate despite the post-rolling reduction in metal strength properties determining the cyclic life which may be indicative of a high steel intensity of the variable profile spring plate.

10. An introduction of single variable profile leaf springs should certainly lead to modification of the existing fabrication process or alternation of requirements to the rolled-stock supplied.

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Kolotvina S.V., Mashentseva N.G., Bal-Prilipko L.V.

NEW TRENDS OF FERMENTED FOODS LOW IN CHOLESTEROL

State Educational Institution "Moscow State University of Food Production"

National University of Biotechnology and Environmental Sciences of Ukraine

Introduction

Nutrition - the most important factor that affects human health. However, the use of modern intensive technologies in food production is associated with a reduction in the quality of products, and can sometimes lead to the risk of suffering direct harm to human body. Poor diet leads to disruption of metabolic processes in the body, decrease of immunity, chronic diseases, premature aging, including one of the most important factors in the emergence and development of cardiovascular disease by eating food rich in cholesterol. At present, therefore, the establishment of

functional meat products - the mainstream of modern food industry, defining the future preservation of the nation's health.

Given the high probability of contamination of meat products with sanitary indicative microflora, particularly relevant question is developing methods for rapid control of microbiological status of meat products. It is impossible to assess sanitary conditions of meat products in time with the use of bacteriological methods, as the use of selective media screening is time consuming, the average duration of the analysis in this case is 4-7 days. In today's production speed is often needed, so there is no doubt about the relevance of search and adaptation of new methods of rapid analysis. It is important to note that the molecular-genetic methods are the most popular today, primarily because they are directed immediately to study DNA and RNA of cells of microorganisms present in raw meat products, which characterizes them as highly specific and sensitive methods.

1. The problem of cardiovascular diseases

Currently, cardio-vascular system has become the main danger to public health and health care service. Atherosclerosis - the most common chronic disease of the cardiovascular system, characterized by compaction and loss of elasticity of the arteries, narrowing of their lumen with subsequent circulatory disorders. [8].

In the development of arterial disease and related diseases of the heart and blood vessels different types of cholesterol and other fatty substances are involved. [40] Distinguish between "bad" cholesterol (more than one), which form fat-albumin complexes of low density lipoprotein (LDL) and very low density lipoproteins (VLDL) by combining with a particular protein - apoprotein, and "good" cholesterol, or HDL cholesterol (HDL). The least desirable of these is cholesterol of the low-density lipoprotein, it is deposited on the inner wall of the arteries and form plaques. Cholesterol of very low density lipoproteins (VLDL) is 10-15% of total cholesterol, half of which is taken out of the healthy body with liver, the other half degrades in low-density lipoprotein cholesterol, that's why it is not practically measured in the laboratories. A counterweight is HDL cholesterol, it takes LDL cholesterol away from the arterial wall and removes it to the liver to destroy. Atherosclerosis can

develop in cases where the amount of LDL cholesterol in the blood is higher than normal, but with reduced levels of HDL cholesterol. Accordingly, the most desirable option is to combine high levels of LDL cholesterol and low HDL cholesterol. In practice, such combination is observed in more than 60% of patients. To prevent the risk of atherosclerosis total cholesterol in the blood of healthy people should not exceed 200 mg / dL (5.2 mmol / L). [46]

Increase of cholesterol level in the blood may be due to the disturbance of synthesis of cholesterol in the body and in the use of foods high in cholesterol and saturated fatty acids. Last found in large quantities in dairy products, the fat of any animal. Only the fat of fish and vegetable oils are rich in unsaturated fatty acids and have anti-atherosclerotic effect [46].

To avoid complications associated with high cholesterol, you need to conduct a series of activities based on the change in food, lifestyle modification rights, avoiding harmful habits. [46]

In this regard, development of functional meat products, low-cholesterol, with preventive action is relevant and promising direction.

2. *The role of starter cultures in reducing cholesterol levels in fermented meat products*

In ancient times, in the production of fermented meat products the same methods (ripening, drying) were used that are used today. However, at that time people were not aware of the existence of micro-organisms and their effects on raw meat. Centuries passed before the lactic acid bacteria was discovered, its physiology was studied, mechanisms of action in fermented meat products were established. The use of starter cultures allows you to control the modern large-scale production of fermented meat products, while maintaining the traditional taste, color and flavor. [47]

Specially selected strains of lactic acid microorganisms are related to starting cultures, which are added in the form of single or mixed cultures (*Lactobacillus curvatus*, *Lactobacillus sakei*, *Lactobacillus plantarum*, *Pediococcus acidilactici*,

Pediococcus pentosaceus, *Staphylococcus xylosum*, *Staphylococcus carnosus*, etc.). [2]

The main functions of starter cultures include acid production and decrease of pH; intensification of the drying process, suppression of sanitary-indicative microorganisms, the formation of color and color fastness, forming of flavoring compounds, inactivation of the active radicals and slowing of the oxidative damage [2].

When selecting lactic acid microorganisms as starter cultures one of the main criteria is the survival process conditions: growth in a certain temperature range, resistance to salt, sodium nitrite. Additionally the mutual compatibility of strains of lactic acid microorganisms in the process of a composition forming of bacterial drugs and the impact of microorganisms on the flavor characteristics of finished food products are considered.

Some lactic acid bacteria has proteolytic features. During the splitting of proteins, they are able to "liberate" amino acids, such as glutamic acid, alanine, phenylalanine, leucine, methionine, flavor precursors, and thus influence the creation of taste aromatic bouquet. Some microorganisms by glutamate dehydrogenase activity can directly affect the flavor characteristics of the finished meat product. [13]

Due to the product of carbohydrate metabolism of microorganisms, with lactic acid, pyruvic acid, tartaric acid, acetic acid, ethyl alcohol, acetone, acetaldehyde, and other substances are formed. They give the fermented meat products long-lasting taste. Role in the formation of flavor belongs to fats the splitting of which leads to the formation of free fatty acids and carbonyl compounds. [2]

Preventing the growth of starter cultures sanitary-indicative microorganisms can ensure the safety of the product. From this point of view, they serve a protective function and act as a safe culture through the formation of lactic acid from the fermentation of carbohydrates, and thus lowering the pH. Several lactic acid microorganisms can form other bacteriostatic substances that can inhibit the growth of undesirable microorganisms. These substances include acetic acid, carbon dioxide,

hydrogen peroxide, diacetyl, acetoin, and bacteriocins, which are currently of great interest.

Bacteriocins are complex, part of which is a protein or polypeptide component responsible for bactericidal activity, which causes inhibition of growth of bacteria, including pathogenic and spoilage. [7]

Microorganisms also have a positive impact on the intensity of the color. The formation of a pink-red salted meat is due to the fact that water molecules associated with ions of divalent iron myoglobin take part in the reaction of substitution of nitrogen oxides which is formed by reduction of sodium nitrite. This reaction is catalyzed by NO-nitrite certain denitrifying bacteria [20].

The most important property of lactic acid microorganisms is their ability to prevent oxidative damage to lipids of meat products. In lactic acid microorganisms in the process of evolution specialized enzyme systems that protect cells from the toxic action of prokaryotes derived O₂ have been elaborated. Areas of use of starter cultures that have antioxidant properties, help to prevent oxidative spoilage of meat products [10].

Along with this there is a number of published data, which shows that some types of microorganisms can reduce cholesterol in their environment [16, 19, 27].

For a long time it was thought that the main route of the conversion of cholesterol in the body is its oxidation in the process of energy metabolism to bile acids [40], but clinical studies in vivo have shown that cholesterol and its derivatives can also be used in the processes of plastic metabolism of microorganisms of the gastrointestinal tract [3].

Found that the main mechanism of degradation of cholesterol in the metabolism of microorganisms is the restoration of the double bond in the molecule of cholesterol between atoms C5 and C6, resulting forming of koprosterin (koprostanol). Simultaneously, in the process of the oxidation of cholesterol in the small quantities product of microbial degradation - holestenon is produced. Recovery and the oxidation of cholesterol occur under the influence of enzymes of microorganisms but

koprostanol and holestenon are the main products of its microbial transformation (Fig. 1) [48].

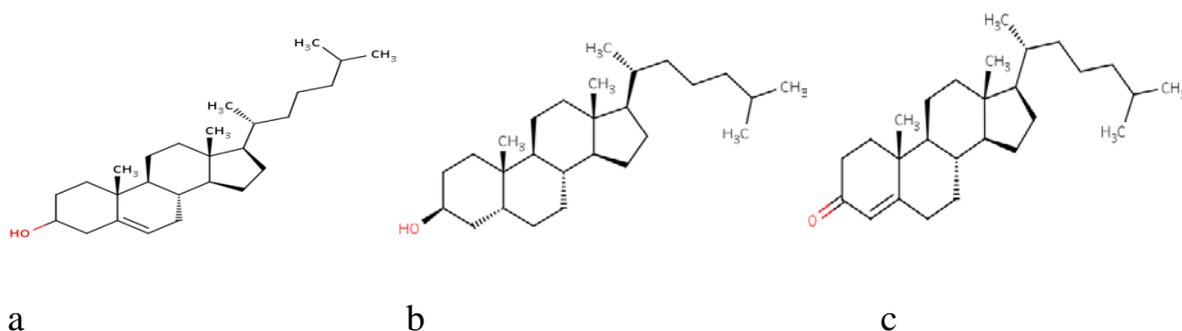


Fig. 1. Chemical structure:

a) cholesterol b) koprostanol c) holestenon

The results obtained on the basis of clinical research has highlighted the assumption that if the intestinal lactic microflora is capable to unstructure cholesterol, lactic acid bacteria used as starter cultures in food production, is able to use cholesterol in the normal course of life.

At Warsaw Agricultural University M. Ziarno and others have studied the ability of starter cultures used in the production of yogurt, to reduce the level of cholesterol in the growing medium for the cultivation of bacteria with the addition of cholesterol (*in vitro*). However, they found that the starter cultures are able to reduce cholesterol in the growing medium from 18% to 38%, and one culture *Lactobacillus acidophilus* - to 55%. Alleged reason for the reduction of cholesterol in the environment is the use of cholesterol by bacteria in their metabolism [38].

Numerous studies show that the ability to lower cholesterol in different strains of lactic acid microorganisms is significantly different [Gilliland et al 1985, Gilliland and Walker 1989, Buck and Gilliland 1994, Gopal et al 1996, Tarantoet et al 1996, Pereira and Gibson 2002] .

For example, Rasic J.L. and colleagues studied the ability of three strains of *Lactobacillus acidophilus* to reduce cholesterol in MRS liquid medium for 18 h at 37 ° C. Depending on the test strains of *Lactobacillus acidophilus* microorganisms use cholesterol ranged from 177 mg to 225 mg in 1 ml of medium. The authors found that

microbial species *Lactobacillus acidophilus* cholesterol decreasing capacity is higher compared to other lactic acid microorganisms (*Streptococcus thermophilus* and *Lactobacillus bulgaricus*). Thus, strains of *Streptococcus thermophilus* used only 59 and 69 mg of cholesterol in 1 ml of medium [31].

Walker D.R. and Gilliland S.E. found that 11 strains of *Lactobacillus acidophilus* have the ability to use cholesterol from 0 to 38 μmol in 1 ml of MRS THIO with the addition of bile. Similar observations with regard to the fact that different strains of *Lactobacillus acidophilus* reduce cholesterol differently, were done by Gopal A. etc. In their study, six strains of *Lactobacillus acidophilus* reduced cholesterol from 15% to 55% in the medium MRS THIO with the addition of bile [36].

There was an active reduction of cholesterol in the growing medium *Bifidobacterium* (Rasic J.L. and others). In this case, significant differences between the two studied strains *B. bifidum* (using 174 mg of cholesterol and 138 mg in 1 ml of medium, respectively) were detected. Tahri and others have noted a different picture in the study of the ability to lower cholesterol in two other strains of *Bifidobacterium breve*. A strain of *B. breve* ATCC 15700 reduced cholesterol in the medium by 50%, and *B. breve* ATCC 15698 by only 9% [31].

The literature also provides information on the learning of the ability of lactic acid microorganisms to reduce cholesterol in the production of fermented dairy products. Data on the effects of lactic acid microorganisms on the cholesterol in meat products were found.

Thus, studies Juskiewicz M. and Panfil-Kuncewicz H., showed that the microorganisms used in the production of fermented milk drinks, have the ability to lower cholesterol in the fermentation process. The authors noted that the level of cholesterol reduction depends on the type of yeast used and the properties of lactic acid microorganisms present in this ferment, and, to a lesser extent, on the fat content in milk. [22]

High levels of cholesterol reduction microorganisms present in a classic starter for yogurt showed, with cholesterol decreased by 22.2% in yoghurt containing 4% fat

and 19.8% in yoghurt containing 8% fat. Another starter for yogurt, with the same qualitative composition, has the ability to lower cholesterol by 11.3% and 15.4%, thereafter. In this work strains of *Lactobacillus acidophilus* (17,5% and 13,6%) and *Bifidobacterium bifidum* (12% and 13.5%) actively reduced cholesterol. The least-capable cholesterol decreasing strain is *Streptococcus thermophilus* (5,7% and 5,6%). [22]

Thus, the cholesterol-lowering lactic acid microorganisms may take place not only in the growing medium *in vitro*, but also in the process of fermentation of food *in situ*, which is of great practical importance and will regulate its content in the finished products.

3. *Current approaches to the assessment of the microbiological safety of meat products*

It is known that the microbiological stability and sanitary and hygienic safety of meat and meat products is one of the main criteria of quality. [4]

To microflora that affects the safety of meat and meat products are coliforms - coliforms, mesophilic aerobes, facultative anaerobes, bacteria of the genera *Salmonella*, *Proteus*, *Listeria*, and coagulase-negative staphylococcus. Microorganisms in foods is strictly controlled by sanitary and epidemiological rules and norms SanPiN 2.3.2.1078-01, which defines the requirements for the quality and safety of food products. To meet the food established requirements of the regulations it is needed along with the definition of chemical, radiological and biological substances and their compounds, to exercise their hygiene control. [4]

Traditional microbiological analysis is based on the phenotypic properties of microorganisms and, in most cases, does not allow to identify the organism to species. The effectiveness of microbiological analysis depends on the quality of culture media, the concentration of organisms in the material, the degree of contamination of extraneous microflora and the time elapsed from the date of manufacture of the product. [1]

In the modern world, along with the traditional microbiological analysis using selective media, there are many different systems for identification of microorganisms.

For example, the company "HayMediaLabs" (Russia) produces ready-made test systems "Bakpechatki", which is a modified version of the standard Petri dishes. In addition, the same company has developed plastic «HiDip». This is a bilateral or trilateral plate, which consists of a flexible plastic base with agar medium for isolation, enumeration and identification of specific bacteria in food. [44]

To assist in the microbiological analysis of the company "3M" (USA) has developed a plate "Petrifilm" for the determination of total bacterial count (QMAFAnM), yeasts and molds, coliforms and *Escherichia coli* (coliforms), Enterobacteriaceae, Staphylococcus, Listeria. Plate "Petrifilm" - is ready to use microbiological systems for the application of the sample, which include growing medium containing a standard set of nutrients, cold water soluble gelling agent and an indicator that facilitates colony counting. [6]

Rapid tests «Singlepath» and «Duopath» produced by «Merck KGaA» (Germany) allow to monitor, identify pathogenic bacteria and their toxins in foods, food raw materials and water. [5]

Along with the use of test kits bacteriological express analyzers such as "Tank-Truck" [45] produced by «SY-LAB» (Austria) are widely used, "Rabit" [39] of the company «Don Whitley Scientific» (UK) and "Lyumiprob-24" of the company «Europrobe» (France) [39]. Automatic bacteriological analyzers allow to have impartial results and reduce the duration of the study, reduce labor costs and greatly reduce the cost of analysis. However, the results of individual tests performed by automated systems which sometimes differ from the classical tests, and may differ among themselves. Obviously, to get the correct results of bacteriological studies should be standardized.

At present, the solutions to these problems phenotypic analysis methods are replaced by molecular genotypic methods based on the study of the genome of

microorganisms [1]. To one of these methods methods of DNA typing using genomic restriction, PCR, etc. Re related.

Bacterial typing method using PCR has been widely used. Currently, there are different techniques based on the use of the polymerase chain reaction. These include: specific-PCR, RAPD-PCR, PCR-DGGE, RFLP, AFLP, species-specific-PCR, real-time-PCR, multiplex-PCR [1].

Methods specific-PCR and species-specific-PCR (specific and species-specific PCR) are that piece of DNA amplification using primers corresponding to the repeating oligonucleotide sequences. The method allows to classify strains of bacteria at the species level [1].

The method of RAPD-PCR (random amplified polymorphic DNA, PCR-based amplification of random fragments of DNA) allows to determine the polymorphism of amplified PCR fragments. This PCR using short DNA fragments genetically specific target DNA. The method consists in the fact that as a primer arbitrary oligonucleotide is used which is capable to hybridizing to the target DNA and amplify it. Many scholars have used this method to differentiate between strains of bacteria [11].

In the method of PCR-DGGE (denaturing gradient gel electrophoresis, electrophoresis in denaturing gradient gel) is PCR analysis of amplified DNA in the gradient gel electrophoresis. The method has a high resolution in the study of the PCR products obtained with heterogeneous matrix, when it presents fragments of varying length and concentration. [1]

In carrying out the method of RFLP (restriction fragments length polymorphism, restriction fragment length analysis of DNA) a comparison of restriction fragments obtained by processing the PCR amplified fragment by restriction enzymes is done [21].

Amplified fragment length polymorphism AFLP (amplified sequence polymorphism). To use this method it is not needed to know either the primary sequence of DNA or the nucleotide sequence of the primers. First, DNA was digested with two different restriction enzymes, and then oligonucleotide adapters are attached

at the ends of DNA fragments. Specific sets of products of DNA cleavage amplified, using a combination of selective primers. Polymorphism can be detected with the use of radioisotopes, fluorescent dyes or coloring with silver nitrate. Thus, by varying the nucleotide sequence of the primers and using various restriction enzymes, we can achieve amplification of only a few fragments, which can be used as a fingerprint ("fingerprint"). AFLP method is used to study DNA polymorphism [42]. It should be noted that the method of PCR-RFLP is the most popular method for studying DNA polymorphism in contrast to the method of AFLP, which first amplifies the target DNA, and then expose it to the action of various restriction enzymes. This method is widely used in genomic "fingerprint" of organisms.

The method of real-time-PCR (RT-PCR) allows the quantification of microorganisms in the products. The method is based on the detection of amplification products during the reaction and monitoring the kinetics of accumulation of amplicons. This means that taking into account the result of PCR (number of amplicons) occurs after each cycle of amplification, and not the end, as in conventional PCR. The more specific DNA the original sample had, the earlier and more the number of specific fragments is increased. [43]

The method of multiplex-PCR (multiplex PCR) is used to distinguish different types of bacteria. The method allows the use several pairs of species-specific primers in a single reaction tube for the simultaneous amplification of the DNA of various bacteria. [1]

4. *The use of molecular genetic techniques to assess hygienic meat pictures*

Scope of molecular genetic studies for sanitary food microbiology and food hygiene is constantly expanding. Nowadays solutions are needed in areas such as the adaptation of methods of DNA extraction from food, and the direct detection and identification of DNA sanitary-indicative microorganisms and starter cultures in the food product. Some scientists have proposed workable approaches for solving these problems [12, 15].

One of the basic molecular genetic techniques to assess microbial contamination of meat is a traditional PCR. The method was highly appreciated by experts. So, for example, Xu X., Wu Q. and others (China) used PCR to detect *Salmonella* spp. in meat products. When creating primers *invA*, *hlyA* genes were selected. The authors, based on the results, characterized this method as a reliable, accurate, highly sensitive and specific, and recommended it to detect *Salmonella* spp. in meat products [37].

PCR has been adapted for the identification of lactic acid microorganisms in fermented meat products. Aymerich T. and others (Spain) studied by conventional PCR content of lactic acid microorganisms and Catalase cocci in fermented sausages (chorizo and fouettes). The results showed in sausages without adding starter cultures that in 11.8% of the microorganisms were found *Lactobacillus sakei* and *Lactobacillus curvatus* and 17,6% - *Lactobacillus plantarum* and *Staphylococcus xylosus*, which are natural microflora of these types of sausages. In making sausages with starter cultures were obtained in 100% of the results of all the samples, which confirmed the high specificity of the method. Application of PCR in the field identification (starter cultures) is of great practical importance, since allows the identification of micro-organisms to form [9].

To reduce the cost of reagents for PCR and electrophoresis, the labor costs for the assay, reducing the load of the equipment and increase the speed of analysis, many scientists replace traditional PCR with multiplex PCR. The method allows to indicate the genomic DNA of different organisms simultaneously in a single tube for more reactions. This variant is used for PCR in the work of Jeong Soon Kim and others (South Korea) for the identification of bacteria in meat products of *Escherichia coli* O157: H7, *Staphylococcus aureus*, *Listeria monocytogenes*, *Vibrio parahaemolyticus*, *Salmonella* spp. The authors recommend the multiplex PCR method as the most appropriate to shorten the traditional PCR [26].

Similar studies were conducted in Japan (Kawasaki S.), where the method of multiplex PCR for identification of *Salmonella* spp., *Listeria monocytogenes*, and *Escherichia coli* O157: H7 in meat with natural microflora, and the artificial addition

of pathogens was compared with conventional microbiological analysis. Studies within two months of storage of meat from 28 of the samples with the addition of pathogenic organisms in 27 cases showed positive results for the presence of *Salmonella enteritidis*, *Listeria monocytogenes* and *Escherichia coli* O157: H7 in the application of multiplex PCR, and only 20 showed positive results during traditional microbiological analysis. Authors on the basis of the results confirmed that the multiplex PCR is more sensitive and specific than conventional microbiological analysis [23, 24].

Multiplex PCR can be used not only to detect in a single tube multiple microbial species, but also for the analysis of multiple genes from one organism that will not only identify, but also differentiate the desired microorganism. Thus, for the detection of *Escherichia coli* O157: H7 in raw meat Visetsripong A. (Bangkok, Thailand), and others used a multiplex PCR using two pairs of primers on *vt* (VTEC) for *rfb* (O157) genes. During the reaction, they got two products with the size of 215 bp amplicons for *vt* and 420 bp for *rfb* (O157). According to the authors, the method of multiplex PCR is the most appropriate for the identification and differentiation of *E. coli* O157: H7 [35].

As seen above, the widespread introduction of safety control of meat products due to PCR analysis of its implementation simplicity, low cost and reliability. However, the PCR method is mainly used for qualitative assessment of sanitary conditions of meat products. However, it is clear that further development in the area will get a PCR quantification of microorganisms in meat products [14, 41].

There are many ways to get data on the concentration of nucleic acids in a sample by PCR, but they all require more labor-intensive phases of work related to titration extracted from a test sample of DNA, or received in the course of PCR amplicons, which leads to an increase in the time required for setting Analysis and interpretation of the results [41]. Also, the presence of additional phases of work increases the quantity of errors and get incorrect results.

there is already a method without above deficiencies - a method of real-time PCR (Real-Time PCR) [18, 32]. The method is to study the accumulation of

amplification products using a special device without subsequent electrophoresis. Since the kinetics of accumulation of amplification products is associated with the original amount of the matrix, it gives the ability to accurately estimate its amount. [41]

The distinctive features of the method, in contrast to traditional PCR is the ability to quantify the DNA / RNA of unknown microorganisms in the products, the lack of stage electrophoresis, less stringent requirements for the organization of the PCR laboratory and automatic registration and interpretation of the results [41].

The absence of electrophoresis phase minimizes the risk of contamination with PCR products and thus drastically reduces the number of false positive results. Since the registration of the results is carried out directly in the PCR, the entire analysis can be performed in one or two rooms, laboratories, and there is no need for a separate room for the detection of the reaction products [41].

The use of mathematical methods of analysis allows automatic interpretation of results and eliminates the problem of subjective evaluation of electrophoregrams [41].

This technique in the past five years has been used successfully in the major diagnostic and research centers of the developed world and in the near future will also become widespread as PCR and in its current format, due to economies of production space, reducing the number of personnel and the demand for quantitative determination of DNA / RNA [41].

For example, Malorny B. and others (Germany) used the method of real-time PCR for the diagnosis of *Salmonella* in food. During the work, the authors have adapted the method for isolating DNA from chicken broth, minced meat, fish and milk, and developed a test system for allocation of *Salmonella*, selecting as a specific site for the primer and probe *ttrRSBCA* locus. The sensitivity of the developed test system was 10³KOE/ml, including pre-wash test product in peptone water, and diagnostic accuracy - 100%. The application of real-time PCR analysis of reduced duration from 4-5 days to 24 hours. According to the authors, this method will meet

the increasing demands of laboratories and serve to guarantee the quality of the studies [28].

Similar studies by adapting the method of real-time PCR to detect *Salmonella* in chicken, pork, beef and raw hamburger were conducted by Fujikawa H. and Shimojima Y. (Japan) [17]. *invA* gene was studied. They developed a standard curve and successfully tested a method of real-time PCR on samples of food. Here it should be noted that the quantitative determination by real-time PCR is performed by comparing the kinetic curves obtained in the analysis of experimental samples with the standard kinetic curves. Standard kinetic curves obtained experimentally by analyzing the type strains with known CFU / ml, in this case, the concentration of *Salmonella enterica* is 10^3 , 10^4 , 10^5 , 10^6 , and 10^7 CFU / ml.

