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CONTENT[1]

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MODELING METHODIC OF THE OPERATION OF THE CLUTCH OF THREE-LINK MAIN ROAD TRAINS REALIZED ON COMPUTERS

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The formation of the friction moment of the clutch depends on the inclusion, which is associated with road conditions, when starting the road train from a place. When the road train is smoothly moving off, when the rotation speeds of the engine flywheel and the clutch driven part are equalized, $\omega_d = \dot{\varphi}_{сц}$ they are blocked. Moreover, taking into account the equations

$$[I_d+(1+\alpha)I_{сц}]\ddot{\varphi}_d + (1-\alpha)M_d = M_d^k[\dot{\varphi}_d, H(t)] - \alpha M_d(t, \dot{\varphi}_d, \dot{\varphi}_{сц})$$

$$[I_{сц}+(1+\alpha)I_d]\ddot{\varphi}_{сц} + M_d = \alpha M_{сц}(t, \dot{\varphi}_d, \dot{\varphi}_{сц}) + (1-\alpha)M_d^k[\dot{\varphi}_d, H(t)]$$

(α – fuel rail).

Can be reported:

$$(I_d + I_{сц})\dot{\omega}_{d,сц} + c_г\left(\varphi_{сц} - \varphi_г\right) + e_г\left(\dot{\varphi}_{сц} + \dot{\varphi}_г\right) = M_d\left[\omega_d, H\left(t\right)\right], \quad (1)$$

where $c_г$, $e_г$ – respectively, torsional stiffness and damping coefficient of the torsional vibration damper of the clutch, reduced to the input shaft.

If the dynamic moment in the transmission exceeds the static friction moment of the clutch

$$c_г\left(\varphi_{сц} - \varphi_г\right) + e_г\left(\dot{\varphi}_{сц} + \dot{\varphi}_г\right) > M_{сц}^{cm}$$

then the clutch discs are unlocked.

The formation of the friction moment of adhesion depends on the speed of inclusion: fast ($T_{сц} \geq 0,25$ s), normal ($0,25c \leq T_{сц} \leq 1,6$) and slow ($T_{сц} \geq 1,6$ s), which is due to road conditions under which the road train is starting off. Since the greatest interest is the smooth starting of a loaded road train on roads with a low coefficient of adhesion, consider the smooth engagement of the clutch.

Thus, the study found that the main reason for the loss of patency when starting off the road train in worsened road conditions is not only reduced coupling quality, but also a largely oscillatory process of the occurrence and action of torques on the tires of the driving wheels.

Given modeling methodic of the operation of the clutch of three-link main road trains is realized on computers .

ON AN INVERSE PROBLEM FOR A "WEAK" SYSTEM OF PARABOLIC EQUATIONS

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In the paper are being investigated the Tikhonov well-posedness of the inverse problem of determining unknown coefficients in the right-hand sides of a "weak" system of second-order parabolic equations.

The following inverse problem of determining $\left\{ f_k\left(t\right), u_k\left(x,t\right), k=\overline{1,m}\right\}$ from the relations is considered:

$$u_{kt} - u_{xx} = f_k\left(t\right)g_k\left(x,t\right), \quad \left(x,t\right)\in D\times\left(0,T\right]\subset R^{n+1}, \tag{1}$$

$$u_k\left(x,0\right)=\phi_k\left(x\right), x\in\bar{D}=D\cup\partial D, \tag{2}$$

$$u_k\left(x,t\right)\Big|_S=\psi_k\left(x,t,\hat{u}_k\right), \left(x,t\right)\in S=\partial D\times\left[0,T\right], \tag{3}$$

$$\int\limits_D u_k\left(x,t\right)dx = h_k\left(t\right), t\in\left[0,T\right] \tag{4}$$

where $g_k\left(x,t\right), \phi_k\left(x\right), \psi_k\left(x,t,\hat{u}_k\right), h_k\left(t\right), k=\overline{1,m}$, are given functions with a certain smoothness, $\hat{u}_k\left(u_1,...,u_{k-1},u_{k+1},...,u_k\right), T>0.$

For problem (1)-(4) the theorem on the uniqueness and stability of solution is proved. By the method of successive approximations existence of a generalized solution of the problem is proved. For an approximate solution of the problem the finite-difference method is used.