For the detection of *Escherichia coli* O157: H7 and *Listeria monocytogenes* in food Nguyen LT and others (U.S.) used the method of real-time PCR. The target genes for *E. coli* O157: H7 and *L. monocytogenes*, and the authors have chosen *rfbE* *hlyA*, thereafter. Analysis of 169 bacterial strains confirmed the specificity of designed primers and probes for the detection of *E. coli* O157: H7 and *L. monocytogenes* by real-time PCR. Detection sensitivity ranged from 10^3 to 10^4 CFU / ml without enrichment and 1,4-2,2 CFU / ml after 4 h of selective enrichment for *E. coli* O157: H7 and 1,2-6,0 CFU / ml for *L. monocytogenes* after 30 h of enrichment. [30]

In addition to identifying health and microflora exponential PCR in real time can be used to identify lactic acid microorganisms belonging to the fermented meat products. For example, Torriani S. and others (Spain) used the method of real-time PCR for identification of tyrosine decarboxylase gene in lactic tdc microorganisms associated with fermented meat products. In their work they studied 87 strains of lactic acid microorganisms (*Enterococcus*, *Staphylococcus epidermidis*, *Lactobacillus brevis*, *Lactobacillus curvatus*, *Lactobacillus fermentum*, and *Staphylococcus xylosus*). The amplification products were obtained by RT-PCR, consistent with results previously obtained by HPLC. According to the authors, the

application of real-time PCR is a fast and reliable tool for the detection of lactic acid microorganisms, including those with specific activity [34].

The same conclusion was done by Martin B. and other authors conducted discovery of *Lactobacillus sakei* in fermented sausages by real-time PCR. For designing primers and probes region 16-23S rRNA gene was used. The detection limit of the method was about 3 cells on the reaction mixture, the ultimate determination of the number - 30 cells per reaction mixture. The results were compared with the traditional method using MRS agar and did not differ significantly, indicating a high convergence between them. In connection with this method of real-time PCR is an alternative to the classical analysis and can quickly and effectively detect *Lactobacillus sakei* in fermented sausages. [29]

One of the latest developments in adapting the method real-time PCR to monitor the sanitary-indicative microorganisms in food is a multiplex real-time PCR. This is evident, for flow experiments in which fewer reactions decrease in half, significantly reduce the cost of the work. But we must keep in mind that the increase in the number of reactions in a single tube complicates the optimization, so no need to do so is not recommended. Control more than two products in a single tube is likely to require a huge effort by adjusting the experiment, and to resort to such schemes should be only in exceptional cases. [49]

However, Kawasaki S. and others (Japan) used the method of multiplex real-time PCR for simultaneous detection of *Salmonella* spp., *Listeria monocytogenes* and *Escherichia coli* O157: H7 in food. The sensitivity of detection was 2×10^2 CFU / ml for each of the desired microorganism, and the efficiency of PCR - 84,2-99,2%. This involves pre-enrichment of 25 g of the sample for 20 hours, and all the analysis took 24 hours. The authors recommend that the multiplex real-time PCR analysis of foodstuffs contaminated with sanitary-indicative microorganisms. [25]

Multiplex real-time PCR was used in studies of Suo B. and others (China) for the analysis of *Salmonella* spp., *Escherichia coli* O157 and *Listeria monocytogenes* in meat products. *invA*, *rfbE* and *hlyA* was used for *Salmonella* spp., *Escherichia coli* O157 and *Listeria monocytogenes*, thereafter. Detection sensitivity was <18 KOE/10,

develop test system was tested on 26 samples of meat, including beef, chicken, turkey and pork, obtained from retail stores. 12 samples were positive for one type of microorganism and 3 samples - for two after a 20-hour concentration in a growing medium. The remaining samples of sanitary-indicative microorganisms were identified. These results were confirmed using the method of real-time PCR for each type of microorganism separately. Based on the results, the authors believe that the multiplex real-time PCR is a rapid and reliable method for evaluating sanitary pictures meat products [33].

All these data only confirm the assertion that real-time PCR is gradually replacing the traditional PCR analysis, and the ability to quantify makes it indispensable in identifying health and indicative microflora and starter cultures in meat products.

5. *Fermented meat products from low-cholesterol pork*

Consumption of foods containing large amounts of fat of animal origin, leads to an increase in overweight and obesity, the prevalence of which in the last 8-9 years has increased from 19 to 23%, increasing the risk of diabetes, cardio-vascular and other diseases. The maximum daily collection rate of cholesterol in the human body is 300 mg, only in meat and meat products an average of 60-73 mg/100 g may be contained. In connection with this acquisition of meat products with reduced cholesterol content is relevant and promising area of modern meat industry. For a long time it was thought that the main route of the conversion of cholesterol in the body is its oxidation in the process of energy metabolism to bile acids, but cholesterol and its derivatives can also be used in the processes of plastic metabolism of microorganisms of the gastrointestinal tract.

Found that the metabolism of microorganisms is a restoration of cholesterol to koprostanola. Simultaneously, in the process of oxidation of cholesterol in the small quantities product of microbial degradation – holestenon is produced. Recovery and oxidation of cholesterol occur under the influence of enzymes of microorganisms and but koprostanol and holestenon are the main products of its microbial transformation [3].

In the literature there is evidence of the ability of lactic acid microorganisms used as starter cultures in the production of dairy products, including yogurt, reduce the amount of cholesterol in the manufacturing process of the product. [38] Based on published data, we have suggested that starter cultures, which are used for the fermentation of meat products may have the ability to lower cholesterol in the process of enzymatic degradation.

To confirm this 41 strain starter cultures in the collection MGUPP was screened. [2] Measurement of cholesterol in the medium was carried out by the colorimetric method Zlatkis-Zak, based on the appearance of a red-violet color in the interaction of cholesterol with acetic and sulfuric acids in the presence of ferric chloride (Fig. 2).

Found that of the 41 strains studied only 3 microorganisms did not have the ability of cholesterol decrease, other microorganisms reduce cholesterol from 2.8% to 24.3%, one strain of *Lactobacillus curvatus* reduced cholesterol content in the environment by 32%.

Given these results, as well as the technological properties of strains with cholesterol decrease maximum capacity, we chose three strains: *Lactobacillus curvatus* 1 (32%), *Pediococcus pentosaceus* 28 (22%), *Staphylococcus carnosus* 108 (15.2%), a strain of *Staphylococcus carnosus* 108 also has a denitrifying ability, which will not only lower cholesterol, but also get a product with a stable color and low residual sodium nitrite in the finished product at the expense of its full recovery to NO.

Selected strains were grouped into the bacterial composition. This paper was accepted ratio 1:1:1 strains considering the significance of the technological properties of each individual strain, and their ability to reduce cholesterol.

For micro-organisms belonging to the bacterial composition, you must consider the ability of cultures to coexist with each other, without inhibiting the growth of each other.

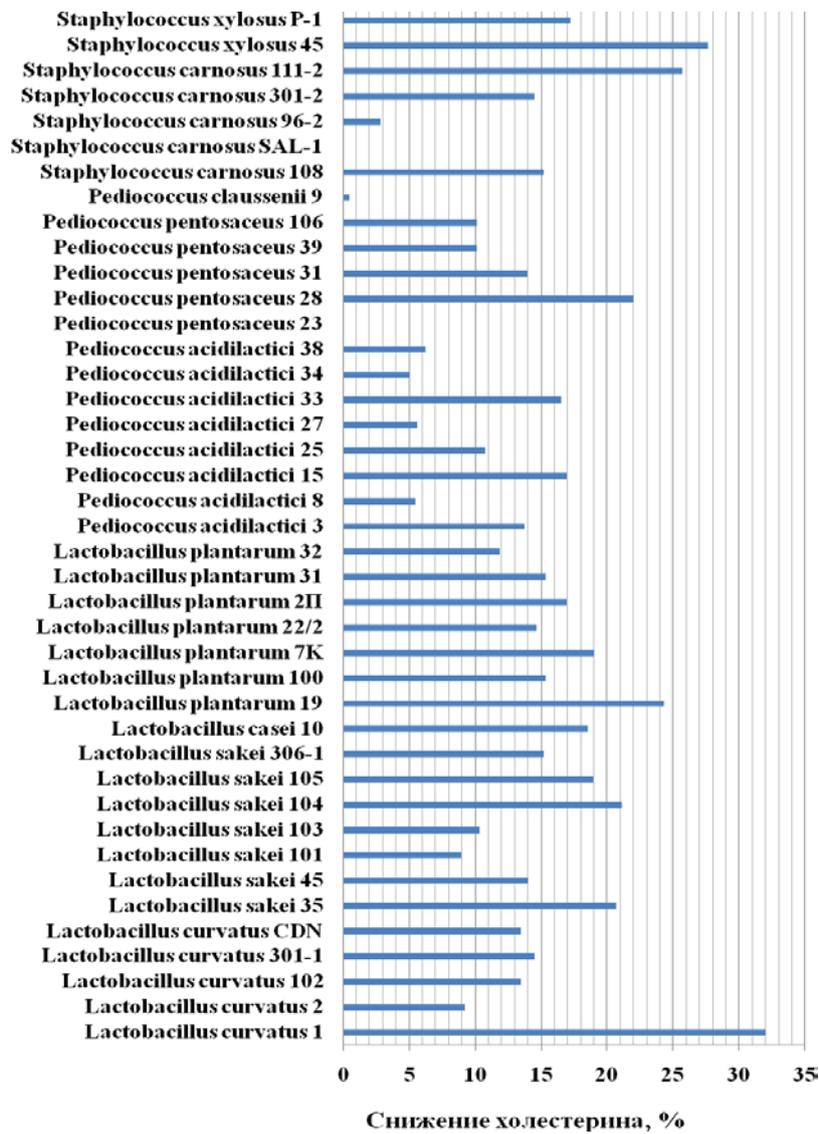


Fig. 2. Cholesterol starter culture

In order to study the lack of antagonism between these strains the method perpendicular lines (Fig. 3).



Fig. 3. The joint growth of strains of starter cultures: *Lactobacillus curvatus* 1 (B-8889), *Pediococcus pentosaceus* 28 (B-8888) and *Staphylococcus carnosus* 108 (B-8953)

The active and equitable growth, lack of microbial growth inhibition zones in the area of contact, and the possibility of sharing these strains in the bacterial composition.

To study the effect of the bacterial composition on the levels of cholesterol have been developed five experimental samples uncooked jerked meat products from pork.

Sample № 1 did not contain bacterial cultures.

Sample 2 contained a number of imported culture bacterial drugs Baktoferm T-SP (*Staphylococcus carnosus* and *Pediococcus pentosaceus*) and Baktoferm LL-1 (*Lactobacillus curvatus*) of "Hansen", Denmark. These bacterial drugs introduced into the sample number 2 in the amount of 10^9 CFU / g in the ratio of 2:1 (thus the species composition of microorganisms introduced sample number 2 corresponded to the species composition of microbial samples № 3-5).

In samples № 3-5 the composition of bacterial have been made (*Lactobacillus curvatus* 1, *Pediococcus pentosaceus* and *Staphylococcus carnosus* 28 108) in the amount of 10^9 CFU / g and a ratio of 1:1:1. The difference between the samples was that the number of samples 4 and 5 was reduced with sodium nitrite concentration in the brine from 0.075 to 0.05 and 0.03%, thereafter. This is due to the fact that the bacterial composition is denitrifying strain *Staphylococcus carnosus* 108. Reducing the concentration of sodium nitrite provided a more complete recovery to NO which will improve the safety of the finished product.

During the microbiological analysis during the process of sanitary-indicative microorganisms were not found. Samples of meat products met the requirements SanPiN 2.3.2.-1078.01.

For the control of starter cultures throughout the process monitoring was carried out by RT-PCR using species-specific test systems to avoid unwanted identification of closely related lactic acid microorganisms that may be present in the feedstock. The samples were identified № 2-5 starter cultures of *Lactobacillus curvatus*, *Staphylococcus carnosus* and *Pediococcus pentosaceus* (see Figure 4 for a sample number 3).

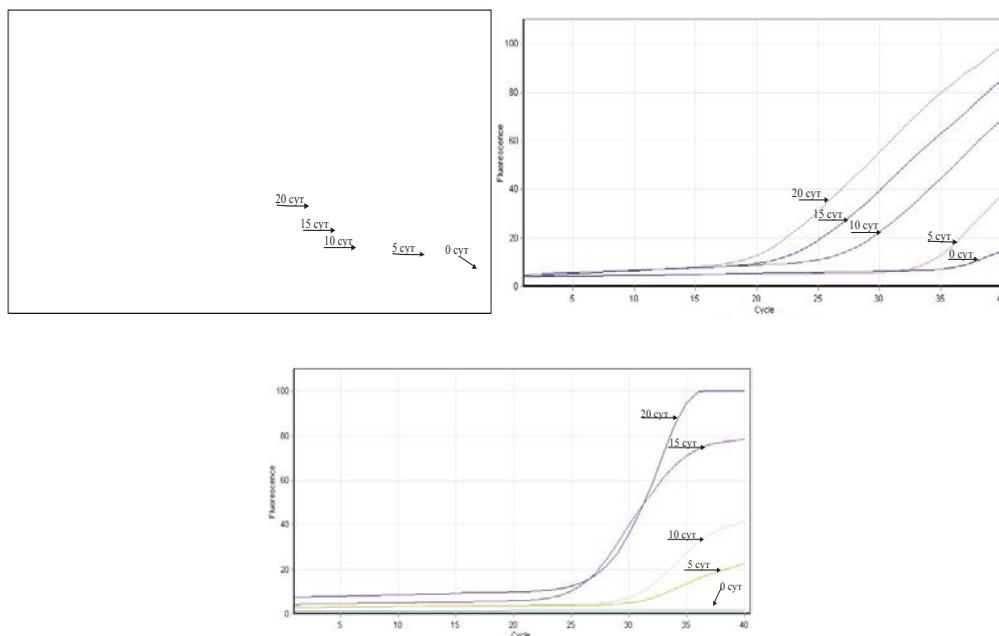


Fig. 4. Results of the study by RT-PCR *Lactobacillus curvatus* (a), *Staphylococcus carnosus* (b), *Pediococcus pentosaceus* (c) 3 in the sample number from 0 to 20 days of drying

As can be seen from Figure 3, the presence of starter cultures of *Lactobacillus curvatus*, *Staphylococcus carnosus* and *Pediococcus pentosaceus* is detected on the 5th day of drying, the growth curves indicates the presence of these microorganisms. During the drying process, a gradual development of starter cultures in the product, which allows us to trace the dynamics of microbial growth and confirms the effectiveness of RT-PCR analysis. Similar results were obtained for samples number 2, 4 and 5.

In the sample number 1 (no added starter cultures) in a study by RT-PCR of bacteria *Lactobacillus curvatus*, *Staphylococcus carnosus* and *Pediococcus pentosaceus* were not identified, it is due to the fact that the sample did not contain target DNA of these microorganisms.

Due to the fact that the main functional property in the samples № 3-5 bacterial composition was contained is the ability to lower cholesterol levels in the finished product was determined by HPLC analysis of cholesterol. Analysis of the samples was performed using chromatographic systems from Knauer (Germany) with a spectrophotometric detector K-2500 and the software "Multichrom" (Fig. 5).

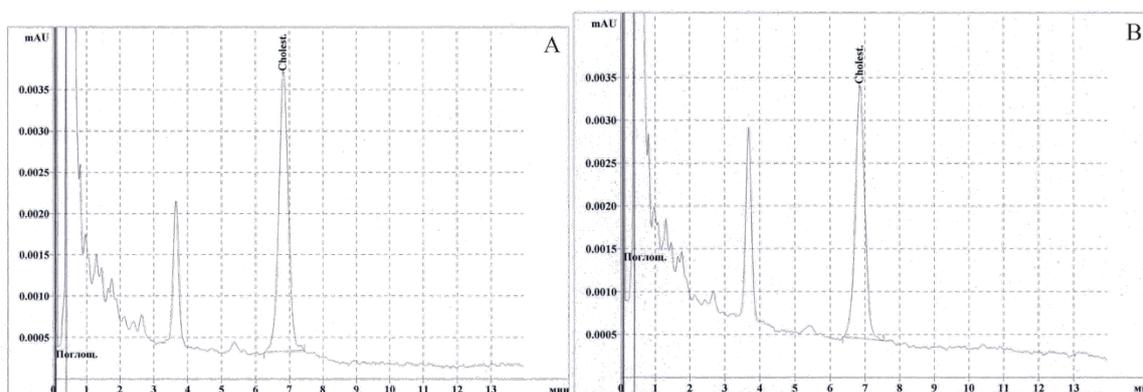


Fig. 5. Chromatogram of cholesterol contained in A - the sample number 1, B - sample number 2 C - sample number 3. D - standard (cholesterol)

In the sample number 1, it was revealed the greatest amount of cholesterol, which amounted to 620.9 mg / kg. Due to the fact that the sample number 1 is not exposed to the starter cultures, these results were taken as a basis. The sample number 2 starter cultures with imported cholesterol was 547.9 mg / kg, which is 11.7% lower than that of sample number 1. For imported starter cultures learning the ability to reduce cholesterol *in vitro* beyond the scope of this paper, however, according to HPLC obvious that the introduction of bacterial preparations Baktoferm T-SP (*Staphylococcus carnosus* and *Pediococcus pentosaceus*) and Baktoferm LL-1 (*Lactobacillus curvatus*) reduced the number of cholesterol levels in the finished product. This can be explained by the fact that the enzyme systems included in the preparation of micro-organisms are able to actively unstructure cholesterol contained in the raw meat.

For sample number 3 with a bacterial composition containing strains with maximum cholesterol decrease abilities was 487.8 mg / kg, which shows the advantage compared to samples number 1 and 2. So in the sample number 3 cholesterol by 21.4% lower than in the sample number 1 without starter cultures and 10.9% lower than in the sample number 2 with imported cultures. These data confirms the efficacy of bacterial composition and allows you to position the product as a product with functional orientation. The general chemical composition of the test samples were not fundamentally

different (Table 1).

Physical and chemical indexes of finished product

Indexes	Sample № 1	Sample № 2	Sample № 3	Sample № 4	Sample № 5
Mass fraction, %:					
– moisture	45,40 ±0,52	42,20 ±0,50	43,33 ±0,68	43,40 ±0,51	43,35 ±0,49
– protein	30,40 ±0,41	30,75 ±0,42	30,10 ±0,44	29,90 ±0,43	30,11 ±0,40
– fat	16,65 ±0,45	19,25 ±0,44	18,69 ±0,49	18,95 ±0,47	18,99 ±0,46
– ash	6,1 ±0,10	6,4 ±0,09	6,3 ±0,09	6,3 ±0,08	6,3 ±0,10
– sodium chloride	3,50 ±0,17	3,40 ±0,16	3,28 ±0,15	3,30 ±0,17	3,27 ±0,16
– sodium nitrite	0,0023 ±0,0002	0,0021 ±0,0002	0,0006 ±0,0002	0,0002 ±0,0002	traces
Quantity of nitrous pigments, %	81,4 ±0,09	82,2 ±0,09	88,5 ±0,08	83,6 ±0,08	80,7 ±0,08

Found that by introducing the recipe strain *Staphylococcus carnosus* 108, having the denitrifying activity in the sample number 3 with the traditional standard introduction to the brine of sodium nitrite, significantly the mass fraction of residual nitrite was reduced than the samples number 1 and 2, with the maximum concentration of nitrous pigments observed. Despite the reduction in the number of injection of sodium nitrite in samples number 4 and 5, the content of nitrous pigments which do not yield control samples at the same time in this sample mass fraction of residual sodium nitrite is sharply reduced.

Found that by introducing the recipe strain *Staphylococcus carnosus* 108, having the denitrifying activity in the sample number 3 with the traditional standard introduction to the brine of sodium nitrite, the mass fraction of residual nitrite was significantly reduced than the samples number 1 and 2, with the maximum concentration of nitrous pigments observed. Despite the reduction in the number of injection of sodium nitrite in samples number 4 and 5, the content of nitrous pigments

does not yield control samples at the same time the mass fraction of residual sodium nitrite is sharply reduced.

Thus, the use of bacterial composition containing denitrifying strain of *Staphylococcus carnosus* 108, reduces the level of the input in a brine of sodium nitrite from 0.075% to 0.03%, the product quality is not deteriorated compared to the product obtained without starter cultures. In addition, due to the complete recovery of sodium nitrite eliminates its entry into the body, which gives the product extra safety.

On the basis of the investigations the expediency of bacterial composition for uncooked jerked pork products is carried out. These results can be extended to other product lines of fermented meat products.

Evaluation of the results shows that the introduction of bacterial composition in the manufacture of meat products helps to reduce cholesterol levels in the product by 21.4%, while the use of denitrifying strains of *Staphylococcus carnosus* 108 will reduce the sodium nitrite content in the brine to 0.03%.

Conclusion

In conclusion, it should be noted that the creation of fermented foods with low levels of cholesterol, which causes their preventive effect, will reduce the potential risk for people suffering from cardiovascular diseases. Promising components for lowering cholesterol in meat products are lactic acid bacteria, which are able to use in the process of cholesterol metabolism. The presence of lactic acid microorganisms specific properties (formation of flavor, prevention of microbial spoilage and oxidation, making the product stable pink-red color) will create a meat product with the required quality characteristics. The application of real-time PCR to monitor the sanitary-indicative microorganisms and starter cultures, allows to assess the sanitary conditions of meat products timely and accurately.

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J11307-232

Bobkov A.V.

THE IMPACT OF LOW FLOW RATE OF THE WORKING BODY FOR THE DESIGN OF A CENTRIFUGAL COMPRESSOR OR PUMP

Komsomolsk-on-Amur state technical University

Introduction

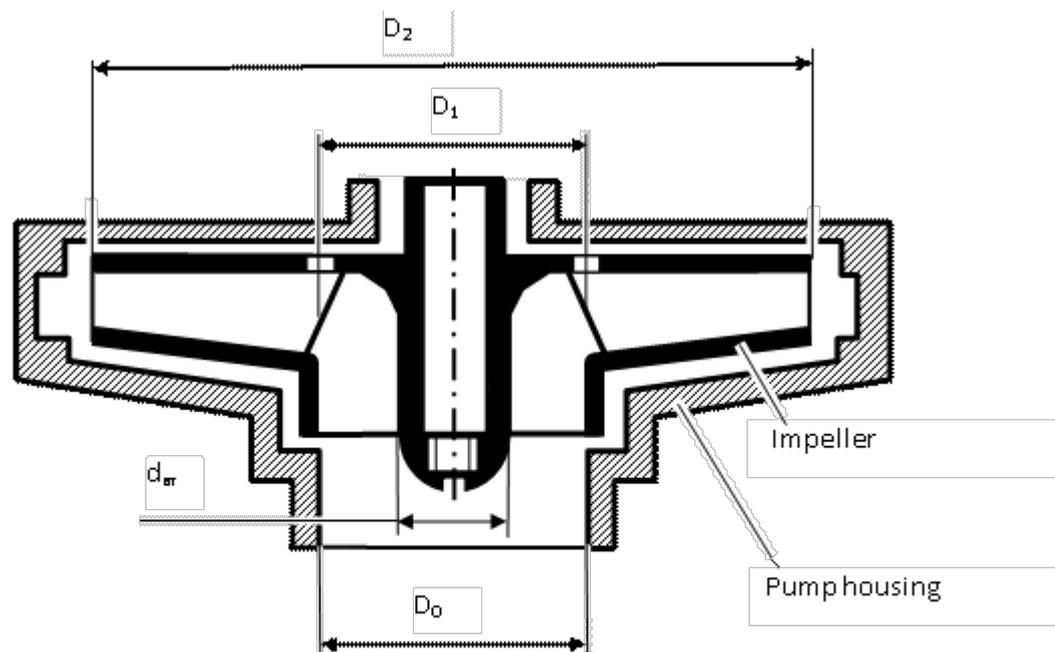


Fig. 1. Elemental composition and radial dimensions of the flow passage of the compressor centrifugal type

Analysis of the history of the development of power engineering industry shows what happens tightening of energy-saving and environmental requirements, as to the power grid as a whole and in their separate elements. In connection with this, there is a growing need in the Autonomous power supply systems of low power, becomes actual process of miniaturization of newly developed equipment, in particular, pumps

and compressors centrifugal type with a diameter of impeller D_2 , not $50 \cdot 10^{-3}$ m (see Fig.1.) and the volumetric flow rate of the exceeding working body $\dot{V} \leq 300 \cdot 10^{-6}$ m³/s.

In this article, the blowers will be summarized title: small centrifugal blowers (SCB).