DIGITAL DICTIONARIES IN MODERN LEXICOGRAPHY

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Dictionaries have been compiled for many years and the form and structure of their content have gone through various changes accordingly. Nowadays, when the development of lexicography is interconnected with the technological advancement, printed dictionaries have been replaced by online ones, which makes it possible to search for the words quickly. As a result of modern technology achievements, when the serious work is done to translate the whole texts online, online space of Georgian-foreign languages can provide the dictionaries such as, translate.ge, Glosbe, targmne.com and others, whose translations are inaccurate and irrelevant.

The perfect computer translation ensures overcoming lots of important and yet unsolved details, such as: the right selection of contextual meanings of polysemantic words by computer, dropping out the vowels in the process of conjugation and case, replacing the consonants and other problems. It represents the precondition for not only single word translation, but also translation of the texts. Eradication of these problems leads to the adjustment of language, especially, the rules of Syntax to the computer system.

Technical-linguistic joint works, the main purpose of which represents the adjustment of polysemantic feature of the word and grammar-semantic transformation to the computer, ensures providing translation, the process which is so arduous and demanding, in fast, convenient conditions.

CONVERGENCE OF SEQUENCE OF MULTIDIMENSIONAL BRANCING RANDOM PROCESSES.

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Let $\xi_n(\varepsilon)=\left(\xi_n^1(\varepsilon),\ldots,\xi_n^d(\varepsilon)\right)$, $n=0,1,2,\ldots$ be a sequence of discrete time branching processes with d-types of particles and generating function $F_\varepsilon(s)=\left(F_\varepsilon^1(s),\ldots,F_\varepsilon^d(s)\right)$, where ε-series parameter, $s=(s_1,\dots s_d)$, $F_\varepsilon^j(s)=M_j s_1^{\xi_1^1(\varepsilon)}\cdots s_d^{\xi_1^d(\varepsilon)}$. Here ξ_n^j is interpreted as a number of particles of j-type in -th generation and M_j is conditional expectation on condition that at the beginning there was only one particle of j-th type.

The average number of j-type descendants from one particle of i-type denote by $a_{ij}(\varepsilon)$, i.e.

$$a_{ij}(\varepsilon)=M\left[\xi_1^j(\varepsilon)|\xi_0(\varepsilon)=e_i\right],\ e_i=\left(\underbrace{0,\dots,0}_{i-1},1,\underbrace{0,\dots,0}_{d-i}\right)$$

Denote $A(\varepsilon)=\left\|a_{ij}\right\|_{i,j=1}^d$.

In this work we consider the following cases: matrix $A(\varepsilon)$ is decomposable, $A(\varepsilon)$ convergences as $\varepsilon\to\infty$ to some matrix A and A has diagonal from.

According to the behavior of matrix $A(\varepsilon)$ the limit theorems on the convergence of suitably normalized discrete time branching processes with many type of particles to the one or multidimensional continuous state space branching processes are obtained.

SOLVABILITY OF A BOUNDARY VALUE PROBLEM FOR SECOND ORDER ELLIPTIC DIFFERENTIAL – OPERATOR EQATIONS WITH A SPECTRAL PARAMETER

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In a separable complex Hilbert space H, we consider the following boundary-value problem for the elliptic differential-operator equation of the second order

$$L(\lambda)u:=\lambda^2u(x)-u''(x)+Au(x)=f(x),\ \ x\in(0,1), \tag{1}$$

$$\begin{aligned}&L_1(\lambda)u:=u'(0)+\lambda u(1)=f_1,\\&L_2u:=u(0)=f_2.\end{aligned} \tag{2}$$

Theorem. Let the operator A is strongly positive in the space H .

Then, for

$$f \in L_p\left((0,1);\, H(A)\right)\left(1 < p < +\infty\right),\ \ f_k \in \left(H\left(A^2\right),\, H\right)_{\frac{1}{2}-\frac{k}{4}+\frac{1}{4p},\, p},$$

and for sufficiently large $|\lambda|$ from the angle $|\arg\lambda| \le \varphi < \frac{\pi}{2}$, the problem in Eqs. (1), (2) has a unique solution $u \in W_p^2\left((0,1);H(A),H\right)$ and this solution satisfies the no coercive estimate

$$|\lambda|^2 \|u\|_{L_p((0,1);H)} + \|u''\|_{L_p((0,1);H)} + \|Au\|_{L_p((0,1);H)} \le C\Bigg[|\lambda|\|f\|_{L_p((0,1);H(A))} + \\ + \sum_{k=1}^{2}\left(\|f_k\|_{\left(H\left(A^2\right),H\right)_{\frac{1}{2}-\frac{k}{4}+\frac{1}{4p},p}} + |\lambda|^{2+k-\frac{1}{p}}\|f_k\|_H\right)\Bigg]$$