1. The relevance of the problem

To the beginning of the actual application of the SCB, for example, in aerospace engineering (in the middle of the last century) was already accumulated sufficient experience of designing large in size centrifugal superchargers: pumps and compressors. Developers SCB began to borrow existing schemes of calculation of the field of engineering of large centrifugal superchargers. In the course of the tests SCB, however, has become identified a significant discrepancy between the estimated and actual parameters of the newly developed designs of the small size. The difference started to eliminate the introduction of the calculation formulas of the modifying factors. Such a scheme of improving the analytical basis for design SCB was acceptable in the conditions of a lack of information on Aero-and hydrodynamics SCB and became a principal for many years. Some of the amendments, for example, on the optimum increase the area of cross-section interscapular channel impeller, have reached (300...500)% of common values and had no adequate explanation [1]. It seems appropriate to consider the impact of small values of flow of working medium on the kinematic relations used in the methods of calculation of the compressors centrifugal type. The results will allow to formulate the criteria of purposeful selection of the circuit miniaturization of centrifugal compressor and to determine the ways of improvement of the given class of the compressors or pumps.

2. Analysis of the problem

Examine the influence of the small cost of the actuator on the ratio of the velocities in the meridional, and radial-district levels. As the characteristic consider the speed of the output of impeller: meridional one component c_{2m} of the absolute velocity:

$$c_{2m} = \frac{\dot{V}}{\pi D_2 b_2 \eta_p}, \quad (1)$$

where \dot{V} is the volume flow rate of the working body, m^3/s ; b_2 - width of the interscapular channel impeller on the diameter D_2 ; η_p - feed efficiency. The attitude in the form of the speed $\bar{c}_{2m} = c_{2m}/u_2$, where u_2 - peripheral speed, is often interpreted as the ratio of consumption and is widely used in the practice of generalization of the energy performance of centrifugal compressors and pumps.

From the Euler equation, taking the $c_{1u}=0$, the value of theoretical pressure in an infinite number of blades define $\bar{H}_{T\infty}$ under the formula:

$$H_{T\infty} = c_{2u\infty} u_2 = u_2^2 (1 - \bar{c}_{2m} \text{ctg} \beta_{2l}) \quad (2)$$

and the theoretical pressure:

$$\bar{H}_r = \frac{k_z \cdot H_{T\infty}}{u_2^2} = k_z (1 - \bar{c}_{2m} \text{ctg} \beta_{2l}), \quad (3)$$

where k_z - coefficient which takes into account the influence of a finite number of blades on the head; β_{2l} - tilt angle of the blades impeller in diameter D_2 .

Let us dwell on the selection of non-dimensional geometric parameters of the impeller, necessary for further analysis.

In the settlement schemes the relationship between the geometrical dimensions of b_2 and D_2 , respectively, in the meridional, and radial-district planes are regulated by one of two possible options:

$\bar{b}_2 = b_2/D_2$ - the relative width of the channel at the output of the impeller;

$\bar{F} = F_2/F_1$ - the geometric expansion of the cross section channel impeller:

$$\bar{F} = \frac{D_2 b_2 \psi_1 \sin \beta_{2л}}{D_1 b_1 \psi_2 \sin \beta_{1л}}, \quad (4)$$

where ψ - coefficient of the violence of the flow of the working body blades ψ impeller; index «1» refers to the parameters of the entrance in the impeller, the index of «2» to the parameters of the output from the impeller.

The design of the impeller value \bar{F} varies by two parameters: β_{2l} and b_2 . Choosing the angle designers do not take into account the optimal value of the

coefficient \bar{F} . In the majority of cases, it is the selection of b_2 , if already known D_2 , provide the required value \bar{F} , the recommended scheme of optimization of the interscapular channels. It turns out that the increase in cross-sectional channel impeller \bar{F} well as the relative width of the wheel at the output of the \bar{b}_2 used to regulate the relationship between the size - b_2 and D_2 .

Table 1

Recommended values of the parameters \bar{b}_2 и \bar{F}

Source of information	Parameter	Value of Parameter	Type centrifugal blower
[2]	\bar{b}_2	0.025...0.07	BH
[3]	\bar{b}_2	0.03...0.04	BH
[4]	\bar{b}_2	0.02...0.075	BH
[5]	\bar{b}_2	0.05...0.065	BL
[6]	\bar{b}_2	0.02...0.08	BL
[7]	\bar{F}	0.83...1.67	BH
[8]	\bar{F}	2...5	BL

For comparison in table 1 presents the values of \bar{b}_2 and \bar{F} recommended methods of calculation of the compressors centrifugal type. Conditionally blowers are divided into two types: blowers c high -flow of the working body (BH) of working body and blowers c low-flow of the working body (BL).

The group BH attributed centrifugal compressors and pumps of General purpose, centrifugal compressors of aircraft gas turbine, as well as pumps of liquid rocket engines. The group BL compressors attributed centrifugal compressors of refrigeration units, turbo expanders, as well as SCB.

The data in table 1 indicate approximately the same level of values \bar{b}_2 and the tendency of growth of \bar{F} , during the transition from the compressors BH to BL.

Investigate the dependence \bar{c}_{2m} of \bar{F} and \bar{b}_2 on the modes with small amounts

of working body. We estimate the absolute values of the size in meridional and radial-district planes, using various combinations of energy parameters and geometrical proportions. The criterion of optimization of a structure in reducing choose the lowest loss in the impeller.

Find the equation of the connection between the geometrical parameters \bar{b}_2 and \bar{F} , as well as energy parameters: flow of the working body of the \dot{V} and the angular frequency of rotation of ω . Pre-transform (3), expressing through D_1 and \bar{D}_1 dimensions of impeller at the output, the D_2 and b_2 :

$$D_2 = \frac{D_1}{D_1}, \quad b_2 = D_2 \cdot \bar{b}_2 = \frac{D_1}{D_1} \cdot \bar{b}_2.$$

Then the dependence of the speed of c_{2m} on the size of the b_2 assumes the following form:

$$c_{2m} = \frac{\dot{V} \cdot \bar{D}_1^2}{\pi D_1^2 \bar{b}_2 \psi_2 \eta_p}. \quad (5)$$

From the triangle of speed, and idealized scheme currents ($z \rightarrow \infty$), you should:

$$c_{2m} = w_2 \cdot \sin \beta_{21} = \frac{w_1}{\bar{F}} \cdot \sin \beta_{21}. \quad (6)$$

By allowing the system of equations (19) and (6) on b_2 we obtain the equation of the connection between \bar{b}_2 and \bar{F} :

$$\bar{b}_2 = \frac{\dot{V} \cdot \bar{D}_1^2 \cdot \bar{F}}{\pi D_1^2 \psi_2 \eta_p w_1 \sin \beta_{21}}. \quad (7)$$

Explore the nature and magnitude of \bar{b}_2 with most of the recommended for small pumps degree of expansion of the channel impeller $\bar{F}=5$, with a condition $D_2 \leq 50 \cdot 10^{-3} \text{m}$. To obtain the dependence $\bar{b}_2 \Big|_{\bar{F}=\text{const}} = f(\dot{V}, D_2)$ of the transform (7), taking advantage of the value D_1 from (12) and the value of the relative speed:

$$\bar{b}_2 = 1.04 \cdot \frac{\bar{F}}{\pi D_2^2 \sin \beta_{21} \psi_2} \cdot \sqrt[3]{\frac{\dot{V}^2 (1 - k_{dBT}^2) \psi_1}{\omega^2 \cdot \eta_p}}. \quad (8)$$

In Fig. 6 built-line $\bar{b}_2 = \text{const.}$ the zone limited by the parameters of the SCB. The mode with a speed of $n=6000$ rpm, $\beta_{21}=60^\circ$, $\psi_1=0.8$, $\psi_2=0.9$ (ratio of the violence blades flow at the outlet), $\eta_p=0.8$ line level $\bar{b}_2 = \text{const.}$ formed a range of values with boundaries: $\bar{b}_2=0.025$ at $\dot{V}=10^{-4}$ m³/s, $D_2=50 \cdot 10^{-3}$ m, which corresponds to the parameters of the slow-moving impellers machining (small values of n_s), and $\bar{b}_2=0.14$ - level, corresponding to the parameters of normal impellers machining. The upper border of the calculated values of \bar{b}_2 (under the condition $\bar{F}=5$) was in 1.57 times more recommended for BL (see table 1).

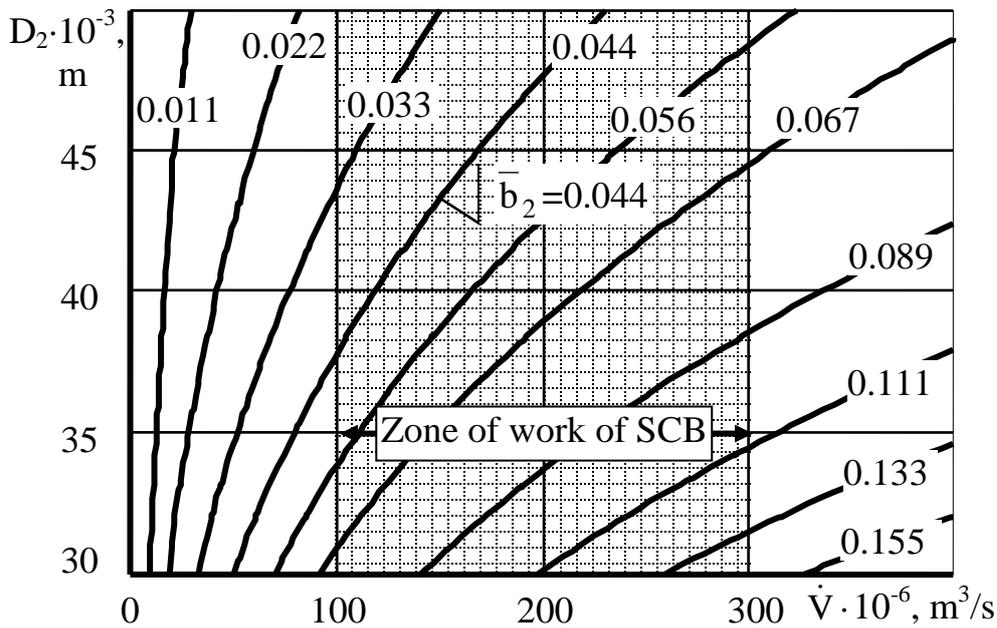


Fig. 6. The distribution of the level lines of the function $\bar{b}_2 = f(\dot{V}, D_2) = \text{const.}$ ($n=6000$ rpm, $\bar{F}=5$, $\bar{D}_1=0.5$, $\beta_{21}=60^\circ$)

Let us consider the distribution of $\bar{b}_2 = \text{const.}$ for the entire range of recommended values of F , excluding from (8) consumption \dot{V} by replacing $D_2 = D_1 / \bar{D}_1$:

$$\bar{b}_2 = 0.423 \frac{\bar{F} \cdot \bar{D}_1^2 \cdot (1 - k_{dBT}^2) \cdot \psi_1}{\pi \cdot \sin \beta_{21} \cdot \psi_2} \tag{9}$$

Fig.7 built distribution of level lines $\bar{b}_2 \Big|_{\bar{D}_1=0,5} = \text{const.}$ for the entire spectrum of values of the angle of $\beta_{21} = 20^\circ \dots 90^\circ$ the degree of increase in the area of cross-

section channels $\bar{F} = 0.5 \dots 10$ and the coefficients of the violence flow $\psi_1 = 0.8$, $\psi_2 =$

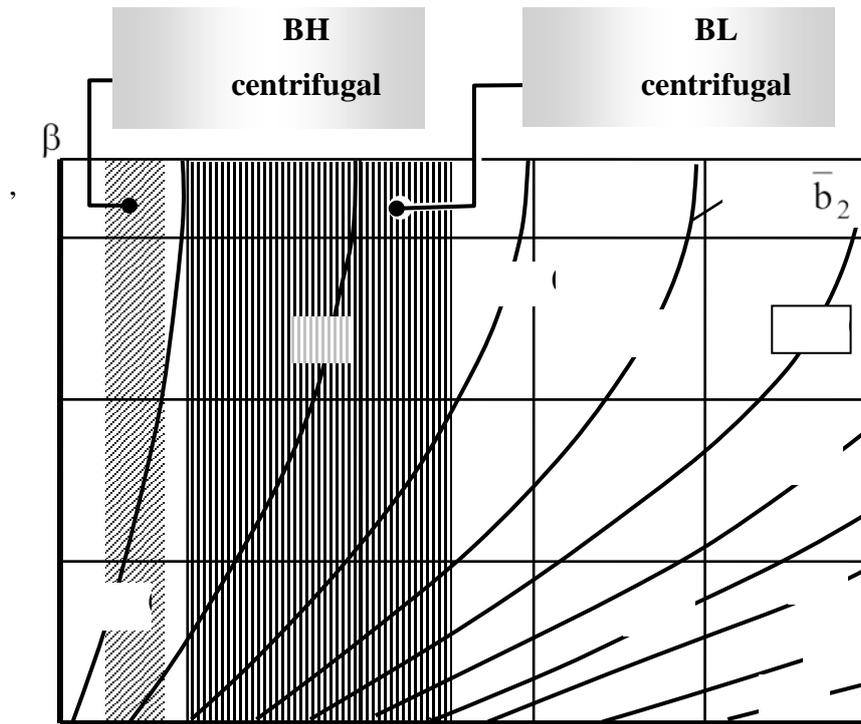


Fig. 7. The distribution of the level lines of the function

$$\bar{b}_2 = f(\bar{F}, \beta_{2,\pi}) = \text{const} \quad (\bar{D}_1 = 0.5)$$

0.9. The recommended values of \bar{F} , given in table 3 are allocated, the shading.

Draws the attention of the asymptotic nature $\bar{b}_2 \Big|_{\bar{D}_1=0,5} = \text{const}$ of dependence $\beta_{2,\pi} \rightarrow 90^\circ$. The field values of \bar{b}_2 for the compressors with a high flow rate of the working body took interval, equal, approximately 0.03...0.12. For compressors with the low flow of the working body values b_2 were in 1.5-3 times greater, and the absolute values amounted to $\bar{b}_2 = 0.055 \dots 0.35$.

The significant growth of b_2 for the SCB can be realized through the width of the blade b_2 at the output of the impeller in $D_2 = \text{const}$. Miniaturization of the centrifugal blower, which allows to convert it into the class BL, accompanied by imbalance scale of the flow part of the impeller in the direction of increase in the relative size of the meridional section of the impeller. Methods of design of compressors centrifugal type with small amounts of working body provide a "broad", compared with BH options,

channels of impeller (Fig.8).

Using the principle of minimization of losses in the impeller, as well as the expression (5), we obtain the dependence \bar{c}_{2m} on energy and geometrical parameters of the compressor:

$$\bar{c}_{2m} = \frac{2 \cdot \dot{V}}{\pi D_2^3 \bar{b}_2 \omega \eta_p \psi_2} \quad (24)$$

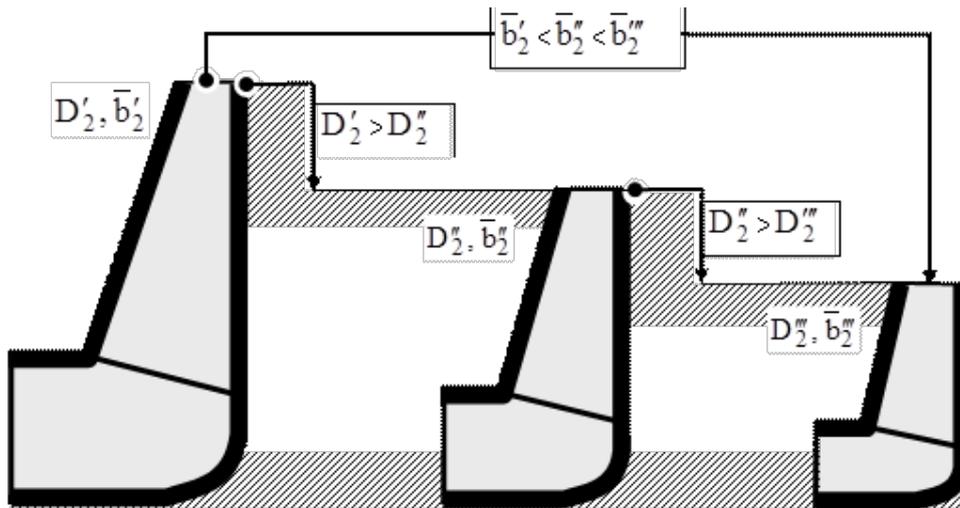


Fig. 8. The scheme of "broadening" the impeller ($\bar{D}_1 = \text{const.}$)

The identification of the limits of change of the velocity as a function of $\bar{c}_{2m}|_{n=\text{const}} = f(\dot{V}, D_2)$, produced in Fig. 9. When calculating asked values: $\bar{b}_2 = 0.2$, $\bar{D}_1 = 0.5$, $\eta_p = 0.8$, $n = 6000$ rpm. Through the corner points of the focal zone held limit line level $\bar{c}_{2m} = \text{const.}$, regulating the boundary changes in this ratio. In the interval of values of $D_2 = (30 \dots 50) \cdot 10^{-3}$ m, $\dot{V} = (100 \dots 300) \cdot 10^{-6}$ m³/s specified area of work SCB.

Table 2 provides a range of values \bar{c}_{2m} for small costs $\dot{V} = (100 \dots 300) \cdot 10^{-6}$ m³/s and the number of revolutions of electric drive $n = (6000 \dots 10000)$ rpm. The values of the speed of $\bar{c}_{2m} \leq 0.09$, which was significantly below the level found in the practice of design industrial compressors centrifugal type.

3. Conclusions

High speed SCB and the disproportionate miniaturization of impeller can lead to a significant drop in the level of values of the speed. The ratio between the expenditure component of the velocity in the absolute flow and portable speed diminishes. The small absolute values are a distinctive feature of the hydrodynamics of a given class of the compressors.

J11307-234

**Bondarenko M.F., Hahanov V.I., Englezi I.P.,
Lobur M.V., Chumachenko S.V., Litvinova E.I., Guz O.A.
GREEN WAVE TRAFFIC ON CLOUD**

*Kharkov national University of Radioelectronics Lviv National Polytechnical
University, Donetsk Academy of Autotransport*

Abstract. A cloud on-line service “Green Wave Traffic” called the Intellectual Road Infrastructure (IRI) is proposed to monitor and control traffic in real-time mode through the use of traffic controllers, RFID cars, global satellite navigation and positioning (GPS, GPRS) in order to improve the quality and safety of vehicle movement, as well as for minimization the time and costs when vehicles are moved at the specified routes. A set of innovative scientific and technological solutions for solving social, human, economic and environmental problems associated with creation and use of a cloud for monitoring and management is developed. All of these technologies and tools are integrated into the automaton model of real-time interaction between monitoring and management clouds, vehicles and road infrastructure. Each car has a virtual model in a cyberspace - an individual cell in the cloud, which is invariant with respect to drivers of vehicles.

1. Introduction

Where does it go real cyber world? Corporate networks, personal computers, as well as individual services (software), go to the "clouds" of a cyberspace, which have an obvious tendency to partition the Internet for specialized services, Fig.1. If today 4 billion users are connected in the Internet (1 zettabytes = $10^{21} = 2^{70}$ bytes) by means of

50 billion gadgets, in five years each active user will have at least 10 devices for connecting in cyberspace. Use of personal computers without replicating data to all devices becomes impossible. But even simple copying requires more non-productive time for servicing systems and projects, which can reach 50% if several devices or servers with identical functions are available. Unprofessional (bad) service of such equipment creates problems reliable data retention, as well as unauthorized access. Also, there is a problem of remote access to the physical devices when migrating users in the space, and obtaining the necessary services and information from gadgets left at home or in the office is difficult. Economic factor of effective use of purchased applications installed in gadgets and personal computers, force the user to give up their purchase in favor of almost rent free services in the clouds. All of the above is an important argument and undeniable evidence of imminent transition or the outcome of all mankind to cyberspace of virtual networks and computers, located in reliable service clouds. Advantages of the virtual world lie in the fact that the micro-cells and macro-networks in the clouds are invariant with respect to numerous gadgets of each user or corporation. Cloud components solve almost all of the above problems of reliability, safety, service and practically don't have disadvantages. So far as the corporations and users go to the clouds, protection of information and cyber components from unauthorized access, destructive penetrations and viruses is topical and market appealing problem. It is necessary to create a reliable, testable and protected from the penetrations cyberspace infrastructure (virtual PCs and corporate networks), similar to currently available solutions in the real cyber world. Thus, each service being developed in the real world should be placed in the appropriate cloud cell that combines components similar in functionality and utility. The above applies directly to the road service, which has a digital representation in cyberspace for subsequent modeling all processes on the cloud to offer every driver quality conditions of movement, saving time and money.

The goal of the project is improving the quality and safety of traffic through creating intelligent road infrastructure, including clouds of traffic monitoring and quasi-optimal motion control in real-time by using RFID-passports of vehicles, which

allow minimizing the time and costs of traffic management and creating innovative scientific and technological solutions of social, humanitarian, economic and environmental problems of the world.

Object of research is technologies for monitoring and management of vehicles integrated with cloud services, based on the use of the existing road infrastructure, RFID, radar and radio navigation.

Subject of research: traffic and road infrastructure of Ukraine and its regions, as well as advanced software and hardware RFID systems for monitoring and road management, based on the use of road controllers, global systems for positioning, navigation (GPS, GPRS), and cloud services in the Internet.

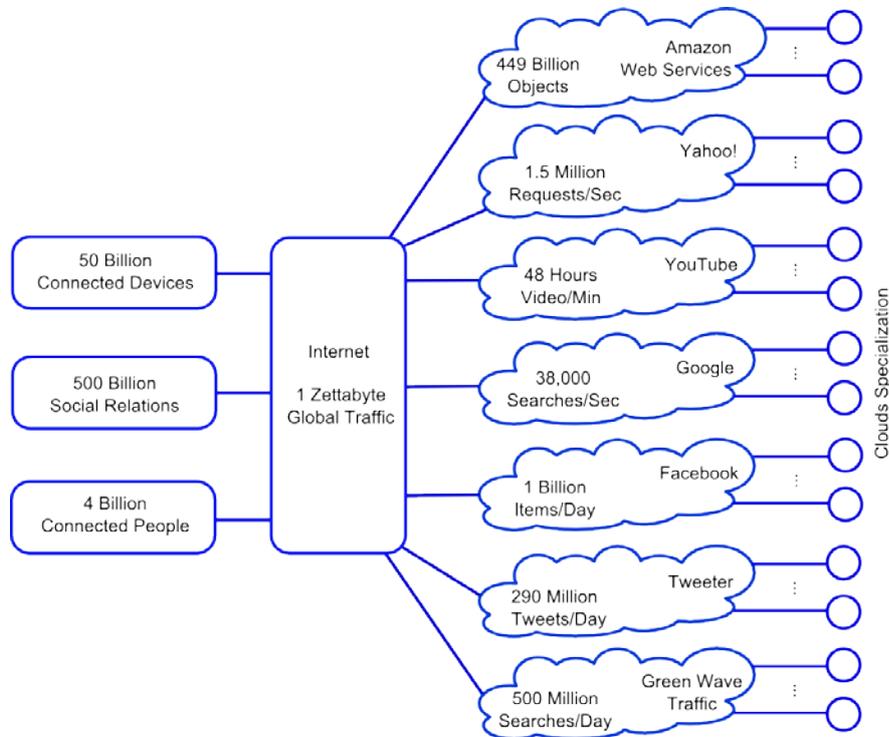


Fig. 1. Virtualization of the real world

The essence of research is creation of intellectual road infrastructure (IRI) – cloud service "Green Wave" for monitoring infrastructure and management of road in real-time, based on creating cloud virtual road infrastructure (Fig. 2), integrated with road traffic controllers, RFID of vehicles in order to improve the quality and safety of vehicle movement, minimization of time and costs when realization of routes.

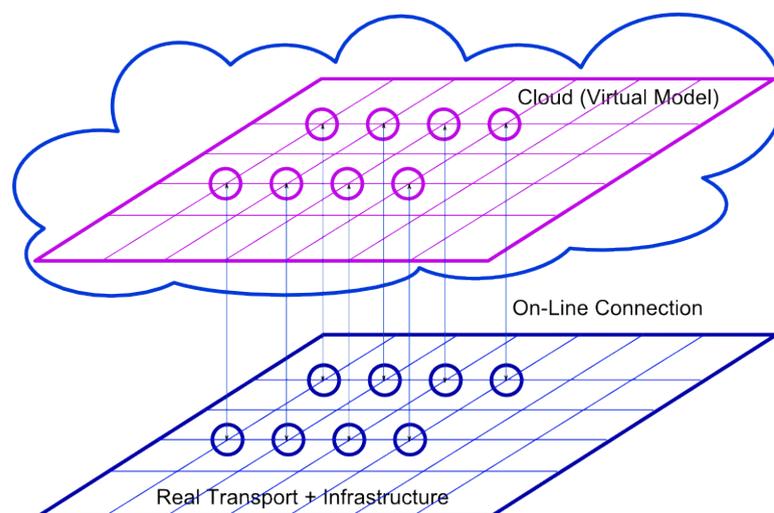


Fig. 2. Mapping of infrastructure and transport in the cloud

2. Innovative appeal and system models

The proposed intelligent system (infrastructure, transport, cloud) for monitoring and road management differs from existing ones by structural integration of three related interactive components: 1) existing mapping services with radiolocation and navigation tools; 2) a novel cloud service for monitoring and road management, based on road controllers; 3) advanced radio frequency identification tools for cars and access to cloud services for comfortable movement on the route, optimization of time and material costs.

Scientific novelty of the project is determined by the system integration of cloud for monitoring and management, RFID blocks of vehicles, monitoring and managing tools of the road infrastructure, which makes it possible to automate the optimal management of vehicles and traffic in real-time in order to solve social, humanitarian, economic and environmental problems.

Automaton model for monitoring and control with vehicles is shown in Fig. 3, where the cars send on-line their identifiers (personal data), the motion parameters and the current coordinates to the cloud, and in return receive in real-time services of optimal route (by time, cost, and quality) and motion mode to achieve final destination. Integrated analysis of road conditions based on processing operational data from vehicles and infrastructure monitors makes it possible to optimal manage road controllers for switching traffic lights on-line.

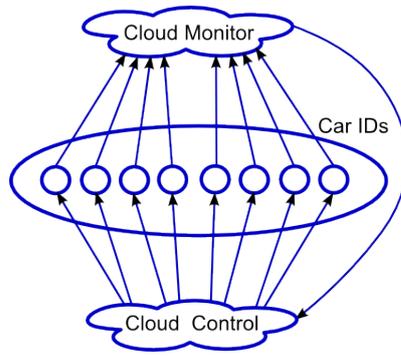


Fig. 3. Structure of vehicle and cloud interaction

The interaction of the real world (car and infrastructure) with a cloud forms two types of relationships defined by the automaton models (Fig. 4): 1) transport infrastructure with a cloud for monitoring and management; 2) a car with a cloud for optimization and providing efficiency of movement. Here the following signals are represented: X_1, Y_1, X_2, Y_2, C, M – input conditions or operands are necessary to ensure the ordered services; the output warning signals, confirming the execution of service operations; input control signals, forming queries for executing services; output variables, which form and identify state of management system; the signals of intelligent driving or road infrastructure; warning signals about execution of operating service. Automata models of road and car management system are represented in the form of variable interaction by the functions of transitions and outputs of the automaton of first kind:

$$\begin{aligned}
 &CC = \{X, Y, C, M, f, g\}, \\
 &\begin{cases} Y(t) = f[(X(t), M(t), Y(t-1))]; \\ C(t) = g[(X(t), M(t), Y(t-1))]. \end{cases}
 \end{aligned}$$

Here, each of the two automata for interacting infrastructure and transport with the cloud has two input variables (services order and state of managed object) and two outputs signals for monitoring the automaton (cloud) state and management of cloud services.

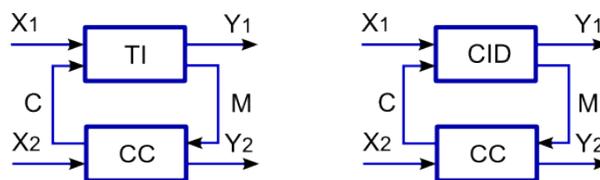


Fig. 4. Interaction of infrastructure, transport and cloud for monitoring and control

More detailed representation of the interaction between real, virtual components and the cloud system for transport monitoring and control is shown in Fig. 5 (buffer computers of road infrastructure, intellectual traffic lights, the Internet, smart dust, Car-ID, satellites of navigation and location, car, electronic map, protection tools of IRI, government services, and communication gadgets or interfaces for the Internet).

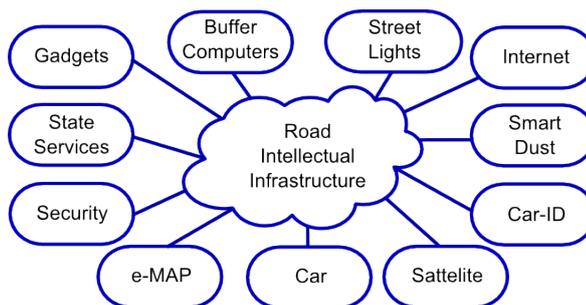


Fig. 5. Intelligent road infrastructure

3. The grounds of research:

1) Market appeal. The capitalization of the business project in Ukraine after three years of the exploitation of IRI cloud - \$ 100 million.

2) The project is focused on providing services for 7 million drivers in Ukraine and 8000 companies. Analogues of such systems do not exist in the world. There are separate components for creating the infrastructure: electronic maps, satellite location and navigation systems, specialized databases in clouds, tools for monitoring, collecting and protecting information. Availability of reliable cellular communication provides the necessary infrastructure for the project. Tools for navigating and monitoring vehicles are financially accessible to drivers. Software, hardware and network centralized management of traffic across the country, as well as cloud computing technologies are available. The technologies used in the infrastructure of roads and cyberspace are continuously improved, and their cost is reduced. Computer, mobile and internet literacy of people is enhanced. The state government understands the need for creating and use of intellectual infrastructure and cloud service for qualitative and safety road.

3) Project (draft) of the state program "Road Safety" with a planned budget of 5.43 billion hryvnas.

4) Theoretical basics of the project (intelligent and brain-like models, methods and engines for analyzing cyberspace related to discrete optimization of searching, recognition and decision-making) are represented in [1-6].

5) Experience in the development and implementation of embedded RFID and digital systems for road monitoring is described in [7-16, 29, 30].

6) Experience in the development and implementation of software and cloud services for optimizing vehicle routes of Ukrainian corporations in order to minimize the financial and time costs and improve the quality of passenger service is represented in [17-27].

7) The developed distributed road management system in large and major cities is based on highly reliable Siemens computing equipment [37-41].

4. Objectives of research:

1) Make an overview and analysis of existing technologies for monitoring and road management, based on interaction of embedded RFID vehicles, cloud services and road infrastructure.

2) Investigate the necessity, possibility and inevitability of creating intelligent cloud service for monitoring and road management that optimizes realization of transport routes by all road users.

3) Create an intelligent road controller for managing traffic, based on programmable logic controller S7-1200 from SIEMENS.

4) Develop metrics and engines to analyze data on the quality and effectiveness of virtual road infrastructure when realizing routes by vehicles.

5) Create intelligent models, methods for synthesis and analysis of virtual infrastructure for evaluating the quality of road traffic, traffic modeling, generation of the optimal route based on the technical, climatic and social factors, the quality of roads, the number of traffic signals, left turns in order to create new and reconstruction of existing road infrastructure.

6) Develop RFID block and equipping transport by tools for access to cloud services, as well as equipping the critical points of road infrastructure by sensors for stationary traffic monitoring.

7) Provide cloud services for transport corporations to improve the quality of passenger service and optimize time and cost within taxi, bus, freight and other transportation companies.

8) Provide cloud services for the driver in order to improve the quality of travel for a given route and optimize the time and cost.

9) Ensure the collection of traffic information of road infrastructure through the use of «smart dust» (car RFID, traffic lights, video cameras) to monitor traffic.

10) Collect the statistical information (intellectualize global, corporate and personal infrastructure) by accumulating traffic history, changing its parameters in time and space in order to route the quasi-optimal paths for future trips.

11) Create a virtual intelligent cloud infrastructure, which map and simulate movement of vehicles in space and time for service road in real time.

12) Creation of information security and authorized access to personal and corporate data in the cloud. Each user can only see his car in the cloud and anonymous traffic flows. All vehicle identifiers are available only for special transport public services.

5. The benefits of implementing cloud services are the following:

1) For government agencies (the police, traffic police) they include the exact vehicle identification, monitoring the positioning of vehicles in time and space, including theft; significant reduction of accidents, reducing the impact of road traffic accidents, increase of safety and comfort of road users;

2) For transport companies – monitoring locations and movement of vehicles, quasi-optimal transportation of passengers and cargo for minimizing the material and/or time costs;

3) For the driver – providing services associated with generating of quasi-optimal routes and timetable under the negative factors of the existing infrastructure in order to minimize the financial and time costs in real time;

4) For the passenger – providing services to monitor the locations and movement of passenger vehicles on bus stops or transportation terminals through the use of stationary computer display or mobile gadgets to communicate with the corresponding cloud services; visualization on the car screen of critical points of the route for a vehicle in real time through the use of surveillance cameras.

6. Technical and functional features of a “cloud” are the following:

1) Monitoring of the actual speed for all vehicles and informing the driver about areas of the speed limits; digital monitoring of passage on prohibiting signs and traffic lights.

2) Fuel economy, reduce of pollution, and reduce of travel time due to selecting the best route proposed by a cloud.

3) Prevention of traffic jams due to pre-planning of vehicle movement, taking into account the plans of the other traffic participants; adjustment of vehicle route in real-time when changing traffic conditions.

4) Intelligent management of the switching cycle of traffic lights depending on road conditions at intersections.

5) Generation of reports and recommendations to improve the road infrastructure, placement of signs, traffic lights, and centralized programming the switching cycles.

6) Prevention of vehicle theft and unauthorized leaving the accident scene through the monitoring the location of each vehicle.

7) Informing of the special services through the panic button about the incidents, which occurred on the road or in the car.

8) Alert of the driver about potential hazards on the route based on information obtained from the clouds during the motion.

9) Automatic registration of crash dynamics by using internally identification module; registration of driving style for insurance companies.

7. Components of cloud road services

“Smart dust” is a set of interconnected autonomous functioning components, which form the microsystem with the transceiver and monitoring tools, designed for

collecting information about the environment state. The problems, which are solved by “smart dust”:

1. Monitoring environmental conditions (temperature, pressure, humidity, precipitation).

2. Monitoring the movement of transport, frequency of movement, speed, size of moving objects.

3. The interaction between moving objects for positioning, identification of moving objects, transmitting information about objects, moving towards each other, to the management cloud.

4. Creating e-passport of moving object.

5. Preventing theft of vehicles.

6. Ensuring a high level protection of electronic IDs from unauthorized access.

The cost of RFID tag is usually less than 1% of the value of the object identification. Its functionality is to maintain one-to-one correspondence between the label and object during the life cycle of a product.

The real world is in need of advanced and precise monitoring and management of cloud. It has long recognized the need for an absolutely precise radio frequency digital identification of all produce and natural sites on the planet, including humans and animals. The next steps are creating cloud virtual digital models of entities (objects) of the real world for accurate modeling, monitoring and management by all possible relations (natural, social, technical, technological) between them.

8. **Problems solved by RFID**

1. Identify product (object or subject) in a local or global coordinate system.

2. Save the parameters, which are characterized the basic properties of the object.

3. Accumulate and store the history of the object life cycle.

4. Transfer this information to the management cloud on the authorized request.

5. Receive the confidential information, making it possible to modify the individual properties of the e-passport of the object.

6. Interact with e-passports of other objects in the field of radio-frequency visibility of the object.

7. Transfer information about all interactions of an object with other ones within the radio visibility.

Thus, the object ID is stand-alone digital system-on-chip with low power transceiver, up to 200 meters, which is able to store information about object, modify it by command of control center, and store information about all the interactions with the surrounding environment to transmit the interaction data to management cloud. Other ID modifications are associated with: 1) mobile phone network; 2) satellite systems for receiving and transmitting information.

The advantages of smart dust, based on low-power active RFID transmitter are:

1) Low cost of Microsystems, implemented in car electronics.

2) Sufficiently low cost of transponders for digital spectrum monitoring of road infrastructure nodes.

3) High accuracy and speed of reading digital information from moving vehicles, including speed, license plates, data about the driver. License plates are not needed, as well as many of the functions of traffic police.

4) Monitoring and prediction of traffic through the analysis of statistical information in the areas of roads and intersections.

5) The possibility of mutual communication by using Microsystems of vehicles moving towards each other, providing information about the traffic on the road sections of the route.

6) Detection of stolen vehicles through global or local monitoring vehicles.

7) Monitoring and alarm of accidents with indicating the exact coordinates of the place and time of the incident.

8) Lock the car engine in case of car theft through the access code of the owner.

9. The arguments against the introduction of “cloud” on a national scale are the following:

1. “Violation of the right to privacy, since in theory the cloud provides total monitoring of all vehicles”. Today there is a system of lawful interception of

telecommunications, implemented in accordance with international requirements. But the interception of telephone calls of any subscriber is only used during the investigation and with the approval of the court. In particular it is possible to track the location of the subscriber. This fact to law-abiding citizens does not create any problem. 2. “The additional costs for the purchase of hardware and software for vehicle authentication and communication with the cloud”. The value of these tools is low and comparable to the average amount of fines for traffic violations. Economic benefits of a cloud associated with the fuel economy and reduce of travel time, offset costs for the year.

10. Corporate transportation management system

The system is already being used for optimal planning routes to deliver goods to reduce time and cost due to: 1) reduce the cost of fuel; 2) the optimal distribution of orders between cars; 3) forecasting the supply of goods to reduce the storage costs; 4) saving staff time or reducing staff; 5) reduce the number of vehicles for a given volume of traffic; 6) monitoring and operational management of the vehicles when delivering goods in real time.

The market appeal of cloud service of transport logistics is determined by the following: wholesalers, regional distributors of food and industrial goods (bakeries, dairies, meat processing plants, brewing plants, industries, transport companies, retailers, logistics service providers, freight forwarding companies, vending companies, ambulance, cash services, courier services, online shopping, cleaning companies) – more than 7,500 companies in Ukraine only.

Logistics technology is in follows. Transportation of goods is a complex, multi-criteria problem that includes a large number of parameters determining the effectiveness of performance of the contract with the customer, and thus profits. Transportation problem is NP-complete, where the number of cases is in the exponential function of the number of input values. The exact solution can be obtained by complete enumeration of all possible variants. For real business problems quasi-optimal methods are used, which do not provide the exact solution, and hence the maximum possible cost savings. It is proposed the optimal method for solving the

transport problem based on the original algorithm that significantly reduces the time. It becomes acceptable for the analysis of most practical situations on maps of the region [28].

Business models are: 1) the sale of licenses to use the software with post-paid service maintenance; 2) the sale of services in accordance with the subscription fee for using the road cloud.

11. Organization of the communications “cloud – car” and “cloud – infrastructure”

The most important aspect of technological (technical) IRI implementation is organization of communications between four system components (Fig. 6), integrated with the cloud: Cloud Servers for creating a cloud of long-term storage of distributed data and services; Buffer Computers for collecting data from infrastructure monitors and delivering management services to road controllers; C-RFID – computer blocks for radio frequency identifying vehicles; I-CMC – infrastructure controllers for traffic monitoring and control based on radio frequency identification of vehicles.

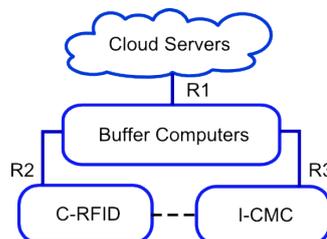


Fig. 6. The structure of communications between IRI components

The structure of communication integration of four IRI components is represented by the transactions: $(R1 * R2) = (SC, BC, C-RFID)$ is delivery of cloud services to the customers; $(R1 * R3) = (SC, BC, I-CMC)$ is delivery of control signals to the road controllers. The route of the first type uses the traditional technologies GPRS, HSPA, Wi-Fi, WiMAX based on Internet. For the transaction of second type additional scientific and technical research is needed when creating a scalable prototype, because the transaction are important and high requirements are imposed to reliability, security and protectability.

It is assumed that the block C-RFID will store an individual vehicle code (CID), the electronic code of residence registration (NID), and the code of the driver (DID), who uses the vehicle at the current time. Reading the triad of codes (CND-ID) is

performed by radio devices, which will be located on all the traffic lights, bridges, tunnels, level crossings and other points of the road network, significant from the standpoint of traffic management, including the critical control points. The structure of the C-RFID unit is shown in Fig. 7, where the modules (CND-ID, CT, SP, ALB, M, D, CU) mean: universal car code, transceiver, protection module, arithmetic and logic unit, memory module, display and control module.

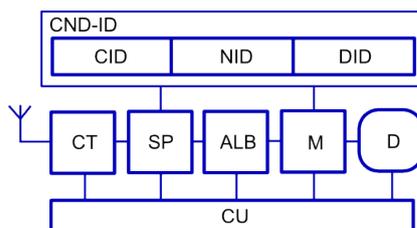


Fig. 7. Structure of C-RFID unit

World experience of RFID application in transportation allows making optimistic forecast concerning the introduction of such technologies in Ukraine. In May 2012 the Ministry of Interior of Russia successfully tested RFID-tags of license plates in the framework of project “Smart City”. In this case, the RFID chip was integrated into the license plates, produced by JSC “Vanguard”, St. Petersburg. In Malaysia, the compulsory setting RFID-chip on the license plates was introduced in 2007. Traffic police can check any car, not even stopping it, as from a fixed position, and from a mobile patrol car. In the United States since the early 1990s, a system 3M GM Automotive Adhesive was used, which can be considered the prototype of the modern RFID technology. The absence of label with a unique number on a vehicle is cause for its detailed review.

Research conducted by Moscow University of Technology in 2001, showed that RFID technology can identify stationary objects and moving vehicles with high accuracy and reliability, and also has high reliability, durability and protectability [29]. However, along with the many benefits of this technology there are also its disadvantages. First of all, the range of RFID-tags is poor. However, research results of Russian scientists published in Components & Technologies claim to range up to 300 meters. It is also noted the negative impact of electronic chips on living and nonliving organisms. Thus, in June 2008 Journal of the American Medical

Association published the results of RFID impact on medical equipment [30]. Electronic interference from RFID-tags resets settings of intravenous infusions, reprograms the electronic pacemakers and are cause of malfunctions of medical equipment. More than a third of tests did reveal malfunctions of medical equipment, which was located at a distance from centimeters up to six meters from the source of RFID. In another third of the tests the serious irregularities of the artificial respirator functioning, infusion pumps, devices for hemodialysis, ECG monitors were revealed. The negative impact of transponders on living organisms and human at times exaggerated in the media and the Internet, which makes it difficult real introduction of electronic passports for population.

In the proposed RFID system the above-mentioned factors are considered. There are used active RFID tags with two data channels - radio and optical. If the active tag is applied the range is limited primarily by output tag power when fixed ratio of antenna directional and the sensitivity of the reception channel. RFID system has the ability to adjust the output power of a transmitter when obligatory limiting the maximum level by +4 dBm. This excludes any impact on the living and non-living organisms, because it is on several orders smaller than the norm of allowable SAR (Specific Absorption Rate)-specific absorption coefficient of electromagnetic radiation by the human body. SAR is measured by watts per kilogram (W/kg). The Federal Communications Commission in the United States (FCC), Industry Ministry of Canada (IC), as well as the regulatory organizations of some other countries the norm SAR of 1.6 W/kg is accepted. In the European Union a rate of SAR 2 W/kg is accepted. The output power of the proposed RFID does not exceed several milliwatt as opposed to mobile phones with output power up to two watts. In addition, RFID module is located far away from the driver and passengers, which eliminates the negative effect of high-frequency radiation.

Concerning violations of medical equipment, it is necessary to note, such equipment is missing on the highways, and in ambulance car the medical equipment is located inside the shielded car. The noise are produced primarily an intense magnetic field generated by the reader for powering the transponder (tag), and in our

case it does not exist, since power supply of transponders are not due to reader field, but is realized by means of car electrical system or transponder battery. In an extreme case, radio channel of transponder can be switched off and only the optical channel can be used.

Addition to RFID can be GPS navigation. Modern GPS receivers based on the chipset SiRF Star III fix the signal even in the hangars and manufactory shops with reinforced concrete floor. Receivers of the latest generation support modern European global positioning system Galileo and Russian system Glonass. The disadvantage of GPS navigation is inability to transfer data about the position of the vehicle to a satellite. Thus, the development of the positioning subsystem IRI can simultaneously realize both of these technologies for their detailed research and application to the task of monitoring and traffic management.

12. Structure of unit CAR-ID

The proposed concept of CAR-ID is based on the principles used in the air traffic control system ADS-B [31, 32, 33]. The essence of CAR-ID is that the transponder of the vehicle periodically transmits a broadcast message, which includes the identification information and data on the coordinates and speed of the vehicle, receiving from the built-in GPS receiver. In addition, the controller CAR-ID generates protocol of vehicle dynamics, receiving information from the acceleration sensor.

Sending a message is realized through two channels - wireless and/or optical. Messages are received by vehicles or fixed stations, which are located in the area of optical or radio coverage. Stationary stations are networked and located in places where there is a power (light signals). When receiving a message, CAR-ID checks for it in the "history" and in the absence add it to the memory of controller. When getting into the zone of the stationary monitor (station) rewriting all the information accumulated since the previous reading from the memory controller to the memory of the station is performed. The information packets are formed and periodically sent to the "cloud".

To ensure high noise immunity, structural stealth of signal and eliminate impact of noise on other radio equipment CAR-ID direct spread spectrum DSSS are used [34]. The unit can operate in the unlicensed ISM band with an output of 0 - 4dBm. This is sufficient to ensure the radio visibility up to 100 meters when using omnidirectional antennas.

All information transmitted via open channels, is pre-encoded. To eliminate collisions in the block the method Slotted – ALOHA is applied [35]. If necessary, the entire information stored by controller for a day, can be read by the police or other fiscal services by using a special reader. Thus, a distributed intelligent wireless network based on RFID unit is created (Fig. 8), the advantage of which is the presence of distributed storage devices and rapid information exchange [36].

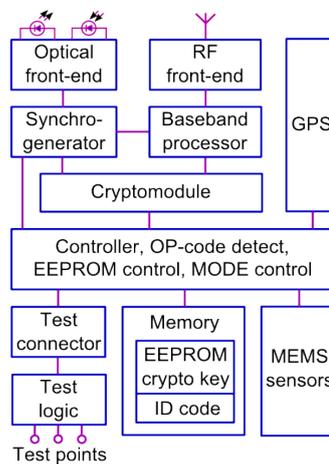


Fig. 8. Structure of CAR-ID unit

The structure of CAR-ID unit contains the following modules: Optical front-end is optical interface; RF front-end is RF interface; Synchrogenerator is frequency generator; Baseband processor is designed for processing signals after demodulation; GPS is positioning module; Cryptomodule is encryption module; Controller, OP-code detect, EEPROM control, Mode control are unit management system; Test connector is switch for unit testing; Test logic (Test points) is module for test management and programming; Memory (EEPROM crypto key, ID code) is memory card for storing data and proprietary information; MEMS sensors are module of sensors.

13. Road management and monitoring

Modern cities have a complex road infrastructure, where road management is carried out through the traffic lights by using traffic management systems (TMS),

which include hundreds of traffic lights. Here, under the traffic lights we will understand TMS subsystem that provides monitoring and control of traffic on the separate section of the road network. The central part of the subsystem (see Fig. 9) is specialized traffic controllers (TC) with built-in switched power circuits, which are designed to control the traffic lights. Controllers SITRAFFIC C800 [37] are able to inquire up to 84 vehicle detectors of inductive type and control 48 groups of signals of the total capacity 4 kW in real time with maximum permissible cycle in 300 seconds. C800VX controller supports up to 120 of these modules in management segment, each segment is able to function independently and integrated into TMS network based on wireless technologies (GPRS, WiMAX); it is centrally managed from the traffic control center (TCC) [38].

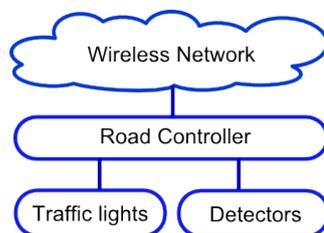


Fig. 9. The general structure of traffic light object

On present trends of road infrastructure expansion, it is clear that the use of such solutions is possible subject to high reliability of such systems. It is known that if TMS structure is extended (the number of traffic lights controlled by the system is increased) the reliability will be decreased [39]. Therefore, developing more reliable TMS structures including advanced distributed automation technology is topical scientific and industrial problem. Cheaper and much more flexible variant of TMS organization on such principle was proposed in [40], where the authors propose to improve the quality of traffic through distributed automating key processes and creating a system of distributed traffic control. They found that to improve the reliability of the system along with providing information and control functions of the cloud, TMS should be organized according the principle of centralization-decentralization. In this case, the buffer computer of IRI (Fig. 6) executes functions of data server and provides connectivity to peripheral workstations, as well as it manages multiple controllers, segmented (10 – 20 traffic lights per segment) on

geographical basis. This TMS architecture allows positioning servers anywhere in the city and organizing mobile control center that provides the coordinated functioning all TCs at the object. This control structure is implementation of the component I-CMC (see Fig. 6) and it is represented as a matrix (see Fig. 10), elements of which are traffic controllers (R-PLC), and the columns correspond to the segments of the road network, controlled by segment servers (RSS), which in turn are controlled by the buffer computer of IRI.

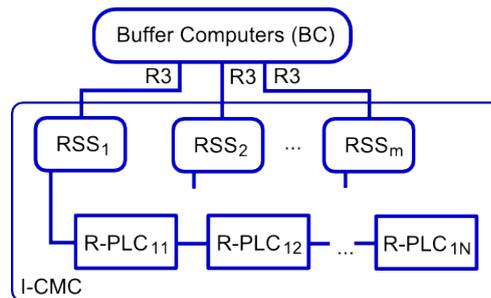


Fig. 10. Structure of I-CMC unit from Fig. 6

Here RSS module is reliable industrial computer; component R-PLC is based on PLC SIMATIC S7-1200, which is compact and power programmable logic controller from SIEMENS for programming engineering process [41]. To solve the problems of automatic control, motion control and can be used in engineering, enterprise management systems, and in many other areas. It is multifunctional and has relatively low cost. Compact modular design combined with high computing power allows the use of SIMATIC S7-1200 for a wide range of automation problems. The advantages of PLC S7-1200 are: 1) high reliability, the mean time before failure of more than 30 years; 2) the ability of reprogramming of the controller when it is running; 3) service directly at the place of object location; 4) high performance about 10^5 instructions per second under a clock cycle time 15 ns; 5) high accuracy of cyclic commands; 6) programming language STEP-7 Basic with integrated fuzzy logic.