SOLUTION OF CAUCHY PROBLEM FOR A DISCRETE POWERATIVE DERIVATIVE CUBIC EQUATION

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Let's look at the equation as follows:

$$y_n^{\{III\}} \equiv \left(\left(y_n^{\{I\}}\right)^{\{I\}}\right)^{\{I\}} = f_n, n \ge 0, \qquad (1)$$

here $f_n,\ n \ge 0$ is the given sequence, and y_n is the sequence under investigation.

Therefore, we return to equation (1) and mark it in the following form:

$$\left(y_n^{\{II\}}\right)^{\{I\}} = f_n\ ,\ \mathrm{n} \ge 0 \qquad (2)$$

Here using the definition of a discrete verativ derivative:

$$\sqrt[y_n^{\{II\}}]{y_{n+1}^{\{II\}}} = f_n\ ,\ \mathrm{n} \ge 0\,,$$

or

$$y_{n+1}^{\{II\}} = f_n^{\,y_n^{\{II\}}}\ ,\ \mathrm{n} \ge 0. \qquad (3)$$

Here we give *n* estimates and we take the notation as follows:

$$g_n\left(y_0^{\{II\}}\right) \equiv f_{n-1}^{f_{n-2}^{\cdot^{\cdot^{\cdot f_1^{f_0^{y_0^{\{II\}}}}}}}}, \quad n \ge 1, \tag{4}$$

then(3) will be in the following form:

$$y_n^{\{II\}} = g_n\left(y_0^{\{II\}}\right), \qquad n \ge 1. \tag{5}$$

writing in such a form, using the definition of a discrete powerative derivative, we will get:

$$y_{n+1}^{\{I\}} = g_n^{y_n^{\{I\}}}, \qquad n$$

And now, by analogy with (4), we adopt the following notation:

$$y_n^{\{I\}} = g_{n-1}^{g_{n-1}^{\cdot^{\cdot^{\cdot g_2^{g_1^{y_1^{\{I\}}}}}}}}, \quad n \ge 2. \tag{6}$$

$$h_n\left(y_0^{\{II\}}, y_1^{\{I\}}\right) \equiv g_{n-1}^{g_{n-1}^{\cdot^{\cdot^{\cdot g_2^{g_1^{y_1^{\{I\}}}}}}}}, \quad n \ge 2, \tag{7}$$

Then (6) will be as follows:

$$y_n^{\{I\}} = h_n\left(y_0^{\{II\}}, y_1^{\{I\}}\right), \quad n \ge 2. \tag{8}$$

$$y_n = h_{n-1}^{h_{n-1}^{\cdot^{\cdot^{\cdot h_3^{h_2^{y_2^{\{I\}}}}}}}}, \tag{9}$$

Cauchy problem:

Suppose that for equation (1)

$$y_k = \alpha_k, \ k=\overline{0,2}, \tag{10}$$

The initial conditions are given.

As we said above, using the data (10), we can define arbitrary constants that participate in the general solution:

$$y_2 = \alpha_2, \tag{11}$$

$$y_1^{\{I\}} = \sqrt[y_1]{y_2} = \sqrt[\alpha_1]{\alpha_2}, \tag{12}$$

$$y_0^{\{II\}} = \left(y_0^{\{I\}}\right)^{\{I\}} = \sqrt[y_0^{\{I\}}]{y_1^{\{I\}}} = \sqrt[y_0^{\{I\}}\sqrt{y_1^{\{I\}}}]{y_1^{\{I\}}\sqrt{y_2^{\{I\}}}} = \sqrt[y_1^{y_0^{-1}}]{y_2^{y_1^{-1}}} = \left(y_2^{y_1^{-1}}\right)^{y_1^{y_0^{-1}}} =$$

$$y_2^{y_1^{-1} \cdot y_1^{y_0^{-1}}} = y_2^{y_1^{-1-y_0^{-1}}} =$$

$$= y_2^{y_1^{-\left(1+y_0^{-1}\right)}} = \alpha_2^{\alpha_1^{-\left(1+\alpha_0^{-1}\right)}}. \tag{13}$$

Thus, we get the following judgment.

Theorem: If α_k, k=$\overline{0,2}$- are positive real numbers, then there is only one solution to the Cauchy problem (1), (12) and this solution is in (4), (7) and (9) should be taken into account in accordance with (10) - (13).

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THE ADJOINT PROBLEM TO A BOUNDARY VALUE PROBLEM WITH AN ADDITIVE DISCRETE DERIVATIVE

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Consider the following problem

$$ly_n \equiv y_n(1)+ay_n=fn\ , \quad 0 \le n < N, \qquad (1)$$

$$y_N+\alpha\, y_0=0\ , \qquad (2)$$

where a and α are known constant numbers, fn is a given sequence, y_n is a desired sequence, and $y_n^{(1)}=y_{n+1}$ - is a discrete additive derivative.

By multiplying the left-hand side of the equation (1) by $\tilde{l}z_n \equiv z_n^{(1)}+bz_n$ and taking into account the quantities $(y_nz_n)^{(1)}= y_n^{(1)}\ z_n^{(1)}+ y_n^{(1)}\ z_n+ y_n\ z_n^{(1)}$, we obtain the following relation for the adjoint equation

$$l^*z_n=(a-1)\ z_n(1)+ \alpha z_n, \qquad 0 \le n < N, \qquad (3)$$

Using the analogue of the Lagrange formula for the boundary condition of the adjoint problem, we get

$$\alpha z_n + z_0 = 0 \qquad (4)$$

If a = 2, then equation (1) and the adjoint equation (3) coincides, i.e. equations (1) is self-adjoint. In the case of $\alpha = 1$, the boundary condition (2) and the boundary condition of the adjoint problem (4) coincide.

Theorem. If a = 2 and $\alpha = 1$, then the boundary-value problem (1) - (2) with discrete additive derivatives is self-adjoint.

Some different discrete problems were considered in [1].

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ON THE MATHEMATICAL EXPECTATION OF THE REINSURANCE SURPLUS PROCESS WITH DEPENDENT COMPONENTS

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Reinsurance is one of the major risk and capital management tools available to primary insurance companies. Reinsurance is insurance for insurers. Insurers buy reinsurance for risks they cannot or do not wish to retain fully themselves. We call the insurer’s surplus process as reinsurance surplus process when the insurer effects reinsurance.

Basically, there are some types of reinsurance contracts: proportional reinsurance, excess of loss reinsurance and excess stop loss reinsurance. If the insurer effects reinsurance, then the amount of claim paid by insurer is given by a function h in each type of reinsurance, so, if the amount of claim is x, then the insurer pays the amount of $h(x)$: $0 \le h(x) \le x$ (see, for example, [1-4]).

We consider reinsurance surplus process with dependent components and obtain distribution function of claims, formulas for moments of claims and joint moment of interarrival times and claims. Using these formulas we derive asymptotic for the mathematical expectation of this process.

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THE IMPACT OF PSYCHOLOGY ON THE DECISION-MAKING PROCESS IN AESTHETIC CREATIVITY

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The present scientific paper outlines the relationships between aesthetics, ethics, and new media art by discussing the process, influences and consequences of aesthetic judgments - the ability to make considered decisions or come to sensible results and conclusions. This work proposes that the aesthetic judgments of artworks created in any medium, including new media; function as mechanisms for propagating certain ethical values. According to Georgian Philosopher Irma Bagrationi's work "Konstantine Kapaneli's Philosophical and Aesthetical Conceptions" Aesthetics is generally defined as "the philosophical study of beauty and taste" [1]. As we know, when an art work is examined according to its mechanism, we pursue an understanding of what it is. And when an artwork is examined according to its function, we pursue an understanding of what it does. This article will outline a perspective for distinguishing the function from the mechanism of artworks created in any medium, including those created with new media technologies. Using this perspective, the scientific theory will explore the relationships between aesthetics, ethics, and new media art by discussing how people decide that particular artworks are good, the influences of their aesthetic judgments, and the consequences of their judgments [4].