14. Remote module “SHERLOCK”

It is designed for creating distributed monitoring and control systems, including mobile. The module is an electronic device, based on three new technologies Mobile-to-Mobile, GPS and GPRS.

The problems solved by the module are:

- 1) Automatic vehicle location (AVL).
- 2) Vehicle fleet management, logistics.
- 3) Automation of taxi.
- 4) Monitoring the route and timetable of vehicle.
- 5) Monitoring the operation modes of vehicles.

Module specification is represented below. GPS is multi-channel receiver with high sensitivity and low power consumption, designed for utilizing in urban areas and at the presence of reflected signals. GSM is three band GSM/GPRS module that can run in all existing GSM networks in Ukraine. The module has 8 digital and 1 analog inputs, as well as 7 digital outputs (open collector). Interface is CAN 2.0 bus for connecting to vehicle network, managing actuators and inquiring additional sensors. Memory involves 512 KB of internal memory to store telemetric information. Built-in temperature sensor, built-in hardware self-diagnosis, monitoring of operating temperatures and supply voltages are implemented in the module.

Remote module “SHERLOCK” is realized in small plastic case; it has one 24-pin connector for a power source, actuators and sensors. Two high-frequency SMA connectors are used to connect the GPS and GSM antennas. Remote controller for operation in GPRS requires definition of the access point name (APN, Access Point Name), the name or IP-address of the server and port number.

Operation of the module is performed as follows. Attempt to get in touch with GPRS is taken every 10 minutes. Data on the change of coordinates taken by GPS receiver is transferred to the server at intervals of 10 to 90 seconds depending on the speed of the object, on which the device is installed. Remote command control is carried out by using SMS-commands: 1) Request status; 2) Mode configuration for GSM/GPRS; 3) Control outputs; 4) Request to execute USSD commands; 5) On-line monitoring service.

Access to the online monitoring service is realized around the clock from link <http://gps.rfid.com.ua> . To access the service, users have to log in with a username and password. On service home page a map with location data of mobile objects is shown. Map information from company “VISICOM“ is used. Control tools involve

the ability of choosing one, two, or all of the objects owned by the user, and duration of time for which it is necessary to view information about movement. The status of objects and route for the selected time period, as well as the duration of parking are represented on the map. Map size and location can be changed by using the mouse and control tools. At the bottom of the home page there are elements, which allow quickly switching between the parts of the route and objects, as well as statistical information. If only one object is selected an additional function for calculating the distance is available. On the Settings page, a user can enter information about his/her email address, change password, map size and view a summary of the settings and communication.

Objects page is designed for changing object name, description and parameters. Rules for sending messages about object movement are indicated in appropriate menu item. The rules can be changed on the basis of information about occurrence of an object in the area, leaving it, and the transition from one area to another one. Area control is realized by menu item that allows closing areas on the map, which can be used for setting parameters. Coordinate page shows a summary statistical information about the location of mobile objects in the current time, as well as information about the nearest geographical object known to the system. The database stores the information about the coordinates of several tens of thousands of addresses in Kiev city. Communication page is used to obtain statistical information about the system. The last coordinates of mobile objects are displayed, as well as the following information: the time of coordinate receiving, telemetry information, and information about the area where every object is located. Remote module is distributed with antenna GPS, antenna GSM, connecting cable, instruction manual; SIM-card.

15. Scientific novelty, market appeal and social importance

It is difficult to forecast social, technological and technical positive effects of the revolutionary transformation of the existing world related to implementation cloud road services. In the limit, in 10 years, we should expect a service for automatically routing vehicles without driver. However, on the way to full automation some obvious innovative scientific and technological solutions of social, humanitarian,

economic and environmental problems associated with the emergence of cloud monitoring and management, are represented below.

Scientific novelty lies in the system integration of three components: cloud for monitoring and management, RFID blocks of vehicles, and road infrastructure tools for monitoring and management, which makes it possible to automate optimal control of transport and traffic in real-time for social, humanitarian, economic and environmental issues.

Practical value of research is defined by following services:

1. On-line switching traffic lights to provide free traffic on the route for special machines or tuples (children, important government officials, ambulance, fire department, military convoys, dangerous goods).

2. Optimal on-line control of traffic lights on the roads and intersections with accurate digital monitoring traffic through the use of RFID-tags of cars, enabling to minimize the movement time of all road users.

3. Planning the best route to achieve one or more destinations by a car in time and space, that allows reducing time and cost for a given quality of comfort (time of day and year, road surfacing, left turns, weather, traffic jams, repairs).

4. Intellectual history of car movement, based on car virtual model in cyberspace in the form of an individual cell of the cloud, which is invariant with respect to vehicle drivers. It allows tracking any vehicle movement in the past, and to predict the desired routes and future travels without the driver.

5. Service for intelligent managing traffic light controller, when switch signals are generated depending on the availability (quantity) of vehicles, which send the requests from car RFID blocks (C-RFIDs).

6. Cloud on-line monitoring RFID tags of vehicles that eliminates the license plates from the accounting system and has the following benefits: 1) exclusion of the direct participation of the traffic police in commit traffic violations (speeding, travel to prohibit traffic lights, improper maneuvering); 2) saving thousands of tones of metal to produce numbers and simplify registration of cars when buying from a few days to a few minutes; 3) automated completing written reports about an accident

without the traffic police by means of digital monitoring digital map of the incident that has been copied from the cloud; 4) considerably ($\times 2 - \times 5$) reducing the staff of the traffic police, because the history of car movement and its traffic violations is completely transparent for the cloud, which will make it possible to automatically pay the penalties for violations in accordance with country laws; 5) completely eliminate corruption in relation between the driver and traffic police due to inability to erase information about the violation in the cloud; 6) virtually eliminate criminals in car theft, thanks to use built-in car RFID block that provides on-line twenty-four-hour observability of vehicles, on condition that a car is not physically destroyed; 7) simplify the legalization of driver by adding the driver's license to the list of authorized persons of car RFID block via "Bluetooth", which eliminates necessity of special papers and power of attorney for others; 8) reducing in several times the number of accidents and considerably improving the quality of life for drivers and passengers due to total monitoring of violations and the certainty of punishment for them; 9) decreasing by 30% automotive carbon emissions by reducing the idle time at intersections and selecting the optimum mode of transport and routes of movement; 10) ensuring high market appeal of cloud services through selling the services to companies and individuals that guarantees high profits – from hundreds of millions up to tens of billions of dollars – which is scalable depending on the area of service coverage: cities, states, countries, entire world. In the presence of 10 million cars in the country and if the value of one RFID tag equal to \$ 100, the cost of equipping the entire fleet is equal to 1 billion dollars. The cost of creating a scalable IRI prototype is \$ 10 million dollars plus the overhead of technical support and maintenance of infrastructure – \$ 10 million dollars a year. The annual cost of sales for cloud service is not more than \$ 100 dollars for each car. This amounts to nearly \$ 2 billion dollars in profits after three years of the cloud maintenance. Payback period IRI is 1.5 years. 11) Near future. The real world is in need of advanced and precise monitoring and management of cloud. The problem can be solved only by using radio frequency digital identification of all produce and natural sites on the planet, including humans and animals. The next steps are creating cloud virtual digital models of entities

(objects) of the real world and all possible relations (natural, social, technical, technological) between them to create services for precise digital modeling, monitoring and management of processes and phenomena in the world.

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COMPUTER MODELING OF ACTIVE PROCESSES

Siberian state aerospace university named after academician M.F. Reshetnev

Introduction. During the recent decades the organizational processes attract the attention of investigators. The processes where a human or a group of people, in particular, industrial objects, commercial structures, regional units and others belong to these processes. Their typical feature is uncompleted a priori information, uncertainty, intercorrelation, difficulty of coordinated objectives formation and the manners of their achievements and etc. Incompleteness of a priori information leads to the necessity to formulate these or those objectives of local nature in various differed very much ways a question is stated. And their unifying in one system is of serious theoretical problems. In particular, a problem of organization or group management is mainly art than science. It is due to the fact that a human (group) presence in the investigation process needs to take into account some factors, and exactly: moral, psychological, prestige and some other features and peculiarities of a human, the most important of which is the information misrepresentation about the opportunities, objectives, manners and means of their achievement. The similar processes and systems corresponding to them are called active [1]. Different levels of a priori information, processes characteristics, modeling problems are considered in details earlier [2,3]. Below the subjects of research will be active systems which differ very much from technical systems (as it is above stated).

The substantial remark about the considered problem is that "input-output" variables of the organizational process are material as well as expert estimations, i.e. variables which estimation (measurement) can be done only by an expert or group of experts. This estimation can be done in different scales [4]. As distinct from technical control systems in active control systems we have the necessity to introduce a control contours by the realization process of the obtained management decisions. The last ones belong to an active processes class. At last the input variables estimation of the

process (a reply of the system to the corresponding managing influence) is also realized by an active system that includes a human (a group of experts). There is no doubt that psychological, emotional and other human's features as well as experts' experience will play an important role. It is possible due to that reason organizational, regional and management is rather art than science. It is supposed the most effective direction of the control system by active processes formations restricted rational synthesis of two components: art and science on the basis of the stored experience.

In this case the role of the investigation in the field of learnt systems has been increasing [5, 6]. It is natural to make demands of learning, i.e. to increase the control quality in the process of its operation, to active control systems (it is more profitable to be intellectual computer systems). In other words a learnt active control system in the process of its operating is to become more and more "smart". It is connected not only with information accumulation and analysis, not simple problem, but with the theory about learnt and self-learnt systems development.

1. Active systems

Let's consider a rather detailed scheme of local organizational system presented in Figure 1, where A – an unknown operator of the object, $x(t)$, $q(t)$, $z(t)$ – output variables of the process, $u(t)$ – control influence, $\mu(t)$ – input checked but uncontrollable variable of the process, $\omega(t)$ – a variable characterizing intermediate state of the process; $\theta(t)$ – influence on the object of the environment. For the organizational systems they are some instructions, resolutions, orders, legislative acts that have these or those changes in time. An input value $\lambda(t)$ can't be controllable, $\xi(t)$ – vector random influence, (t) – continuous time, H^μ , H^u , H^x , H^θ , H^ω , H^q , H^z – communication channels corresponding to different variables that influence control means, devices for observed variables values, μ_t , u_t , x_t , θ_t , q_t , z_t , ω_t – denotes observation $\mu(t)$, $u(t)$, $x(t)$, $\theta(t)$, $q(t)$, $z(t)$, $\omega(t)$ in discrete time t . The control of variables $(x, u, \mu, \theta, q, z)$ is realized in some time interval, i.e. x_i , u_i , μ_i , θ_i , q_i , z_i , ω_i , $i = \overline{1, s}$ – a dimension sample of a process $(x_1, u_1, \mu_1, \theta_1, q_1, z_1, \omega_1)$,

$(x_2, u_2, \mu_2, \theta_2, q_2, z_2, \omega_2), \dots, (x_s, u_s, \mu_s, \theta_s, q_s, z_s, \omega_s), \dots$, s – a sample size, $h^\mu(t)$, $h^x(t)$, $h^u(t)$, $h^\omega(t)$, $h^\theta(t)$, $h^q(t)$, $h^z(t)$ with a mark above – random dimension noise of the process.

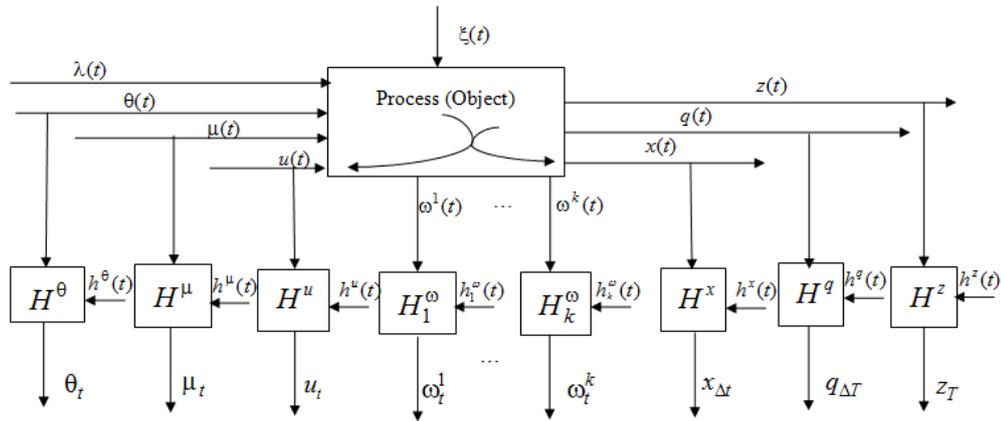


Figure 1 - General scheme of the multidimensional active process

Let's point out the essential difference of input variables $z(t)$, $q(t)$ and $x(t)$, presented in Figure 1. An output variable $x(t)$ is controlled in time interval Δt , as well as input variables, and $q(t)$ is controlled in comparatively large time intervals ΔT , $z(t)$ – in T ($T \gg \Delta T \gg \Delta t$). From practical point of view the control of $z(t)$ is often more important for the investigation process. The real difference of discreteness of input variables $q(t)$ and $z(t)$ control is considered by that fact. Arrows inside the object (Figure 1) symbolize a human (a group of people) presence in the object.

In this case $x(t)$ is determined the following way:

$$x(t) = A(u(t - \tau), \mu(t - \tau), \omega(t - \tau), \lambda(t - \tau), \theta(t - \tau), \xi(t), t). \quad (1)$$

Don't confuse delay τ , inherent to the process and delay (lag) while dimension or estimating these or those variables of the process.

The model of the investigated process $x(t)$ can be presented the following way:

$$\hat{x}(t) = \hat{A}_x(u(t - \tau), \mu(t - \tau), \omega(t - \tau), \theta(t - \tau), t). \quad (2)$$

For forecasting $q(t)$ and $z(t)$ it is expedient to use the following models:

$$\hat{q}(t) = \hat{A}_q(u(t - \tau), \mu(t - \tau), \omega(t - \tau), \theta(t - \tau), \hat{x}(t), t), \quad (3)$$

$$\hat{z}(t) = \hat{A}_z(u(t - \tau), \mu(t - \tau), \omega(t - \tau), \theta(t - \tau), \hat{x}(t), \hat{q}(t), t), \quad (4)$$

where τ – delays that differ by the corresponding communication channels (we use one and the same symbol for simplicity reason), so a symbol « \wedge » means a model of the corresponding process. Though in present paper to describe a model one uses material variables, but nevertheless it is clear that variables could be also qualitative. This circumstance of course can't be omitted while realizing social and economic processes.

Further all input controllable variables will be united into one combined vector $v(t)$, and output variables – will be united into one combined vector $y(t)$, vectors of intermediate variables will be denoted $\omega(t)$ as earlier. Then the scheme presented in Figure 1 is as follows (DB – dimension block of variables):

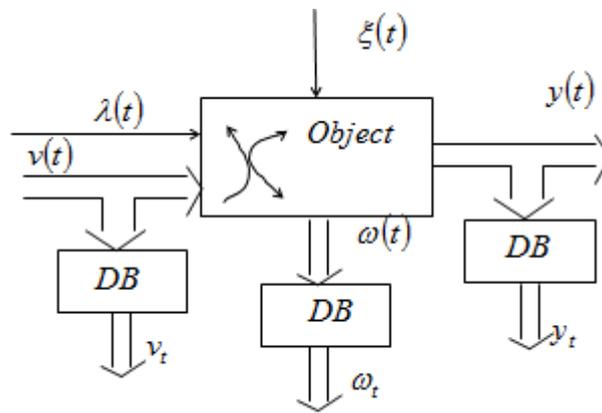


Figure 2 - Simplified of the active system

Let's explain the meaning of the term "a combined vector". It is a vector composed of some components of the corresponding vectors. For example, vector components of input variables (Figure 2) $v(t)$ could be as follows:

$$v_t^1 = (u_t^1, \mu_t^3, \theta_t^1, u_t^2), \quad v_t^2 = (u_t^2, u_t^4, \theta_t^3, \mu_t^1, \mu_t^3), \quad \text{and so on.}$$

Correspondingly, a component vector $\omega(t)$ and $y(t)$ could be composed as follows: $\omega_t^1 = (\omega_{1t}, \omega_{3t}, \omega_{4t}),$

$$\omega_t^2 = (\omega_{2t}, \omega_{3t}); \quad y_t^1 = (x_t^1, x_t^2, z_t^2, q_t^1), \quad y_t^2 = (x_t^3, z_t^2, q_t^1, q_t^2, x_t^4), \quad \text{and so on.}$$

The structure of component combined vectors is in direct dependence from the concrete investigated process, a priori information about its presence, its characteristics, features and etc.

The fundamental difference of organizational systems modeling from others is in the existence of feedback, control counters and so on, "built-in" in to the following

process from the outside. It changes radically the understanding of the identification problem also redoubled by the necessity to study the identification problem in "wide" sense. Nevertheless in conditions of nonparametric uncertainty [2] we could use statistics $y_s(t) = S(v(t), \omega(t), \vec{y}_s, \vec{v}_s, \vec{\omega}_s)$, where S – nonparametric statistic [3, 7, 8], $\vec{y}_s = (y_1, \dots, y_s)$, $\vec{v}_s = (v_1, \dots, v_s)$, $\vec{\omega}_s = (\omega_1, \dots, \omega_s)$ – time vectors, s – observation sample size of "input-output" variables of the object.

As nonparametric models of some active systems fragments the following statistics can be accepted:

$$y_s(v(t), \omega(t)) = \frac{\sum_{i=1}^s y_i W(\eta_s(v(t) - v_i)) W(\eta_s(\omega(t) - \omega_i))}{\sum_{i=1}^s W(\eta_s(v(t) - v_i)) W(\eta_s(\omega(t) - \omega_i))}, \quad (5)$$

where $W(\cdot)$ – functions analogous to bell-shaped (kernel) functions from [7, 8], weight coefficients η_s – coefficients back to diffusion parameter included into the nonparametric estimation and algorithms [2, 7, 8], with the only difference that $\eta_s \rightarrow \infty$, but acts as weight coefficient at the corresponding vector components $v(t)$ and $\omega(t)$, and that is why we will miss index s at η further. The principal difference of statistics (5) from generally accepted estimations [2, 7, 8] is the insolvency of the supposition about the population presence, tendency s to infinity, and as its consequence, the lack of any asymptotic features supposing $s \rightarrow \infty$.

The estimation from the class (5) in multidimensional case is as follows

$$y_s(v(t), \omega(t)) = \frac{\sum_{i=1}^s y_i \prod_{j=1}^n W(\eta_t^j(v^j(t) - v_i^j)) \prod_{j=1}^k W(\eta_t^j(\omega^j(t) - \omega_i^j))}{\sum_{i=1}^s \prod_{j=1}^n W(\eta_t^j(v^j(t) - v_i^j)) \prod_{j=1}^k W(\eta_t^j(\omega^j(t) - \omega_i^j))}, \quad (6)$$

or

$$y_s(v(t), \omega(t)) = \sum_{i=1}^s \alpha_i(v(t), \omega(t)) y_i, \quad (7)$$

where

$$\alpha_i(v(t), \omega(t)) = \frac{\prod_{j=1}^n W(\eta_t^j(v^j(t) - v_i^j)) \prod_{j=1}^k W(\eta_t^j(\omega^j(t) - \omega_i^j))}{\sum_{i=1}^s \prod_{j=1}^n W(\eta_t^j(v^j(t) - v_i^j)) \prod_{j=1}^k W(\eta_t^j(\omega^j(t) - \omega_i^j))}, \quad (8)$$

and $\sum_{i=1}^s \alpha_i(v(t), \omega(t)) = 1$ for any t , coefficients η_t are weight coefficients, n – a number of compound combined vectors $v(t)$.

Let's notice that algorithms (5-8) are not anymore nonparametric estimations in generally accepted sense [3, 7, 8]. We leave a term nonparametric, taking into account the lack of nonparametric model, leaving some information about features of the qualitative nature of the investigated process.

The more general scheme of the active system is shown in the following figure:

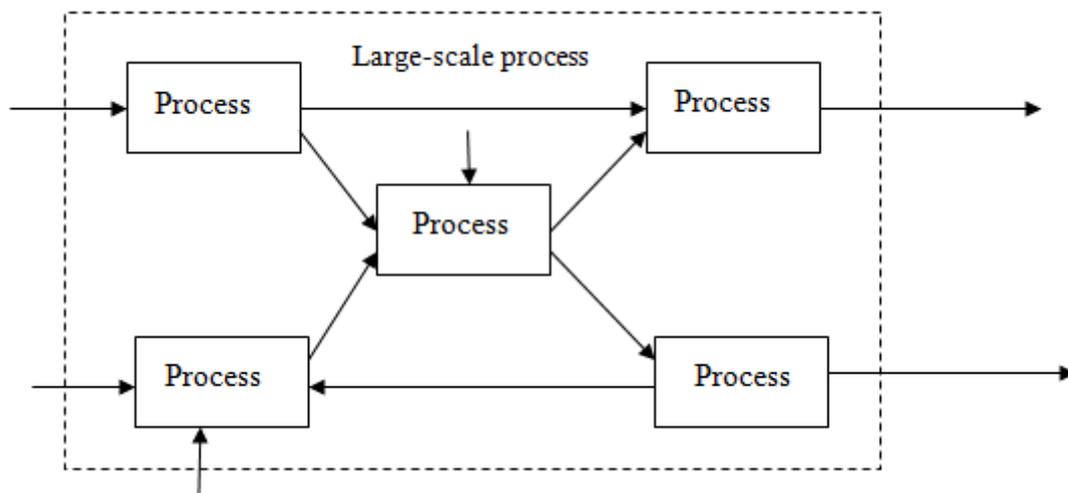


Fig. 3– Fragment of the organizational process

In Figure 3 for simplicity reason we do not introduce a special meaning of "input-output" variables (see Figure 1), but we are restricted only by connections between separate local processes.

2. Control by active systems

First let's give the enlarged scheme of control by a technical object, approximated to the reality in the sufficient degree.

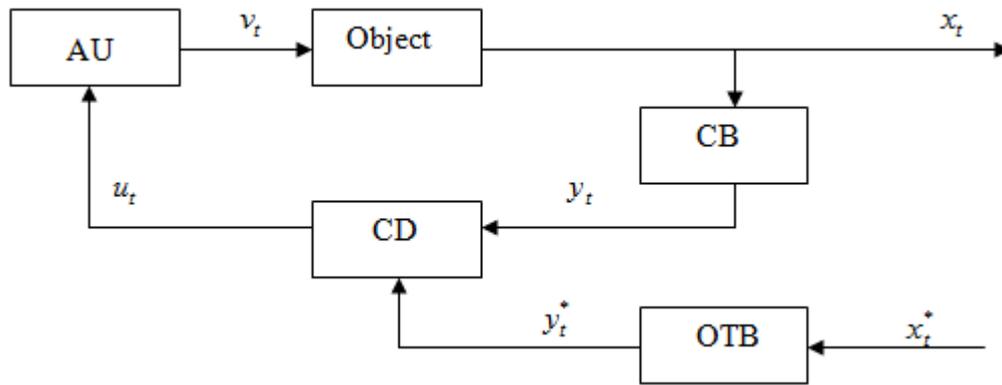


Figure 4 - simplified scheme of control by a technical object

The symbols are given here: CD – control device; AU – actuating unit; CB – control block; OTB – outstanding task block; u_t – the obtained (calculated) control influence; v_t – control influence given AU to the object; x_t – output object variable ; y_t – measured value x_t ; x_t^* – given value of the object output; y_t^* – the task given to the CD. Though the scheme of the control system given above is simplified it contains all important elements, in particular: actuating unit, control block of the output variable of the process, outstanding setting influence block. One should take into account that all these devices, units and so on fulfill actions prescribed to them with this or that random error. Of course, to develop automation means, control by these or those processes one tries to use all new achievements of science, technique, technologies and etc. and gets success in different fields in practice and manufacture, in particular electromechanical mechanisms, turbines, reactors, aerospace vehicles, melting furnaces and many others.

It is somewhat different when organizational systems investigation or modeling means for them development. The main difference of control systems by active processes from the mentioned above is that all blocks or their major part are active systems (see Figure 5).

Let's introduce the following symbols: O – object of control; BCPR – block of control process realization; CD – control device; CRP – control by the realization process of the developed CD of the control influence; CEB – control and estimation block of the vector component of output variables of the controlled process: CS CEB

– controlled system of CEB ; CCD – correcting control device by CD block; FBGI – formation block of the given influences; E – environment. Let' denote once more that all blocks included into the control system by an active object (process) are active. It is a main difference of control systems by active systems from the control systems by technical, technological, manufacturing and many other processes though the last ones don't eliminate a human participation in the operation process of the corresponding control systems blocks.