The paper discusses, that a primary goal in the field of aesthetics is to investigate aesthetic judgments, the decisions people make when they decide “What is art?” and “What is good art?” Although some writings on aesthetics are prescriptive in their approach, this viewpoint will not provide a precise definition of good art, nor will it advise readers to use specific criteria for judging art. Instead, it will discuss how people make aesthetic judgments. The Institutional Theory of Art, set forth by George Dickie in 1974, proposed that “works of art are art as the result of the position or place they occupy within an established practice, the art world” [3] According to this theory, the established network of curators, galleries, and museums that sell and exhibit professional artworks are responsible for determining what is art and what is not. The classification used within this conception is derived from Georg Dickie’s aesthetic theory: a work will be designated as an artwork according to its capacity to promote the art world, providing it with more prestige, power, or whatever the art world considers valuable.

Using this classification, the specific aesthetic features within a work, its medium, and its style are less indicative of a work being art than its capacity to promote something within the art world. A primary problem that results from using a specific aesthetic criterion for judging the quality of an artwork is the evaluation of the criterion itself. If beauty is selected as a primary aesthetic criterion, the evaluation of an artwork’s quality is determined by the definition of beauty. The primary aesthetic question “What is good art?” becomes dependent on the question “What is beauty?” The subjectivity of defining good art is replaced with the subjectivity of defining beauty. In this research, the subjectivity of aesthetic judgments is acknowledged by replacing the primary questions of aesthetics with the following: "What are the criteria for something to be art?" and "What are the criteria for something to be good art as aesthetic and artistic creativity?" [2] An artwork is comprised of a collection of characteristics called aesthetic features that can influence a person’s liking or disliking of an artwork, its aesthetic value. The loudness of sound, particular sound editing software or a work’s production costs can all be aesthetic features within a sound installation. A broad definition of aesthetic features is used to support the perspective that a compositional element is any characteristic of an artwork that can influence aesthetic judgments, including characteristics that some writers consider to be context or extrinsic features. The specific qualities that a person associates with good artworks are determined by a person’s aesthetic perspective, an idiosyncratic collection of criteria that defines which aesthetic features must be present for artworks to be judged as good. The judgment of an artwork is dependent on its aesthetic features and the aesthetic perspective used by a person for judging it. Using this model, disagreements on the aesthetic value of a work are viewed as the consequences of people using different aesthetic or artistic perspectives [2].

The paper concludes that aesthetic judgments of art function as mechanisms for promoting specific conceptual, personal and social entities. An entity can be an abstract concept, an ethical value, a specific person, or an organized social institution with cultural or political responsibilities. The aesthetic criteria used by people for judging artworks - rather than artworks' aesthetic features - determine which entities are promoted through aesthetic judgments. Some people, however, may be unaware of which entities are being promoted through their judgments because of a lack of knowledge or awareness, or because media subterfuges are being used. Our work has avoided stating which specific entities are being promoted through aesthetic judgments because the intention is to provide a perspective that enables readers to determine these relationships for themselves. By understanding the ethical consequences of compositional decisions and aesthetic judgments, artists and audiences can have increased responsibility for the propagation of ethical values, the concepts that dictate which behaviors we deem appropriate and which we do not. Without this awareness, a person might promote any value whatsoever through aesthetic judgments. Having an awareness of the influences and consequences of aesthetic judgments is desirable because it enables a person to promote specific values with intention.

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DECISION-MAKING ON COVID-19 OVERCOME UNDER HIGH UNCERTAINTY AND HIGH RISK

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The COVID-19 pandemic has reached about 200 countries and poses greate threats to humanity. Over time new data on the SARS-CoV-2 coronavirus, analytical materials and statistics regarding risk factors, the course and potential consequences of a pandemic (medical, social, economic, etc.) become available. But the information need to predict the consequences of strategic and operational decisions remains incomplete and inaccurate. In particular, estimates of case number show that it can significantly exceed official statistics due to incomplete registration of cases. According to [1] for Ukraine corresponding multiplier as of 02.04.2020 was 24, for USA – 21, for Italy – 19, for Iceland (country with massive testing of asymptomatic people) – 4.5. Estimates of mortality rate for ill persons vary from <0.1% to 4-5%.

Different countries use different strategies aimed on COVID-19 overcome. But now there is no evidence of the benefits of any of the major strategies in terms of reducing the overall mortality rate. There are some reasons to believe that strategies aimed at protecting risk groups and permitting limited economic activity may have less destructive social and economic consequences than strong restrictions and lockdown strategies. But the economic and social component of strategies, as well as the ability of governments to support citizens and businesses, can make more impact in this respect. Some detailed data are presented in [2, 3]

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COMPUTERIZED LEARNING PROCESSES AND OPTIMIZATION OPPORTUNITIES

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The report addresses the issues of improving the quality of educational processes through the introduction of modern computer-aided learning technologies. The dependence of national income on the intellectual potential of the nation is expected to increase significantly in the near future. Modern processes of global computerization and optimization of various systems and processes are already effectively implemented in the processes of classroom, distance, correspondence and various forms of individually oriented integrated learning. Methods of optimal control based on the construction of adequate mathematical models already permeate almost all directions of development of world sciences, including science pedagogical in preparing a person for life in the globally computerized world. The latest information technology to enhance learning quality is created as a tool to learn how to acquire new knowledge by performing computational experiments first with simpler numerical cause and effect models and increasingly complex stationary and dynamic systems. Modern e-learning systems provide access to free access to new knowledge from the world's leading universities on the Internet. All you have to do is create your account at www.edx.org and enroll in the preferred courses of any partner university for the courses. Similar possibilities are provided for mastering the latest mathematical-computer methods for solving complex problems of mathematical modeling and optimization in various fields of science and technology, different methods and universal open source software WolframAlpha, Python Octava, SciLab, R-Studio, etc. The Wolfram Notebook (WolframAlpha) allows you to enter data in an arbitrary form and to receive instant replies, the results of all calculations are stored in a notebook in an active state, providing truly unlimited possibilities to perform computational experiments in search of new knowledge - the optimization of the educational process is carried out on the basis of the introduction of experimental search for the acquisition of new knowledge instead of their drilling.

OPTIMAL CONTROL APPROXIMATION OF PROCESSES WITH DISTRIBUTED PARAMETERS

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Optimal controls of distributed parameter processes are usually associated with finding admissible controls $u \in U$ that maximize a given functional $F(x(u))$ on trajectories $x(u)$ of a controlled partial differential equation system

$$F_{\Omega}\left(x(s,t), \frac{\partial x(s,t)}{\partial n}, \frac{\partial x(s,t)}{\partial s}, \frac{\partial^2 x(s,t)}{\partial t^2}, ..., t, u(s,t) \right) = 0, s \in \Omega, t \in [0,T],$$

$$F_{\Gamma}\left(x(s,t), \frac{\partial x(s,t)}{\partial n}, \frac{\partial x(s,t)}{\partial s}, \frac{\partial^2 x(s,t)}{\partial t^2}, ..., t, u(s,t) \right) = 0, s \in \Gamma, t \in [0,T],$$

for which there is no such time-dependent control function $u^* \in U$ that satisfy the inequality $F(x^*) \geq F(x(u))$ for all admissable $u \in U$. The report examines cases where there is no optimal control, but for any $\varepsilon > 0$, there is an admissible control $u_\varepsilon \in U$ and the corresponding trajectories $\Phi(u_\varepsilon)$ that satisfy the inequality

$$F(x(u_\varepsilon)) \geq \sup_u F(x(u)) - \varepsilon .$$

Methods of practical construction of such approximate solutions are considered. Possibilities of practical construction of approximate solutions $(x_\varepsilon, u_\varepsilon)$ are considered, as well as construction of such a trajectory $\bar{x}$, in conditions where there is no optimal control, which satisfies equality

$$F(\bar{x}) = \sup_{u \in U} F(x(u)).$$

Numerical algorithms for constructing such approximate solutions of the problem of control processes with distributed parameters optimization are constructed either by linearization methods, by which the system of partial differential equations is approximated by a controlled system of ordinary differential equations, or by discrete approximations of all derivatives in order to came to approximate the optimization problems in finite-dimensional Euclidean spaces.

SAFETY OF INFORMATIONAL INTERACTION

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Providing safety of informational interaction via local and individual computer open networks, namely via Internet is possible with effective solving of the following tasks:

– securing connection of operating computers and local networks which are connected to open channels from outside unauthorized action;

– securing information during transferring process via open channels.

In general, firewalls are used to secure local networks and computers from outside unauthorized actions, it helps securing informational interaction by means of bilateral filtration of messeages, as well as by functioning as mediartor while exchanging information. Firewalls are placed between local and open networks. Securing information during transferring through open networks is based on using virtually secured VPN networks.