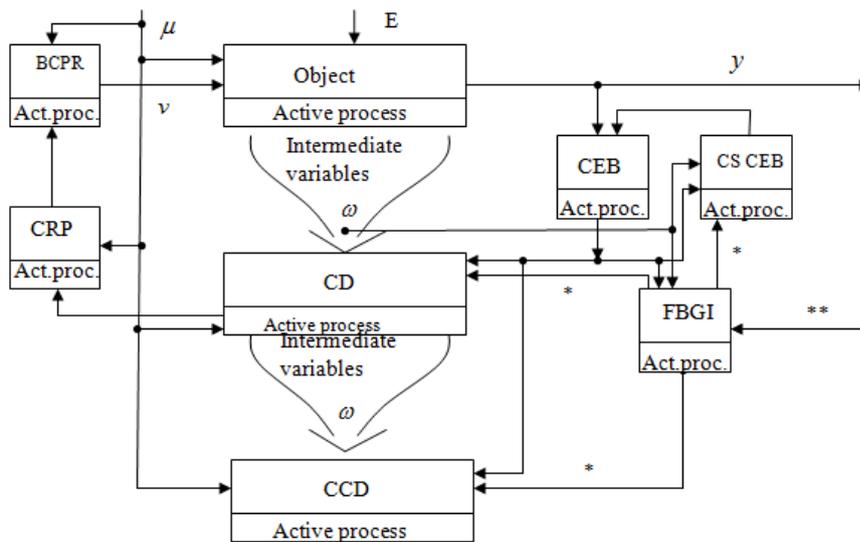


Figure 5 - General scheme of control systems by active process

The given above scheme of control by active objects is certainly of a general character. When control system by a concrete active object development the corresponding contents filling of all the system blocks is necessary. The important stage here is complex use of a priory information in the whole volume, learnt samples and so on. Nevertheless the problem of learnt samples formation is of a great importance and needs additional consideration. Two important aspects of this problem are analyzed below.

The first problem is that it is necessary to have a learnt sample of all measured variables with noise charactering the investigated process to formate this or that learnt system. According to the symbols given above in Figure 2, it can be presented as follows $\{\vec{v}_s, \vec{\omega}_s, \vec{y}_s\}$, where an arrow denotes a time vector. In this connection the corresponding compound vectors are formed according to concrete communication channels and control from vector components v, ω, y . A real situation is that a sample

size is catastrophically small in comparison with the smoothing of the corresponding vectors that makes a lot of problems to be unsolved from the control theory and mathematical statistics point of view. This problem attracts attention of investigator and has been called as a problem of "small samples". The situation becomes complicated because we can't change the situation due to some reasons. A sample size increasing at the expense observation time increasing is inadmissible for many cases because of the changed nature of active process operating, a priori information incompleteness, the environment influences and so on. Moreover this sample size increasing could be harmful due to changed conditions of the process operating in comparison with the previous ones that possibly won't repeat. So we come to the conclusion that basic motions of the theory of probability and mathematical statistics such as population, sample representation, function distribution, asymptotic convergence, in this or that sense are no applicable for a number of organizational processes investigation, as well as for learnt systems of control by active systems design. These problems have paid attention of investigator for a long time, in particular some analysis was done in [9]. Nevertheless it is necessary to develop learnt models, control systems by active processes as practice needs. Let's analyze one direction of research here.

Let's take a fragment of the following active system:

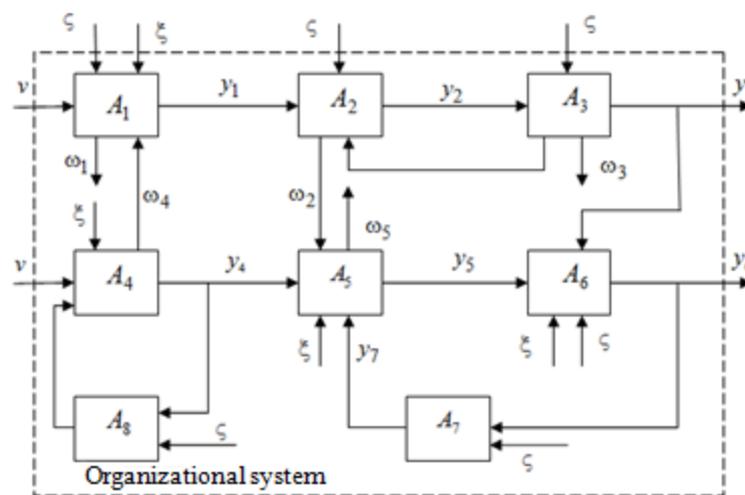


Figure 6 – Fragment of the active system

The system shown in Figure 6 is rather general fragment of an active system that can be transformed into the concrete one (it is extensional and serious work) on the basis of though system analysis of the real process from this or that field of human activity. Further it is necessary for illustration investigation method of the similar systems and processes occurred in the last ones. In Figure 6 A_i , $i = 1, \dots, 8$ denote objects "included" into the system. They are also operators transforming input variables into output ones influencing the object. The input variables are $\nu, \varsigma, \xi, \omega$, as well as output variables of the previous objects, for example, output variable $A_1 - y_1$ is an output variable with respect to A_2 , ω – intermediate controllable variables that give additional information about the process run in corresponding objects, ς – known disturbance influencing the object, and ξ – random noise that can't be measured. Taking into account that all objects are multichannel, all vector variables given in Figure 6 are compound.

The investigation process of the concrete real system of the fragment in Figure 6 as an example can be formed the following way:

I. On the basis of the existed a priori information, learnt samples and their preliminary analysis, system study of separate blocks and their interconnections operators A_i , $i = \overline{1,8}$ and corresponding compound vectors of input and output intermediate variables are formed.

II. At the second stage operator estimation A_i , $i = \overline{1,8}$ or (and) their parameters with the existed learnt samples use is realized. So we get estimations \hat{A}_i , $i = \overline{1,8}$ and add procedures of adaptive setting of these operators according to the current information (measurement results of these variables used in the investigated system) or their parameters.

III. The third stage is computer modeling in fact. For that values $\nu \in \Omega(\nu)$, $\varsigma \in \Omega(\varsigma)$ are defined, random noise from $\xi \in \Omega(\xi)$ are introduced, as well as $\omega \in \Omega(\omega)$, then replies of some objects and the whole system $y \in \Omega(y)$ are calculated. Having different values of input variables $\nu, \varsigma, \xi, \omega$ and a reply for their

values of output variables one can jump to the following stage - retrospective analysis of the whole system operating.

IV. The stage of retrospective analysis in estimation of the whole system operation - corresponding of the system operating to so called "human" understanding of the system to be operated at the corresponding values of input variables. The most important role here belongs to learnt samples, accumulating the experience, knowledge, behavior of similar systems at the analogous actions earlier. When analyzing feedback will play an important role. In details – if system behavior answers our understanding of the reality, it could be used to form the following decisions (managing influences at the corresponding concrete conditions), in other case it would be necessary to analysis stage I. In this case it is clear that if we have mistakes at the first stage of the problem – formulation of some variables, parameters determination, connection nature of the variables of the process included into the model as well as weigh coefficients and decision making algorithms must be corrected (here we mean variables, parameters not to be estimated at stage II but defined by the investigator from personal, emotional, psychological, social and other considerations). Then we go back to stage III and etc.

3. Learnt models and decision making algorithms

The necessity to build adaptive models and decision making algorithms come after identification problem formulation using available a priori information about the investigated process, corresponding compound vectors formation and available learnt samples analysis. We shall consider that learnt samples are formed without losing generality as follow $\vec{v}_s, \vec{\zeta}_s, \vec{y}_s, \vec{\omega}_s, s$ – a sample size. The learnt models are designed analogously as nonparametric models, but their operating mechanism differs in some way from the last ones and it is based on the averaging idea widely used in mathematics. So objectively existed unknown dependence $y = f(\zeta, v, \omega)$ can be presented as follows

$$y_s(v, \zeta, \omega) = \frac{\sum_{i=1}^s y_i \prod_{j=1}^n W(\eta_j^v(v^j - v_i^j)) \prod_{j=1}^m W(\eta_j^\lambda(\zeta^j - \zeta_i^j)) \prod_{j=1}^k W(\eta_j^\omega(\omega^j - \omega_i^j))}{\sum_{i=1}^s \prod_{j=1}^n W(\eta_j^v(v^j - v_i^j)) \prod_{j=1}^m W(\eta_j^\lambda(\zeta^j - \zeta_i^j)) \prod_{j=1}^k W(\eta_j^\omega(\omega^j - \omega_i^j))}, \quad (9)$$

where $W(\eta_j^v(v^j - v_i^j))$ – bell-shaped functions, η – weight coefficients corresponding to components of compound vectors $\{y, v, \zeta, \omega\}$, m – dimension of the input vector ζ . Note that coefficients η don't satisfy asymptotic conditions, analogous to smooth parameters in nonparametric adaptation algorithms [2] and s don't lead to infinity, i.e. $s \rightarrow \infty$. Also note that some elements of learnt samples are formed not in the result of natural observations about the investigated object, but by a group of experts with the work experience with objects, analogous to investigated ones. These and some other problems that arise when we investigate active systems as well as modeling and control system development of similar nature need detailed analysis in each concrete case.

Restrictions and difficulties arise when we form learnt samples (high dimension of problems and small sample size s) lead to the necessity to change estimation (9), for example,

$$\hat{y}_s = \frac{\sum_{i=1}^s \varphi_i(v, \zeta, \omega) \prod_{j=1}^k W(\eta_j^v(v^j - v_i^j)) \prod_{j=1}^m W(\eta_j^\lambda(\zeta^j - \zeta_i^j)) \prod_{j=1}^n W(\eta_j^\omega(\omega^j - \omega_i^j))}{\sum_{i=1}^s \prod_{j=1}^k W(\eta_j^v(v^j - v_i^j)) \prod_{j=1}^m W(\eta_j^\lambda(\zeta^j - \zeta_i^j)) \prod_{j=1}^n W(\eta_j^\omega(\omega^j - \omega_i^j))}, \quad (10)$$

where $\varphi_i(v, \zeta, \omega)$, $i = \overline{1, s}$ – hyper plane of arguments $\{v, \zeta, \omega\}$, estimated according to the initial sample $\vec{v}_s, \vec{\zeta}_s, \vec{y}_s, \vec{\omega}_s$ this or that way, for example, by stochastic approximation method or by the method of least squares. Changing y_i , $i = \overline{1, s}$ in (9) for hyper plane $\varphi_i(v, \zeta, \omega)$, $i = \overline{1, s}$ in neighborhood of the point $\{v_i, \zeta_i, \omega_i, i = \overline{1, s}\}$ let us improve the approximation quality $y = f(v, \zeta, \omega)$ and avoid uncertainty in (10) [10].

If we have a fragment of the "tube" structure [3] while its parametric modeling in the investigated process in the space of "input-output" variables, it is necessary to

introduce the corresponding indicator. If a fragment of an active process is described as a parametric model:

$$y_{\beta}(v^{<\beta>}, \zeta^{<\beta>}, \omega^{<\beta>}) = f^{\beta}(v^{<\beta>}, \zeta^{<\beta>}, \omega^{<\beta>}), \quad (11)$$

where β – parameter vector, $f^{\beta}(\cdot)$ – nonparametric model describing this or that block or its separate channels, $(v^{<\beta>}, \zeta^{<\beta>}, \omega^{<\beta>})$ – compound vectors of input variables of the investigated block, then it must be added with the following indicator:

$$I_s = \text{sgn} \sum_{i=1}^s \prod_{j=1}^k W(\eta_j^v(v^j - v_i^j)) \prod_{j=1}^m W(\eta_j^{\zeta}(\zeta^j - \zeta_i^j)) \prod_{j=1}^n W(\eta_j^{\omega}(\omega^j - \omega_i^j)). \quad (12)$$

In this case the model is as follows [3]:

$$y_{\beta}(v^{<\beta>}, \zeta^{<\beta>}, \omega^{<\beta>}) = f^{\beta}(v^{<\beta>}, \zeta^{<\beta>}, \omega^{<\beta>}) I_s. \quad (13)$$

When the indicator I_s turns to zero in (13) it means that values (v, ζ, ω) don't belong to the space of variable values determining a "tube" structure. In other words it is clear that $(v, \zeta, \omega) \in \Omega(v, \zeta, \omega)$, $\Omega(v, \zeta, \omega)$ is always known. Let's denote a "tube" space as $\Omega^H(v, \zeta, \omega) \subset \Omega(v, \zeta, \omega)$. Therefore not every point $(v, \zeta, \omega) \in \Omega(v, \zeta, \omega)$ belongs to $\Omega^H(v, \zeta, \omega)$. As values (v, ζ, ω) in some cases are set by an investigator himself, when we analyze active processes this circumstance must be a point for special consideration. Let's remind that $\Omega^H(v, \zeta, \omega)$ is mainly unknown to our investigator.

The learnt algorithm of decision making is as follows:

$$v_s^p(y^*, \zeta, \omega) = \frac{\sum_{i=1}^s v_i^p \prod_{j=1}^k W(\eta_j^y(y^{*j} - y_i^j)) \prod_{j=1}^m W(\eta_j^{\zeta}(\zeta^j - \zeta_i^j)) \prod_{j=1}^n W(\eta_j^{\omega}(\omega^j - \omega_i^j))}{\sum_{i=1}^s \prod_{j=1}^k W(\eta_j^v(y^{*j} - y_i^j)) \prod_{j=1}^m W(\eta_j^{\zeta}(\zeta^j - \zeta_i^j)) \prod_{j=1}^n W(\eta_j^{\omega}(\omega^j - \omega_i^j))}, \quad (14)$$

where p – index of the p – the vector component of the control influences, and y^* – set values of the output variable.

It is clear that in different "sections" of the investigated process meaning of the control influence $v_s^p(y^*, \zeta, \omega)$ will be filled with different content.

The learnt algorithm given above is of a sufficiently general nature. Its concretization can be carried out only when we investigate a concrete active process of this or that field.

4. General scheme of the organizational system investigation

As it was mentioned previously when a concrete active process investigation, a detailed "immersion" into the problem interested is necessary. As not only technical, production, social and other elements but a human, group of people are elements of organizational systems, it is absolutely necessary to sociologies, psychologists and specialists to be involved. As a result we must describe an investigation process in language "understandable" to a computer. Let's apply to organizational system presented in Figure 6 and take its separate elements, for example,

$$y_5 = A_5^y(y_4, y_7, \omega_2, \xi, \beta), \quad \omega_5 = A_5^\omega(y_4, y_7, \omega_2, \xi, c), \quad (15)$$

where A_5^y and A_5^ω – operators describing a separate process, β, c – coefficient vectors involved into models. They may be algebraic or difference equations with a delay as well as equation systems. Some vector components β and c can be estimated on the basis of observations, estimations of the corresponding variables. Other components can be determined only by experts, the content of these vector components coefficients will reflect subjective, psychological, moral and other aspects of a human or a group included into an organizational system. It must be clear that we can investigate an organizational process only on the basis of information about the past and current situation analysis. In other words the similar process is to be in the past. Here it would be appropriately to remind well-known Baryon's word: "The best prophet for the future is the past". In other case a detailed analysis of the current process state, a sample of some suppositions, hypothesis about its features, model development, getting controllable influence with their help if there is necessity, "careful" randomization control strategy apply.

From models of the type (15) for each object of the investigated organizational system a macro-model for the whole active process presented in Figure 6 can be determined. Now determination of input variables (y, v, ζ, ξ) , corresponding to the current situation of the system is an important stage. So we see here dualism at the system investigation that means that the experience and information about the past "included" in to the model of the type (15), and a concrete current situation is a basis for decision making taking into account the available experience. If in this experiment we get an expected (desired) reply of the whole system, our actions expressed in values (y, v, ζ, ξ) are true. If reply of the system differs very much from the expected (desired), the values of input variables and meanings of internal variables β, c , determined by experts are to be determined.

If as a result we come to satisfactory modeling system by this or that concrete organizational process, then we can "display" different situations of external influences on the system development as well as consider the control problem by an active process. One should take into account here may appear the necessity to revise used before parameter volumes β, c and internal interconnections of an organizational system. Let's pay attention once more at the necessity of active processes analysis and study accrued in the past. Undoubtedly we can affirm that new for a human active processes need thorough investigation of their analogies in the past, in other case any sharp changes of output influences, including of control influence nature is extremely undesirable as they can lead to negative consequences. It is in place to recall remarkable words of Democritus: "Even insignificant deviation from the truth leads further to infinite mistakes".

5. Variables control, measurements, estimation

Here we emphasize the importance of measurement problem of "input-output" variables of the investigated process. We should take into account that differing control means of variables estimation even for one and the same processes lead to different identification problems formulation. The main what we must point out in this problem is sometimes we are to consider dynamic object as static with a delay

because of the prolonged control procedure (measurement, analysis) of some variables that exceed a time constant of the object.

Undoubtedly it is more expedient to use all the variables that can be changed when modeling and control by discrete and continuous processes. But it needs a detailed analysis of not only a concrete object itself but means, control technologies of all the admissible variables, a priori information that can correspond to different levels simultaneously by different channels of variables measurement of the multidimensional object system. Elimination of these or those variables, parameters, measurement and control nature, a priori information as well as "unrestricting" in some way when consumptions are taken unavoidable when we state a mathematical problem may lead finally to negative consequences. All these questions are often omitted when we investigate modeling problems from theoretical point of view. But it is not possible to solve applied problems of concrete processes as "the truth doesn't suffer at all if someone doesn't recognize it" (I.F.Schiller). It is appropriate to emphasize the investigator the identification problem of the real process formulation at the initial stage.

We should mark that measurements of the variables of the investigated organizational process can differ due to its nature. We should take into account that while development corresponding models of active processes their control algorithms. The most commonly used measurement scales are [4]: a material scale, relationship scale, interval scale, dimension scale, designation scale. Generally speaking the determination of interval scale is closely connected with the content of the concrete social and economical process.

A fundamental difference of organizational systems from technical is in means of control differed very much and the corresponding variables measurement. And the main is that a human, expert, group of experts is an element of some measurement means of "input-output variables" characterizing the process state. We leave aside the technology of this measurement, estimations, expert opinions. Here it is important that measurement, estimation of some variables is not possible without a human, that is taking into account subjective factors, such as: psychological, emotional and etc.

6. Mathematical statement of modeling and control problems

Earlier [3] we paid attention to the necessity to use all the available information about the development process of K-models based on the triad: *fundamental laws*, a priori information about *parametric* structure of separate communication (channels) of the process and available information of *qualitative* nature. It is natural the formation of observation matrix included variables of different type which belong to different scales is a subject for special consideration in each concrete case.

It is known that control influences search at the corresponding conditions is carried out in the dialogue "computer (learnt, intellectual) system – decision making person (DMP)". But computer control system with DMP organizational processes needs also a control system by realization processes of making managing decision. It differs very much the control process by active systems from technical ones.

It follows from the stated above that a control system by organizational processes is fundamentally hierarchical multicircuit system included a human as a necessary and the most important element. Conversion into a new operation of the similar process, its reconstruction is sufficiently non-linear problem, complex both from theoretical and practical point of view. As it was correctly noticed in [11] "we don't need, however a special mathematical theory to understand that neglect by laws of nature and society (it could be gravitation law, cost law or the necessity of feedback), specialists competence and lack of personal responsibility for decision making lead to catastrophe some time or other. The mathematical theory of reconstructions was created long before the present-day reconstruction. The reconstruction problem difficulty is connected with its non-linearity. The usual control methods when result are proportional to efforts don't operate and its necessary to work out a special non-linear intuition based sometimes on paradoxical conclusions of non-linear theory".

It is absolutely evident that there exist very much different a priori information about the investigated process [2]. And its consequence we have different mathematical problem statements from mathematical strictness point of view. One of the main "stumbling-blocks" here is the disparity of our suppositions about the

investigated object to the object itself (process). After the traditional phrase "Let the process..." suppositions, hypothesis which are far from being real follow. It is difficult to imagine a process, object which characteristics were unchangeable or they were changing according to the known law in time. We mean the processes described in [3], means and technologies of variables objects measurements that are of interest in the existed theory of automatic control. Their main features are a priori information shortage, random factors influence with unknown yet characteristics, lack and imperfection of variables control means, unauthenticity of samples selection for measurements and other operations. We must change our lack of knowledge, unfortunately, into "Let...". It is clear that our assumptions are close to reality, so as a result we can expect success when we solve this or that problem. In other case failure is inevitably. Really a lot of processes and objects based on fundamental physical, chemical, electrical, mechanical laws and other phenomena can be described with high level of accuracy. Correspondingly we can design both models and control systems of rather high quality that is typical for many cases.

If assumptions are too "rude" there may exist two methods. The first one is to complete our "lack of knowledge" about the process when a problem statement can be fulfilled accurately from mathematical point of view. The second method means mathematical approach development adequate to the level of a priori information we have.

Y.Z. Tsipkin spoke not once about the necessity to take into account reality [12], in particular: "Analytical methods in one's first opinion seem to be more attractive as they lead to evidently formal problem solution, but this attractiveness is paid a high price for, that is strict restriction of opportunities. These methods are applied only for relatively simple problems solution. They may be often formulated only due to idealization reaching far, sometimes so far that one solves absolutely another problem instead the stated one." And then: "...optimality theory was developed on the basis of the ground, elegant from mathematical point of view and unsteady from practical point of view".

In future we are to model and control real processes described in [3], including organizational ones as reality and practice need it. In particular a lot of economical processes can be referred to organizational processes. As early as middle of the last century John von Neumann and Oskar Morgenstern wrote about the use of mathematics in economics [13]: “First of all, let’s give yourself aware of the fact that at the present time in economic theory there is no universal system, and that if it will be created, then it is unlikely that this will happen in the nearest time. The reason for this lies in the fact that the economy is too complex science...” And then: “Often the argument against the mathematics application is in references to the subjective elements, psychological factors, etc. ...”. “It is important to realize that economists can hope for no more light fate, than that one that befell scientists in other disciplines”.

It is necessary to concern seriously to the word stated below: “The importance of social phenomena, the abundance and diversity of its manifestations, as well as the complexity of their structure, at least, the same as in physics. Therefore, we should expect (or fear) that to achieve in this area decisive success will require mathematical discoveries, comparable with the opening of the infinitesimal calculus. Moreover, it is unlikely that the mere repetition of the mathematical techniques that helped us in physics, will help us in the economy also. This probability seems even less, when we see that in our discussions mathematical problems appear, quite different from the problems encountered in physics.

These considerations should be taken into account in connection with having a place in our days of abuse in the use of differential and integral calculus, differential equations, etc. as the main method in mathematical economics”. And then: “Undoubtedly, it seems reasonable to clarify, what led to progress in other fields of science, and study why the application of these principles may not lead to progress in the economy. If you really need to apply some other principles to economy, then it can be observed only in the actual development of the economic theory. It will be a revolution in science”.

It has been more than half a century, but mathematicians for economic science, as well as for modeling and control of organizational processes does not appear, although we have some progress in this direction: theory of active systems basis, theory of fuzzy sets, decision making theory, system analysis and systems theory, etc.

Conclusion. Here I'd like to pay attention to the result if the investigation of this or that concrete active process according to the scheme given above. It is clear that in this case we should speak about a specific organizational, social and social and economic process, in particular that is nowadays under a rather heated discussion. In particular, one of them is given in [14]. Above we were not discussing any particular organizational process, as the main attention was paid to the general scheme of processes investigation of general nature. Nevertheless, even in this case, I would like to point out the main features of such investigation. The most promising one is analysis of the process occurred in the past to a large extent, and, therefore, we can expect that it was well studied, described and etc. Thus, we can «immerse » into the past in order to study this or that active process, for example, an educational process. Similarly, it is natural to study and investigate this or that process, which takes place at present. The principal interest is in evaluation (result) of the active process functioning in the past and at present, as well as the analysis of external factors influencing the final result. Of course, it is clear this or that active process in the past and at present are different in this or that way. But, nevertheless, analysis and experience of the past, of course, will be necessary for making managerial decisions at present time. Here it is appropriate to recall once again the above stated idea of George Byron.

It is natural to begin computer investigation of a particular active process with the formation of input, output disturbing factors determining the process progress in time. The most important role will belong to the vector of the model parameters formation (2)-(4) included into the model. We should take into account that the variables characterizing the state of the investigated process are output variables ($x(t)$, $z(t)$, $q(t)$) input variables ($u(t)$, $\mu(t)$, $\lambda(t)$), variables determining the influence of the external environment ($\xi(t)$, $\theta(t)$), intermediate variables should be filled with

corresponding content, taking into account psychological, emotional and other factors typical for a human, group of people. And included into the models (2)-(4) parameters determine the weight of these factors from negative and positive points of view. Computer investigation of these processes will provide a reply of the active system to the corresponding changes of input variables. If this response coincides with the known output variables values of the past, it is natural to assume that such a model is credible, otherwise are to change numerical values of the parameters in the model, and possibly a set of certain variables that characterizes their mutual influence to the process under study maybe changed. The latter means the combination of process variables and parameters that control their weight that seems to us the right, does not lead to the desired goal. Some questions about errors in management are considered in [15]. In particular, referring to the educational process, we inevitably come to the conclusion that the attempts to improve the educational process at present conditions haven't not led to the desired result. The overall result is the educational level of students is now lower than it was in previous decades. Of course, one of the important factors is changes of social and economic nature. Therefore, having the ability to change the variables and parameters of the model in a computer dialogue we can understand the causes that led to this outcome. It will allow us to know the reasons and weights of the population of factors influencing the analyzed active process. As a result, the changed values, role of psychological, emotional, characteristic, ethical, and other factors can be defined and changed. In fact, this is the main objective of the first stage of investigation showing the true state of the active process. The next important step is correction, changing the scheme describing the investigation process, as well as the change of weights included into it, in order to bring the active process to the desired state and further analysis of the process, estimation of its "operation", etc.