VPN tunnel is a connection in an open network, through which a cryptographically secured informational packages of virtual network messages are being transferred. Securing information while transferring through VPN tunnel is based on fulfillment of the following functions:

– authentication of interacting sides;

– cryptographic closing (encoding) of the data which is transferred;

– checking the validity and safety of the transferred information;

These functions are characterized with interconnection. Cryptographic methods of information securing is used while their fulfillment. VPN tunnels which are formed with VPN equipment, has the features of secured separated line. At the same time, this secured separated line is spread within the frames of common connection network

In the given work we paid our attention to all these issues.

THE ASYMPTOTIC OF THE PROBABILITY OF BANKRUPTCY IN CASE OF "HEAVY TAILS" AND EXISTING INTEREST RATES ON RESERVE CAPITAL

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The asymptotic behavior of probability of bankruptcy in case of "heavy tails" is considered, in particular, in [1], [2] the asymptotics of probability of bankruptcy for Pareto, Weibull, Benktander type I and II distributions are shown in that paper. However, these results don't work if there is an interest rate on the reserve capital.

The risk process in the case of the classic Kramer-Lundberg model, where in addition to insurance fee, the insurance company receives interest rate on reserve capital $\delta > 0$ defined as

$$U_\delta(t) = ue^{\delta t} + c\int_0^t e^{\delta v} dv - \int_0^t e^{\delta(t-v)} dS(v), t \geq 0,$$

where $S(t) = \sum_{n=1}^{N(t)} X_n$, the intensity of insurance fee $c > 0$, u – initial capital. [3]

Kluppelberg and Stadmuller considered such a model in [4]. We have found the probability of bankruptcy for payments having Pareto and Benktander distributions.

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NUMERICAL METHOD FOR THE SOLUTION OF THE CAUCHY PROBLEM OF NONLINEAR PARABOLIC EQUATION IN A CLASS OF DISCONTINUOUS FUNCTIONS

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In this study two finite differences schema for obtaining a numerical solution of the Cauchy problem for the equation

$$u_t\left(x,t\right)=Au^{\alpha}{}_{xx}\left(x,t\right)+Bu^{\beta}\left(x,t\right)\# \tag{1}$$

$$u\left(x,t\right)=u_0\left(x\right) \tag{2}$$

are investigated. Here, A and B are given constants and $u_0\left(x\right)$ is a known function.

In order to calculate the numerical solution we introduce the following as called an following auxiliary problem having some advantages over main problem

$$\frac{\partial v\left(x,t\right)}{\partial t}=A\frac{\partial}{\partial x}\left[\left(\frac{\partial v\left(x,t\right)}{\partial t}\right)^{\alpha}\right]+B\int_{-\infty}^{x}\left(\frac{\partial v\left(\xi,t\right)}{\partial t}\right)^{\beta}d\xi\,, \tag{3}$$

$$v\left(x,0\right)=v_0\left(x\right) \tag{4}$$

is proposed. Here, $v_0\left(x\right)$ is any continuously differentiable function of the $\frac{dv_0}{dx}=u_0\left(x\right)$ equation. In this case $u\left(x,t\right)=\frac{\partial v\left(x,t\right)}{\partial x}$ is proved.

Sometimes happen conveniently lead out the second type auxiliary problem defined as follows

$$\frac{\partial w\left(x,t\right)}{\partial t}=A\frac{\partial^2 w\left(x.t\right)}{\partial x^2}+B\int_{-\infty}^{x}{}_{,}\left(x-\xi\right)u^{\beta}\left(\xi\ t\right)d\xi\,, \tag{5}$$

$$w\left(x,0\right)=w_0\left(x\right). \tag{6}$$

In this case $w_0\left(x\right)$ is any continuously differentiable function of the equation $\frac{d^2v_0\left(x\right)}{dx^2}=u_0\left(x\right)$.

The relation is valid $u\left(x,t\right)=\dfrac{\partial^2 w\left(x.t\right)}{\partial x^2}$. Using those advantages high sensitive algorithms have been proposed.

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APPROXIMATION OF THE CONTROL PROBLEM IN THE MARKOV ENVIRONMENT

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In the series scheme the transfer process *y(t)* is determined by stochastic differential equation

$dy^{\varepsilon}(t)=a(y^{\varepsilon}(t),x(t/\varepsilon),u^{\varepsilon}(t))dt+\sigma(y^{\varepsilon}(t),x(t/\varepsilon),u^{\varepsilon}(t))dw(t),$ (1) where $x(t),t\geq 0,$ **-** uniform ergodic Markov process in the measurable phase space $(X,\boldsymbol{X})$ with stationary distribution $\pi(B),B\in\boldsymbol{X}$ [1].