It is clear that a great volume of work of specialists of different professions. the conduct of such work connected with investigation of a particular social process, But success in this field can considerably help in the development of the appropriate management decisions in order to bring the process to the desired state. When we

analyze a particular process, we certainly meet with a situation when not quite good decisions (and sometimes questionable goals) continued "to be improved" for a long time. While in the first approximation, the educational process, which, in spite all its "improvements" over the past two decades has led to significant negative consequences (I think there is no necessity to prove it; we have enough information in media, newspaper "Search", etc.) is quite a striking example. The practical implementation of the approach stated above to the analysis of the educational process would allow well-reasonably, taking into actual social, psychological and other relevant factors to estimate what happened and to identify practical ways to improve, and not "invent" more and more "improvements". The overall result of this work is in comparatively general analysis of the modeling and control problem of organizational processes. Here we consider the following questions:

- models and algorithms for decision making for organizational systems from the class of nonparametric adaptation algorithms;
- in the control by active processes its elements are also active blocks, that differs the latter from control systems by technical systems;
- possible alternative structure of active control and its distinctive features of the control system by a technical object is given;
- stages of computer and active control systems development were determined;
- learnt model of active processes are given. It was noted that, in spite its external similarity to the non-parametric adaptation algorithms, the mechanism of their operation is very much different from the last.

And let's consider one more important circumstance. Certainly, it is absolutely not enough to use only a mathematical approach for modeling and control by active processes as it's a lot of its elements (blocks) simply can't be formalized mathematically. N. Vinner's confidence that "management models in society and economy can be studied by the same methods, as in technical control units" can be fair only for separate fragments, blocks, channels, being elements of an active process. Ideas of John von Neumann and Oskar Morgenstern about it are given above. It is difficult to disagree with professor F.P. Tarasenko that "the WORLD in which we

should exist all the life, was unimaginably huge and complex. It is possible only to survive, grow and develop in it in agreement with it, without contradicting its natural features and restrictions which we present as a notion "nature laws". Only those our purposes, plans and actions which don't contradict these laws are realized. Therefore the necessity to know how the nature "is arranged" and what occurs in it" [16]. In this case it is expediency to use while studying this "world" synthesis of existing mathematical technology, computer and information technologies and further development of what N.N. Moiseev called machine mathematics, generating the ability to work with material, linguistic, qualitative and other variables in various scales [4]. It is absolutely clear that all this investigation "movement" should be begun with a concrete social and economic process, but of a process "in general". It is clear also that going on this way and involving into the investigation process other organizational processes, we, thereby, have chances to receive "a computer picture" of the world interesting for us in its "typical" appearance.

And, at least, the last. Certainly, it would be tempting "to put" a return operator, speaking in language of the control theory, at entrance of the operated system. It is clear, that in this case, it is possible to speak only about its approximation. Nevertheless, this idea doesn't seem to be so hopeless. Moreover, in this design (a return operator – an object/an operator/) it is possible to see some analogy to concept of symmetry. A great mathematician of the last century German Weyl delivered lectures about symmetry [17] and called them "a swan song" in his declining years: "I want to express my gratitude to Publishing house of Princeton University and its employees for that thorough attention which they showed concerning this small book. I express not less sincere gratitude to the governing body of Princeton University that gave me opportunity to deliver these lectures – my swan song – on the eve of leaving Institute of Advanced Study". At the very beginning of his speech he introduced the following idea: "If I am not mistaken, in our daily language the word symmetry is used in two meanings. In one meaning the symmetric is something possessing a good ratio of proportions, counterbalanced, and *symmetry* is that agreement type of separate parts which unites them in a whole. Beauty is closely connected with

symmetry". And further: "Symmetry in a broad or narrow sense depending on how you defined the meaning of this term is that idea by means of which a human throughout centuries tried to achieve and create order, beauty and perfection ... At first we will consider mirror symmetry and its role in art, in live and lifeless nature" in a bit more details. Certainly, it is possible to doubt that the mankind tends to "order, beauty and perfection", observing what occurs in the world today.

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Ryzhkova T.N.

RESULTS OF INVESTIGATIONS OF GOAT'S MILK COMPOSITION AND ITS MICROBIOLOGICAL VALUES USED FOR THE DEVELOPMENT OF STATE STANDARD OF UKRAINE (GOST)

Comparative characteristics of the review articles and the results of own researches of physical and chemical composition and microbiological indices of cow and goat's milk used by the author when developing state standards - GOST of Ukraine on goat's milk and dairy products and determination method of their microbiological purity by plates «Petrifilm».

Key words: physical and chemical composition, cow, goat's milk, GOST

Introduction. Ukraine has 300 farms with different forms of property that specialize in goat breeding but it is not sufficient to overcome the deficiency in goat's milk products that have high nutritive and biological value as compared to the

products from cow's milk. However, the production of drinking milk, rennet cheese and cottage cheese on the industrial basis has not found the wide use in Ukraine. One of the deterrents of processing goat's milk into drinking milk and fermented products is the imperfection of the standards: the lack of national standards of Ukraine (until recently) on the storing goat's milk, drinking milk and fermented dairy products (rennet cheese and cottage cheese). The development of the above standards is not possible for lack of the results of the comparative analysis of physical and chemical values of goat's and cow's milk.

The analysis of the published results of the investigation of physical and chemical composition of milk of different species of animals including goat's milk showed the large intervals of divergence of the indices of its main components (mass rate of fat, protein, lactose) [2 – 4]. The trustworthy values are the ones that apply to the changes of the physical and chemical composition of goat's milk depending on the breed and stage of lactation. Thus, at the beginning and at the end of lactation the goat's milk has more fat, in the middle of lactation when the productivity of animals is maximum due to summer feeds, the content of fat is lower; the density of milk is higher at the beginning and lower in the middle and at the end of lactation, the index of freshness of goat's milk in the summer period is higher as compared to the analogous value of winter milk, that can be explained by the influence of high temperature of the environment [5 – 7].

It has been known from the literature that goat's milk differs in its physical and chemical composition from cow's milk [8 – 9], but in some publications it has been stated that goat's milk maximally approaches to cow's milk in the content of the main components such as fat, protein and lactose [10 – 11]. Though there are considerable differences between goat's milk and cow's milk in the amount and size (diameter) of fatty balls (FB). Thus, it has been known from the publications that the diameter of FB of goat's milk is 2 micromol but the diameter of FB in cow's milk is 21,2 ... 31,2 micromol [12–13]. The above mentioned contradictions in the scientific publications testify to the necessity to conduct the additional investigations of the physical and chemical composition, the sanitary and ecological values of cow's and goat's milk.

Mass rate of fat, %	3,69± ±0,5	4,10± ±0,5	3,48± ±0,5	3,52± ±0,5	4,3± ±0,5	4,95± ±0,5	4,6± ±0,5	5,6± ±0,5
Mass rate of protein, %	3,25± ±0,5	3,41± ±0,5	3,30± ±0,5	3,37± ±0,5	3,29± ±0,5	3,40± ±0,5	3,2± ±0,5	3,6± ±0,5
Milk-sugar, %	4,49± ±0,5	4,50± ±0,5	4,48± ±0,5	4,58± ±0,5	4,52± ±0,5	4,56± ±0,5	4,92± ±0,5	5,38± ±0,5
Dry matters, %	12,37± ±0,5	13,8± ±0,5	12,36± ±0,5	12,50± ±0,5	12,34± ±0,5	13,74± ±0,5	13,2± ±0,5	15,0± ±0,5
Acidity, °T	17,0± 0,5	15,0± ±0,5	19,0± ±0,5	16,0± ±0,5	18,0± ±0,5	14,0± ±0,5	16,0± ±0,5	13,0± ±0,5
Density, °A	27,9± ±0,5	29,0± ±0,5	28,0± ±0,5	29,0± ±0,5	28,0± ±0,5	31,0± ±0,5	28,2± ±0,5	30,4± ±0,5

It can be seen from Table 1 that beginning from spring, summer and up to autumn and winter period there is a tendency of the increase in the mass rate of fat in both kinds of milk. In the winter season the mass rate of fat in cow's milk was higher than in the milk of the spring, summer and autumn seasons respectively by 0,91 and 1,12 % ($P \geq 0,99$) and by 0,3 % ($P \geq 0,95$). The samples of dairy raw materials had the largest quantity of the mass rate of fat in goat's milk in the winter season and it exceeded the same rate in the milk received in the spring, summer and autumn periods by 1,5 and 2,08 5 ($P > 0,99$) and 0,65 ($P \geq 0,95$) respectively.

The mass rate of fat in goat's milk in the above seasons except summer exceeded the analogous value in the cow's milk by 0,41 %, 0,65 % ($P \geq 0,95$) and by 1,0 % ($P \geq 0,99$) respectively. But in the summer season the trustworthy differences in the values of mass rate of fat in both kinds of milk was not revealed ($P \leq 0,95$).

The mass rate of protein in cow's milk in the winter period was higher as compared to the analogous value of the mass rate of protein in the spring, summer and autumn seasons by 0,15, 0,10 % and by 0,11 % ($P \geq 0,95$) respectively. There were no significant differences in the indices of the mass rate of protein in cow's milk received in spring, summer and autumn seasons ($P \leq 0,95$).

The mass rate of protein in goat's milk received in the winter period as compared to the analogous value in spring, summer and autumn seasons was higher by 0,19, 0,23 and by 0,17 % ($P \geq 0,95$).

The mass rate of protein in goat's milk as compared to the analogous value in cow's milk was higher by 0,16, 0,14 and by 0,2% respectively ($P \geq 0,95$). There was no significant difference between the indices of the mass rate of protein in cow's and goat's milk in the summer period ($P \geq 0,95$). The mass rate of milk- sugar in cow's milk in the winter period was higher than the analogous value in spring, summer and autumn periods by 0,43, 0,44 and by 0,40 % respectively, ($P \geq 0,95$).

The mass rate of milk - sugar in goat's milk in the winter period of the year was higher than the analogous value in spring, summer and autumn by 0,88, 0,8 and by 0,82 % respectively, ($P \geq 0,99$).

No trustworthy difference between the mass rate of milk – sugar in cow's and goat's milk in autumn period of the year was established ($P \leq 0,95$). In summer, autumn and winter periods the mass rate of milk - sugar in goat's milk as compared to the analogous value in cow's milk was higher by 0,1 % ($P \geq 0,95$) and by 0,46 % ($P \geq 0,99$) respectively.

If the amount of milk-sugar in the goat's milk is larger than the analogous value in the cow's milk its size is smaller. Milk-sugar in the goat's milk will be attacked by ferment - lactose more intensively (b-galactosidase is produced by ferment milk acid microflora as compared to the intensity of the action on the larger crystals of the analogous component that cow's milk contains.

That testifies about the possibility to use goat's milk for diet and child nutrition.

The mass rate of dry matters in cow's milk in all the above mentioned seasons except the winter one was at one and the same level ($P < 0,95$).

The mass rate of dry matters in cow's milk was higher by 0,83 % ($P \geq 0,99$) in the winter period as compared to the spring one.

The largest amount of dry matters in goat's milk (15,0 %) was in the winter period and it was higher than the same value in spring, summer and autumn months by 1,2; 2,7; and 1,26 % ($P > 0,95$) respectively.

The mass rate of dry matters in goat's milk in spring, autumn and winter periods of the year was higher as compared to the same values in cow's milk by 1,43; 1,40; and 1,8 % ($P > 0,99$) respectively. There were no trustworthy difference between the above values in both kinds of milk in summer period ($P < 0,95$).

It turned out that the level of SOMO in cow's milk in summer period was higher than the analogous value in the milk of spring, summer and autumn months by 0,2; 0,84; and 0,28 % ($P \geq 0,95$) respectively. The largest amount of DSMR (dry skimmed milk rest) in goat's milk was in the spring period.

It was found out that the level of DSMR was lower in the spring period in comparison with the analogous index in the milk of summer, autumn and winter periods by 0,72; 0,91; and 0,3 % ($P \geq 0,95$) respectively.

The mass rate of DSMR in goat's milk as compared to the analogous value in all the above mentioned seasons was higher by 1,02 % ($P \geq 0,99$), 0,1% ($P \geq 0,95$), 0,75 and 0,8 % ($P \geq 0,95$). Thus, the higher rate of DSMR in goat's milk proves that it is more technological as compared to cow's milk. There were no significant differences in the value of acidity between cow's and goat's milk in summer period. Thus, titrating acidity of cow's milk was by 1 °T higher as compared to the analogous value of goat's milk, that can be explained by higher temperature of the environment in the summer period ($P < 0,95$). Goat's milk acidity as compared to the acidity of cow's milk in all the rest seasons was lower by 2...3 °T than the analogous index in the cow's milk that is the manifestation of the species peculiarities of goat's milk ($P \geq 0,99$). There were no significant differences in the value of cow's milk density in all the seasons ($P < 0,95$). The density of goat's milk (in spring, summer, autumn and winter) was higher as compared to the analogous value of cow's milk in all the above mentioned seasons by 1,1, 1,0, 3 and 2,2 °A ($P > 0,99$) respectively. The density value of goat's milk was the highest in the autumn period – 31,0 °A. It turned out to be higher as compared to the same value in the winter milk by 2 and 0,6 °A ($P \geq 0,99$). There were no significant differences in the values of density of cow's and goat's milk in the summer period of the year ($P \geq 0,95$). The analysis of the above results of the investigations gave the possibility to determine the average values of

goat's milk composition and introduce the data of the research in the proper part of the developed standard that was introduced into practice from 01.01. 2010: National Standard of Ukraine "Raw goat's milk" [14]. In the publications of foreign scientists there are some data on the use of the plates "Petrifilm" to control the quality of milk and dairy product by the values of their microbiological purity. The formula for the count of foreign microorganisms cultivated on the plates "Petrifilm" that was described in the "Methodical recommendations" of the Russian Federation Republic does not give the trustworthy indices of the results of the investigations and the specification is needed [15 - 16]. The comparative microbiological investigations of the inoculations of milk and dairy products and their dilutions for the quantitative determination of the presence of foreign microflora in them with the help of Petri plates and plates "Petrifilm" have been conducted. Microbiological indices of cow's and goat's milk samples and cheese produced from it were determined. For that the inoculation from one and the same sample of milk and dairy products or their dilutions" was done three times on the Petri plates or plates "Petrifilm. The results of the investigation are presented in table 2.

Table 2

Microbiological values of goat' milk and cheese, CFU /cm³

Name of the sample	Values			
	MAFAnM (Petri plate)		MAFAnM (plates "Petrifilm")	
	total	including yeast	total	including yeast
Goat's milk, in 1 cm ³ . Sample № 1	$7,37 \times 10^3$	$7,37 \times 10^3$	$7,27 \times 10^3$	$2,43 \times 10^3$
Cheese from goat's milk, in 1 g of product. Sample № 2	$6,1 \times 10^4$	no	$6,8 \times 10^4$	no
Cheese from goat's milk, in 1 g of product. Sample № 2	$4,43 \times 10^4$	the same	$4,60 \times 10^4$	the same

It can be seen from Table 2 that in the milk the average amount of MAFAnM grown on the sowings of the dilutions on the plates is $7,37 \times 10^3$ CFU / cm³ and $7,27 \times 10^3$ CFU / cm³ respectively including the amount of yeast and mould is $2,47 \times 10^3$

CFU/ cm³ and $2,43 \times 10^3$ CFU/ cm³ , respectively. In the goat's milk the average amount of MAFAnM cultivated on the plates is $4,43 \times 10^4$ CFU / cm³ and $4,60 \times 10^4$ CFU / cm³ on each plate respectively. There were no yeast and mould in the samples of cheese. The absence of yeast in the sample of cheese can be explained by the suppression of its development by microflora of ferment for small cheese used in the production of pickled /brine/ cheese in the amount of 2 % from the weight of the milk for processing. It has been stated that when one and the same average daily sample of goat's milk (further milk) was cultivated three-times simultaneously the discrepancy between the average indices of microbiological investigations of the amount of MAFAnM was the following: by the Petri plate method – 30,3 %, 9,1 % and 21,3 %; with the use of the plates – 27,9 %, 10,6 % and 17,5 %. When counting the amount of yeast in the milk sample the divergence between the average indices was: with the use Petri plate method: 39,8 %, 6,9 % and 59,5 %, with the use of the plates – 39,2; 53,0 and 58,8 %. By the determination of the amount of MAFAnM in the cheese sample the divergence between the average indices was: with the Petri plate method: 27,4 %, 50,3 % and 12,9 %, with the use of the plates – 32,6; 56,5 and 8,7 %. The results of the data received in our experiment coincide with the scientists' point of view that the divergence between the investigations can be more than 30 %. The investigation of the samples of milk and pickled cheese has been conducted to determine the content of MAFAnM, yeast and mould and *enteroB* in them on the basis of Kharkiv institute of animal breeding, NAAS of Ukraine (Table 3).

Table 3

Microbiological values of milk and cheese CFU /cm³ or g/cm³

Name of the sample	Amount of microbial cells in 1 cm ³ of milk and cheese			
	on Petri plates	on plates		
	MAFAnM	MAFA _H M	yeast	enteroB
Goat's milk. Sample № 1	$9,6 \times 10^5$	$3,0 \times 10^5$	$4,1 \times 10^3$	$1,0 \times 10^1$
Goat's milk. Sample № 2	$6,7 \times 10^5$	$2,5 \times 10^5$	$2,3 \times 10^3$	$1,9 \times 10^1$

Goat's milk. Sample № 3	$5,8 \times 10^4$	$1,2 \times 10^4$	$1,0 \times 10^2$	$5,5 \times 10^1$
Cheese "Molodyozhnyy" from goat's milk. Sample № 1	$2,1 \times 10^4$	$6,8 \times 10^4$	no	$2,0 \times 10^1$
Cheese "Zhemchuzhnyy" from goat's milk. Sample № 2	$2,2 \times 10^4$	$2,0 \times 10^4$	the same	$6,0 \times 10^1$
Cheese "Dorozhnyy" from goat's milk with the use of improved hydrolized ferment. Sample № 3.	$5,0 \times 10^3$	$5,0 \times 10^3$	the same	$1,3 \times 10^1$

Note: Cheese "Molodyozhnyy" was produced with the use of 3 kinds of ferment microflora (lactococcus, propion acid bacteria and lactobacillus).

It can be seen from Table 3 that the investigation of milk and cheese samples carried out in the institute of animal breeding, National Academy of Agricultural Science and Food of Ukraine by cultivation on Petri plates and simultaneously on the plates showed the significant divergence in the results. As for the microbiological purity it has been found out that cheese "Molodyozhnyy" produced with the introduction in the technological process of cheese making the ferment containing 3 kinds of ferment cultures: ferment for small rennet cheese, propion acid bacteria and acidophilic milk acid rod-shaped bacteria was less contaminated.

Cheese "Dorozhnyy" produced with the use of the improved kind of hydrolized ferment was of high microbiological purity.

The comparative evaluation of the detection of the amount of MAFAnM and coli forms in cow's and goat's milk and pickled cheese produced from the milk by the cultivation of the dilutions of samples under investigation on the medium in Petri plates (PP) and simultaneously on the plate "Petrifilm" or (3M "Petrifilm"™) (PPF) has been done. For that the samples of cow's and goat's milk have been taken on the private farms in Kharkiv region. The milk was processed to produce pickled cheese.

The content of MAFAnM and coli forms (CF) in the milk and cheese has been determined by the simultaneous cultivations on PP and PPF.

The data that the trustworthy interval for the level of probability 95 % is: $\pm 0,45 \log_{10}$ from the initially received result in the experiment have been taken into consideration. During the investigation various mediums from the producers have been compared. In our opinion, when evaluating the results it would be more correct

to use the trustworthy interval $\pm 0,45 \log_{10}$ from the amount of microorganisms or coli forms cultivated on the traditional mediums cultivated on Petri plates.

The determination of coli forms was done in accordance with the requirement of the State Standard GOST 30518 by cultivation of the products under investigation on PP on Endo's medium.

The results of the investigation of milk and cheese for the presence of MAFAnM in the milk and cheese are presented in Table 4.

Quantity of MAFAnM in milk and cheese

Name of the object under investigation	Number of microorganisms (MAFAnM)			
	Petri plate, GRM-agar	Trustworthy interval for the level of probability 95 %		PPF, Aerobic Count Plate
		$\pm 0,25 \log_{10}$	$\pm 0,45 \log_{10}$	
1	2	3	4	5
Milk				
Goat's pasteurized milk. Sample № 1	$2,0 \times 10^4$	$1,1 \times 10^4 - 3,6 \times 10^4$	$7,1 \times 10^3 - 5,6 \times 10^4$	$2,0 \times 10^4$
Raw goat's milk Sample № 2	$4,4 \times 10^6$	$2,5 \times 10^6 - 7,8 \times 10^6$	$1,6 \times 10^5 - 1,2 \times 10^6$	$4,0 \times 10^6$
Raw goat's milk Sample № 3	$< 10^5$	$< 5,6 \times 10^4 - 8 \times 10^5$	$< 3,6 \cdot 10^4 - < 2,8 \cdot 10^5$	$3,0 \times 10^5$
Raw goat's milk Sample № 4	$7,5 \times 10^5$	$4,2 \times 10^5 - 1,3 \times 10^6$	$2,7 \times 10^6 - 2,1 \cdot 10^5$	$6,0 \times 10^5$
Raw goat's milk Sample № 5	$1,2 \times 10^6$	$6,7 \times 10^6 - 2,1 \times 10^5$	$4,3 \times 10^5 - 3,4 \times 10^6$	$1,4 \times 10^6$
Goat's pasteurized milk. Sample № 6	$> 1,0 \times 10^3$	$> 5,6 \times 10^3 - 1,8 \times 10^3$	$> 3,6 \cdot 10^3 - > 2,8 \times 10^3$	$1,6 \times 10^3$
Cheese				
Cheese from raw milk without ferment. Sample № 1	$4,5 \times 10^6$	$2,5 \times 10^6 - 8,0 \times 10^6$	$1,6 \times 10^5 - 1,3 \times 10^6$	$3,6 \times 10^6$
Cheese from pasteurized milk without ferment. Sample № 2	$5,2 \times 10^3$	$2,9 \times 10^3 - 9,3 \times 10^3$	$1,9 \times 10^3 - 1,5 \times 10^4$	$2,4 \times 10^3$
Cheese from pasteurized milk with three kinds of ferment «SMS», propion acid bacteria and acidophilic rod-shaped bacteria. Sample № 3	$6,0 \times 10^6$	$3,4 \times 10^5 - 1,1 \times 10^6$	$2,1 \times 10^5 - 1,7 \times 10^6$	$5,6 \times 10^3$
Cheese from raw milk with ferment «SMS». Sample № 4	$2,8 \times 10^6$	$1,6 \times 10^5 - 1,0 \times 10^6$	$1,0 \times 10^5 - 1,8 \times 10^6$	$7,2 \times 10^5$
Cheese from pasteurized milk with ferment «SMS». Sample № 5	$8,3 \times 10^3$	$4,7 \times 10^4 - 1,5 \times 10^5$	$3,0 \times 10^4 - 1,3 \times 10^5$	$1,7 \times 10^5$

It can be seen from Table 4 that by the determination of the amount of MAFAnM in the four out of six samples of milk (66,7 %) the amount of microorganisms determined by the cultivation on PPF was not only within the limits of the trustworthy interval: $\pm 0,45 \log_{10}$ but it was $\pm 0,25 \log_{10}$. It corresponded to the level of probability 95 %. From 5 samples of cheese only in two samples (40 %) the amount of MAFAnM determined by the cultivation on PPF was within the ranges of the trustworthy interval: $\pm 0,45 \log_{10}$. The amount of microorganisms in one of the samples was within the ranges of the trustworthy interval: $\pm 0,25 \log_{10}$. Thus, only in six samples out of 11 samples under investigation (54,5 %) the quantity of MAFAnM that was determined by the cultivation on PPF was within the interval $\pm 0,45 \log_{10}$ including 5 samples (45,5 %) within the interval $\pm 0,25 \log_{10}$. In five samples (№ 1,2,4,5,7) the quantity of MAFAnM on PP on GRM/// agar and PPF either was the same or the difference was not more than 27 %. In two samples (№ 3, 8) the quantity of MAFAnM was different by 3 times. In three samples (№ № 6,10,11) the amount of microorganisms on PP was 39 – 63 times as large as on PPF, in one sample (№9) – more than 1000 times. In nine samples (81, 8 %) out of 11 samples of milk and cheese the quantity of MAFAnM on PP on GRM-agar exceeded the amount of microorganisms on PPF and in two samples it was 1,2 – 3 times lower. The quantity of coli forms in milk and cheese have been determined (Table 5).

Table 5

Quantity of coli forms in milk and cheese

Name and number of the sample	Amount of coli forms			
	Petri plate, Endo's medium	Trustworthy interval for the level of probability 95 %		
		$\pm 0,25 \log_{10}$	$\pm 0,45 \log_{10}$	
1	2	3	4	5
Milk				
Goat's pasteurised.	$1,0 \times 10^3$	$5,6 \times 10^4 - 2,8 \times 10^3$	$3,6 \times 10^3 - 2,8 \times 10^3$	$3,1 \times 10^3$
Raw goat's milk	$6,1 \times 10^4$	$3,4 \times 10^4 - 1 \times 10^5$	$2,2 \times 10^4 - 1,7 \times 10^5$	$6,2 \times 10^5$
- goat's. Sample № 1	$2,0 \times 10^6$	$1,1 \times 10^6 - 3,6 \times 10^6$	$7,1 \times 10^5 - 5,6 \times 10^6$	$1,7 \times 10^6$

- goat's. Sample №2	$1,6 \times 10^6$	$9,0 \times 10^5 - 2,8 \times 10^6$	$5,7 \times 10^5 - 4,5 \times 10^6$	$4,8 \times 10^6$
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Continuation of table 5

1	2	3	4	5
- goat's. Sample №3	$>1,3 \times 10^5$	$>7,3 \times 10^5 \rightarrow 2,3 \times 10^6$	$>4,6 \times 10^5 \rightarrow 3,6 \times 10^6$	$1,1 \times 10^6$
- goat's. Sample №4	$1,2 \times 10^4$	$6,7 \times 10^3 - 2,1 \times 10^4$	$4,3 \times 10^3 - 3,4 \times 10^4$	$5,6 \times 10^3$
- goat's. Sample №5	$4,4 \times 10^4$	$2,5 \times 10^4 - 7,8 \times 10^4$	$1,6 \times 10^4 - 1,2 \times 10^5$	$1,3 \times 10^5$
- goat's. Sample № 6	$6,7 \times 10^4$	$3,8 \times 10^4 - 1,2 \times 10^5$	$2,4 \times 10^4 - 1,9 \times 10^5$	$5,9 \times 10^5$
- goat's. Sample №7	$6,7 \times 10^5$	$3,8 \times 10^5 - 1,2 \times 10^6$	$2,4 \times 10^5 - 1,9 \times 10^6$	$1,3 \times 10^6$
- goat's. Sample №8	$3,1 \times 10^5$	$1,7 \times 10^5 - 5,5 \times 10^5$	$1,1 \times 10^5 - 8,7 \times 10^5$	$2,6 \times 10^5$
Cow's pasteurisated	$6,0 \times 10^4$	$3,4 \times 10^4 - 1,1 \times 10^5$	$2,1 \times 10^4 - 1,7 \times 10^5$	$2,2 \times 10^5$
Cheese				
Cheese. Sample №1	$2,3 \times 10^4$	$1,3 \times 10^4 - 4,1 \times 10^4$	$8,2 \times 10^3 - 6,4 \times 10^4$	$6,9 \times 10^4$
Cheese. Sample №2	$1,9 \times 10^6$	$1,1 \times 10^6 - 3,4 \times 10^6$	$6,8 \times 10^5 - 5,3 \times 10^6$	$1,4 \times 10^6$
Cheese. Sample №3	$3,3 \times 10^6$	$1,8 \times 10^6 - 5,9 \times 10^6$	$1,2 \times 10^6 - 9,2 \times 10^6$	$7,2 \times 10^6$
Cheese. Sample №4	$1,7 \times 10^6$	$9,6 \times 10^6 - 3,0 \times 10^7$	$6,1 \times 10^6 - 4,8 \times 10^6$	$3,7 \times 10^6$
Cheese. Sample №5	$4,1 \times 10^6$	$2,3 \times 10^6 - 7,3 \times 10^7$	$1,5 \times 10^7 - 1,2 \times 10^6$	$2,2 \times 10^6$

It can be seen from Table 5 that the quantity of BGKP in 4 out of 11 milk samples under investigation on PPF were within the range $\pm 0,45 \log_{10}$. Samples № 3, 6, 8, 9: in two of them (№ 3, № 8) – within the interval $\pm 0,25 \log_{10}$.

In 2 out of 15 cheese samples under investigation the quantity of BGKP on PPF was within the interval $\pm 0,45 \log_{10}$. In one sample among them - within the interval $\pm 0,25 \log_{10}$. Thus, 6 out of 16 tested samples (37,5 %) the quantity of BGKP on PPF was within the interval $\pm 0,45 \log_{10}$ including 3 samples - within the interval $\pm 0,25 \log_{10}$. On the whole in the 11 (68,8 %) out of 16 samples under investigation the amount of enteroB on Endo medium on PP exceeded the quantity of coli forms on PPF; in 4 samples (№ № 3,6,8,16) - by 1,1 – 2,0 times; in 4 samples (№ № 4,7,10,11) - by 12 – 34 times; in 3 samples (№ № 1, 5, 13) - by 118 – 323 times; in 3 samples (№ № 9, 14, 15) the amount of enteroB on Endo medium was lower than on PPF by 1,9 – 4,6 times; in 2 samples (№ № 2, 12) - by 10 – 300 times. Thus, the quantity of mesophilic aerobic and facultatively anaerobic microorganisms determined by the cultivation on the plates 3M “Petrifilm” Aerobic Count Plate in six (54,5 %) out of 11 milk and cheese samples under investigation were within the interval $\pm 0,45 \log_{10}$ that corresponds to the level of probability of the result reproduction and it is 95 %.

In 9 (81,8 %) out of 11 samples under investigation the amount of microorganisms grown on PP on GRM – agar was higher than on the plates “Petrifilm” (“PetrifilmTM”).

The quantity of bacteria, group of coli forms, determined by the cultivation on the plates 3M “PetrifilmTM” “ Coliforms Count Plate, in 6 (37,5 %) out of 16 milk and cheese samples under investigation were within the interval $\pm 0,45 \log_{10}$, that corresponds to the level of probability of the reproduction of the result and it is 95 %. On the whole in 11 (68,8 %) out of 16 samples under investigation the amount of enteroB grown on PP on Endo’s medium was greater than the amount of coli forms on the plates “Petrifilm” (3M “PetrifilmTM”).

Thus, the use of the plates in the production laboratories for determination of quantity of MAFAnM as well as coli forms in milk and cheese is more advantageous as compared to the method of product cultivation or its dilutions on Petri plates.

Processing of the results of the investigation. The number of colony forming units of microorganisms N per 1 cm^3 / or 1 g of the product were counted by the formula:

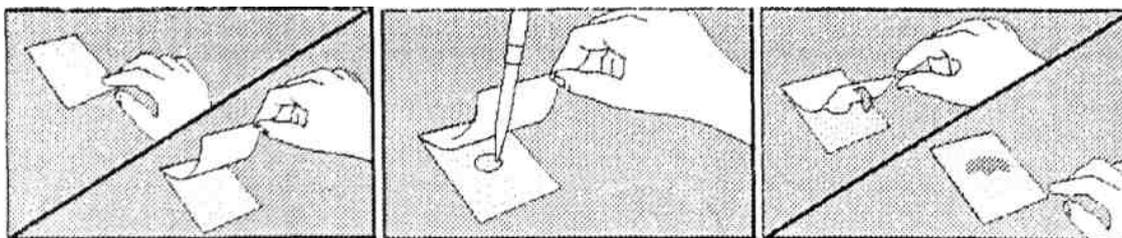


Fig. 1. The general view of plates and method of their use

$$N = \frac{\sum N_1}{(n_1 + 0,1 \cdot n_2) \cdot V} \cdot a, \quad (1)$$

where – sum of the colony forming units of microorganisms counted on all the plate;

n_1 number of the plate with the first dilution of the sample;

n_2 number of the plate with the second and other dilutions of the sample;

a – dilution of the sample

V volume of the sample under investigation that is cultivated on the plate.

The results received according to (1) are approximated to the second decimal number.

The results of the microorganism quantity in 1 g or 1 cm^3 of the product are expressed by the number between $1,0$ and $9,9$ multiplied $1,0 \times$ (where x – is the degree of sample dilution). To obtain the trustworthy results the plate is chosen on which from 15 to 150 colonies of coli form bacteria and from 5 to 50 colonies of *E. coli* were cultivated. The average arithmetic meaning of two simultaneous definitions was taken as a final result.

The general view of the plates and method of their use is presented In Picture 1.

Picture 1. The general view of the plates and method of their use.

Investigation of the bacterial contamination of goat and cow's milk samples. The level of the bacterial contamination of goat and cow's milk samples depending on the season was determined by the amount of MAFAnM (mesophilic aerobic and

facultatively anaerobic microorganisms) and BGEC (bacteria of *E.coli* group) with the help of the plates “Petrifilm”. Microbiological indices of goat and cow’s milk depending on the season are presented in Table 6.

Table 6

Microbiological indices of two kinds of milk, CFU, 1000 in 1cm³

Season	Values of milk			
	cow’s		goat’s	
	MAFAnM	BGEC	MAFAnM	BGEC
spring	$3,0 \times 10^5$	$5,2 \times 10^3$	$9,8 \times 10^3$	$2,2 \times 10^2$
summer	$3,8 \times 10^5$	$9,2 \times 10^3$	$1,2 \times 10^4$	$3,0 \times 10^2$
autumn	$2,8 \times 10^5$	$9,0 \times 10^3$	$9,2 \times 10^2$	$0,9 \times 10^2$
winter	$2,5 \times 10^5$	$8,0 \times 10^3$	$2,2 \times 10^2$	$0,4 \times 10^2$

It can be seen from Table 6 that cow’s milk contains by 1...3 times larger contaminant microflora as compared to the goat’s milk, the total contamination of cow’s milk – raw material (as for MAFAnM 0 was 100 times as high as the goat’s milk, as for BGEC – 10 times.

Special attention should be paid to the fact the level of cow’s milk contamination by foreign microflora practically did not depend on the season, but goat’s milk produced in the summer period was more contaminated than in the spring, autumn and winter periods of the year and it contained MAFAnM and BGEC $1,2 \times 10^4$ and 3×10^2 CFU/cm³ respectively.

There is the directly proportional dependence between the amount of MAFAnM and bacteria of *E.coli* group (BGEC).

The greatest amount of BGEC was in the cow’s milk produced in summer. It contained respectively by 40 000, 2 000 and by 12 000 CFU/ cm³ more than the milk produced in the spring, autumn and winter periods of the year. The amount of MAFAnM in goat’s milk produced in the summer was greater than in the milk produced in the spring, autumn and winter by 22 000, 111 000 and 118 000 CFU/cm³ respectively.

Goat’s milk produced from goats in spring, summer, autumn and winter was different from cow’s milk (in the same seasons) by less contamination by MAFAnM by 2902

000, 3680 000, 2791 000 and 2498 000 CFU/ cm³ respectively. The content of BGEC (bacteria of E.coli group) in goat' milk turned to be less as compared to the same value in cow's milk by 50 000, 89 000, 89,1 000 and 8 000, CFU/ cm³ respectively.

The results received during the investigation were used in the development of two State Standards of Ukraine, the following methods were included in the standards: determination and counting of foreign microflora in milk and dairy products (quantity of MAFAnM, yeast and mould; determination of the quantity of coli forms and E.coli with the help of plates "Petrifilm" [17 – 18].

Conclusions:

1. Goat's milk in all the seasons except summer has higher content of mass rate of fat, protein, dry matter and dry skimmed milk except the value of titrating acidity and the amount of milk – sugar as compared to the analogues indices in cow's milk. However, physical and chemical properties of cow's and goat's milk are nearly the same in the summer period.

2. The analysis of the above results of the investigations gave the possibility to determine the average values of physical and chemical composition of goat's milk and to include them in the relevant part of the state standard of Ukraine that was developed by us "Raw goat's milk. Technical conditions", that was introduced into practice from 01.01.2010 by State Standard of Ukraine.

3. Goat's milk contains less amount of MAFAnM and BGEC as compared to the analogues indices of cow's milk. So, it can be more effective than cow's milk and it can be used for processing to produce food for child's nutrition.

4. The results of the investigations were also used in the development of two State Standards of Ukraine on the determination and counting of foreign microflora in milk and dairy products, amount of MAFAnM, yeast and mould in them as well as the determination of the quantity of coli forms and E.coli with the help of plates "Petrifilm"

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AUTHOR INDEX

Goloskokov K.	Doctor of Technical Sciences	docent	St. Petersburg 191002
Goloskokova N.K.,	graduate student		St. Petersburg 191002
Chirkova M.J.	PhD	docent	St. Petersburg 191002
Akhmetov Bekturgan Sultangalievich	PhD		Almaty 050042
Turgenev D.V.	master		St. Petersburg, Pushkin Leningrad Region 196603
Guguchkina T.I.	Doctor of Agricultural Sciences	professor	Krasnodar 350072
Kushnereva E.V.,	Ph.D.		Krasnodar 350072
Markovski M.G.,	Ph.D.		Krasnodar 350072
.Borisenko, A		docent	Krasnodar 350072
V.V.Dergach	Ph.D.	docent	Krasnodar 350072
K.S. Rushelyuk	Ph.D.	docent	Krasnodar 350072
I.G. K. Tolstikhin,	Ph.D.	docent	Krasnodar 350072
Machekhina D. V	student		Krasnodar 350072
Tuch V.V.	student		Krasnodar 350072
V. Vanin,	Doctor of Technical Sciences	professor	Kiev Kiev region. 02140
V. Virchenko,	graduate student		Kiev Kiev region. 02140
S. Virchenko	student		Kiev Kiev region. 02140
Belich S.S.	graduate student		Shakhty Rostov region. 346500
Alekseev N. N,			Vladivostok Primorsky Krai 690013
Bozhko S.D.,,	Ph.D.	docent	Vladivostok Primorsky Krai 690013
Ershova T.A.,,	Ph.D.	docent	Vladivostok Primorsky Krai 690013
Mukhortov S. A.,	PhD	docent	Vladivostok Primorsky Krai 690013
Son O. M.	Ph.D.	Art. St.	Vladivostok Primorsky Krai 690013
Tekutyeva L.A.,	Ph.D.	docent	Vladivostok Primorsky Krai 690013
Ivanov Y.Y.	master		Vinnitsa Vinnitsa region. 21021
Krivogubchenko D.S.,	Ph.D.	Art. St.	Vinnitsa Vinnitsa region. 21021
Krivogubchenko S.G	Ph.D.	docent	Vinnitsa Vinnitsa region. 21021
Kulyk A.Y	Doctor of Technical Sciences	professor	Vinnitsa Vinnitsa region. 21021
Brzhozovsky B.M	Doctor of Technical Sciences	professor	Saratov 410028

Zinina H.P.,	Ph.D.		Saratov 410028
Martynov V.V.,	Doctor of Technical Sciences	professor	Saratov 410028
Brzhozovsky B.M	Doctor of Technical Sciences	professor	Saratov 410028
Yankin IN	Doctor of Technical Sciences	docent	Saratov 410028
Masleeva O.V	Ph.D.	docent	Nizhny Novgorod Nizhny Novgorod region 603135
Pachurin G.V.	Doctor of Technical Sciences	professor	Nizhny Novgorod Nizhny Novgorod region 603135
Sosnina E.N.	Ph.D.	docent	Nizhny Novgorod Nizhny Novgorod region 603135
Machehina F. V.	student		Krasnoyarsk 660041
Lukash E A	Ph.D.	docent	Belgorod Belgorod region. 308012
Trautvain A.I.	specialist	Art. St.	Belgorod Belgorod region. 308012
Yadykina V.V.,	Doctor of Technical Sciences	professor	Belgorod Belgorod region. 308012
Tchigirinsky Ju. L.	Ph.D.	docent	Volgograd 400005
Kovalsky E.R	Ph.D.	docent	Saint Petersburg 199406
Vinoglodov S.V.,	Ph.D.	docent	Komsomolsk-on-Amur Khabarovsk Krai 681013
Pronin A.I.,	Ph.D.	docent	Komsomolsk-on-Amur Khabarovsk Krai 681013
Savchenko R.E.	student		Komsomolsk-on-Amur Khabarovsk Krai 681013
Samar E.V	graduate student		Komsomolsk-on-Amur Khabarovsk Krai 681013
Shelkunov E.B	Ph.D.	docent	Komsomolsk-on-Amur Khabarovsk Krai 681013
Shelkunova M.E	Ph.D.	docent	Komsomolsk-on-Amur Khabarovsk Krai 681013
Kizim A.V.	Ph.D.	docent	Volgograd 400005
Ivanova N.N.	specialist	Art. St.	Moscow 109651
Viazovik V.	Ph.D.	docent	Cherkassy 18003
Lisenko V.,	master		Cherkassy 18003
Stolyarenko G	Doctor of Technical Sciences	professor	Cherkassy 18003
Eremenko I.A.	Ph.D.	docent	Novocherkassk Rostov region. 346411
Limantseva O.V.	student		Novocherkassk Rostov region. 346411
Malakhov O.S.	Ph.D.	docent	Chelyabinsk Chelyabinsk region 454080
Radionov A.A.,	Doctor of Technical Sciences	professor	Chelyabinsk Chelyabinsk region 454080
Radionova L.V.,	Ph.D.	docent	Chelyabinsk Chelyabinsk region 454080
Mikhailenko V.S.,	Candidate of Legal Sciences	docent	Odessa 65111

Kharchenko R.Y.	graduate student	Art. St.	Odessa 65111
Pogonin A.A.	Doctor of Technical Sciences	professor	Belgorod Belgorod region. 308036
Chetverikov B.S.,	graduate student		Belgorod Belgorod region. 308036
Pogonin D.A.	graduate student		Belgorod Belgorod region. 308036
Dyachenko A.A.	graduate student		Yevpatoriya Crimean region. 97400
Kalenik T.K.,	Doctor of Biological Sciences	professor	Vladivostok Primorsky Krai 690066
Chernysheva V. V.	Ph.D.	docent	Vladivostok Primorsky Krai 690066
Chernysheva I.V	graduate student		Vladivostok Primorsky Krai 690066
Musatkina B.V.	applicant	Art. St.	Omsk Omsk region. 644020
Vanin V.V.,	Doctor of Technical Sciences	professor	Kiev 01014
Gryaznova G.P.	applicant		Kiev 01014
Ezhgurov V.N.,	graduate student		Saint Petersburg 198035
Malcev V.A.	graduate student		Saint Petersburg 198035
Nyrkov A.P	Doctor of Technical Sciences	docent	Saint Petersburg 198035
Sokolov S.S.,	Ph.D.		Saint Petersburg 198035
Kravets A.G.	Doctor of Technical Sciences	professor	Volgograd 400005
Titova O.V.,	applicant		Volgograd 400005
A. V. Demianenko	Ph.D.		Taganrog, Rostov region., 347900
M.V.Orda-Zhigulina	Ph.D.		Taganrog, Rostov region., 347900
Manunina E.V.	student		Volgograd 400087
Parygin D.S.,	applicant		Volgograd 400087
Sadovnikova N.P	Ph.D.	docent	Volgograd 400087
Zhadovsky I.T.	Ph.D.	Art. St.	St. Petersburg 199026
Nikulin A.N	PhD	docent	St. Petersburg 199026
Riabinin D.V.,	student		St. Petersburg 199026
Zaikina E.N.	applicant	Art. St.	Sevastopol 99038
Kozlov L.G.,	Candidate of Legal Sciences	professor	Vinnitsa 21032
Pavluk O.O.,	master		Vinnitsa 21032
Petrov O.V	Ph.D.	docent	Vinnitsa 21032
Pechenkin P.O.,	master		Vinnitsa 21032
Fedotenkov Y.O.	student		Vinnitsa 21032
Lukomskiy Y.O.	graduate student		Donetsk 83001
Molokanova L.V.,	Ph.D.	docent	Donetsk 83001

Kompanets M.A.,	specialist	Art. St.	Vladivostok Primorsky Krai 690011
Kompanets V.A	specialist	Art. St.	Vladivostok Primorsky Krai 690011
Ugai S.M	PhD	docent	Vladivostok Primorsky Krai 690011
Mylnikov V.V.,	Ph.D.	docent	Nizhny Novgorod 603022
Rozhkov I.I	Ph.D.	docent	Nizhny Novgorod 603022
Shetulov D.I.	Doctor of Technical Sciences	professor	Nizhny Novgorod 603022
Tabekina N.A.	graduate student		Belgorod 308012
Denisov M. V	specialist		Volgograd 400005
Akimov D.A.	graduate student		Moscow 107207
Morozova T.Y.,	Doctor of Technical Sciences	professor	Moscow 107207
Sumkin K.S	Ph.D.	docent	Moscow 107207
KOTSUBIVSKA K.I.,	Ph.D.	docent	Vinnitsa 21021
SYVAK I.O.	Doctor of Technical Sciences	professor	Vinnitsa 21021
SYVAK R.I.,	Ph.D.	docent	Vinnitsa 21021
Krylov M.B	student		St. Petersburg 199397
Sovinskiy V.M.	student		St. Petersburg 199397
Korshunova G.F.	Ph.D.	professor	Donetsk 83055
Sabirov O.V	Ph.D.	Art. St.	Donetsk 83055
Adzhieva A.F.	PhD	docent	Stavropol Stavropol region 355000
Kozub Y.G.	Ph.D.	docent	Lugansk 91015
Mironova A.S.,		Art. St.	Sevastopol 90055
Tolmachova Y.S.,	student		Sevastopol 90055
Shumkova A.A.,	student		Sevastopol 90055
Kurzheevskiy I.V		Art. St.	Sevastopol 90055
Tolmachova Y.S.,	student		Sevastopol 90055
Shumkova A.A	student		Sevastopol 90055
Koptiuh L.A.	Doctor of Technical Sciences	professor	Kiev 02156
Osyka V.A.,	Ph.D.	docent	Kiev 02156
Tyricheva E.A.	Ph.D.	docent	Kharkov 61002
Nyrkov A.P.,	Doctor of Technical Sciences	professor	St. Petersburg Kirov 198035
Sokolov S.S.	Ph.D.		St. Petersburg Kirov 198035
Kulneva E.Yu	student		Voronezh 394043
Lvovich I.Ya	Doctor of Technical Sciences	professor	Voronezh 394043
Preobrazhensky A.P.,	Candidate of Physical and Mathematical Sciences	docent	Voronezh 394043
Vaskiv O.M			Lviv Lvivska 79066
Shevchuk I.B.,	PhD		Lviv Lvivska

			79066
Zavistovskaya T.A	student		Moscow 127994
Kovshov E.E.	Doctor of Technical Sciences	professor	Moscow 127994
Batenkina O.V	Ph.D.		Omsk 644050
Ipatov Y.A	Ph.D.	docent	г. Йошкар-Ола Марий Эл 424006
Ipatov Y A	Ph.D.	professor	Yoshkar-Ola Mari El 424006
Vlasov V.A.	Ph.D.	docent	Nizhny Novgorod 603135
Pachurin S.V.,	Doctor of Technical Sciences	professor	Nizhny Novgorod 603135
Chinenkov G.V	Doctor of Technical Sciences	professor	Nizhny Novgorod 603135
Filippov A.A.,	Ph.D.	Art. St.	Nizhny Novgorod 603135
Chinenkov S V	applicant		Nizhny Novgorod 603135
Beskid P.P.,	Doctor of Technical Sciences	professor	St. Petersburg 199155
Chernetsova E.A.,	Ph.D.	docent	St. Petersburg 199155
Shishkin A.D.	Ph.D.	docent	St. Petersburg 199155
Galkin VV	Ph.D.	docent	Nizhny Novgorod 603135
Derbenev AA	graduate student		Nizhny Novgorod 603135
Pachurin G.V	graduate student		Nizhny Novgorod 603135
Pachurin VG	Doctor of Technical Sciences	docent	Nizhny Novgorod 603135
Bal-Prilipko L.V.	Ph.D.	docent	Kiev 03041
Kolotvina S.V	specialist		Kiev 03041
Mashentseva N.G.,	Doctor of Technical Sciences		Kiev 03041
Bobkov A.V.	Doctor of Technical Sciences	docent	Komsomolsk-on-Amur 681003
Bondarenko M.F.,	Doctor of Technical Sciences	professor	Kharkov 61166
Guzh O A	Ph.D.	docent	Kharkov 61166
Litvinova E.I.,	Doctor of Technical Sciences	professor	Kharkov 61166
Lobur M.V	Doctor of Technical Sciences	professor	Kharkov 61166
Hahanov V.I.,	Doctor of Technical Sciences	professor	Kharkov 61166
Chumachenko S.V	Doctor of Technical Sciences	professor	Kharkov 61166
Englezi I.P.,	Ph.D.	docent	Kharkov 61166
Medvedev A. V.	Doctor of Technical Sciences	professor	Krasnoyarsk Krasnoyarsk Territory 660036
Ryzhkova T.N	Doctor of Technical Sciences		Kharkov 61052