The control $u^{\varepsilon}(t)$ is evaluated by the quality criterion $G(y,x,u)$, $y\in R^d$, $u\in R^d$, that has a single maximum point for each state x of process *x(t)* and of process *y(t)* [2].

Then, we get sufficient conditions for convergence by distribution

$$(y^{\varepsilon}(t),u^{\varepsilon}(t))\xrightarrow[\varepsilon\to 0]{}(\hat{y}(t),\hat{u}(t)),$$

The limit control problem $(\hat{y}(t),\hat{u}(t))$ is defined by the system:

$$d\hat{y}(t)=a(\hat{y}(t),\hat{u}(t))dt+\sigma(\hat{y}(t),\hat{u}(t))dw(t),$$

$$d\hat{u}(t)=\alpha(\psi)\nabla_{\beta(t)}G(\hat{y}(t),\hat{u}(t))dt,$$

where $a(y,u)=\int\limits_X \pi(dx)a(y,x,u),\ \sigma^2(y,u)=\int\limits_X \sigma^2(y,x,u)\pi(dx),$

$$\nabla_{\beta(t)}G(y,u)=\int\limits_X \pi(dx)\nabla_{\beta(t)}G(y,x,u),$$

$$\nabla_{\beta(t)}G(y,x,u)=\left\{(G(y,x,u_i^+)-G(y,x,u_i^-))/(2\beta(t)),i=\overline{1,d},\right\},$$

$$u^{\pm} = u \pm \beta(t)e_i, e_i = (0,0,\ldots,1,0,\ldots).$$

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REALIZATION OF THE WORKING MODEL OF DECISION-MAKING SELECTION OF THE SPECIALTY THROUGH THE PETRI NETWORK

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To build the model, we use the first level subclass of standard Peter's network classification - Fig. 1. [1].

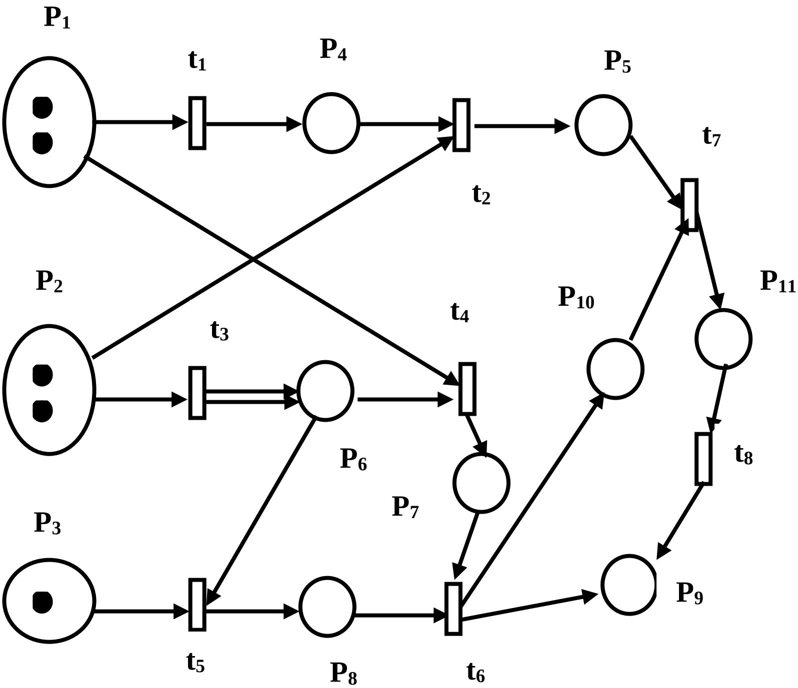

Fig.1 Petry Network

The figure shows the following indicators - $P_j, \ j=\overline{1,\ 11}$ - and positions $t_i, i=\overline{1,\ 8}$.

The types of indicators are: P_1 - a group of professors-professors of the faculty (department); P_2 - system administrator; P_3 - students; P_4 - database of decision-making tests; P_5 - database of control tests; P_6 - Database of Student Specialty, Thoughts and Desires; P_7 - table of views; P_8 - table of completed wishes; P_9 - database of decisions made by students by specialty; P_{10} - database of unacceptable students; P_{10} - Recommendations for students.

Positions (transitions are as follows: t_1 - preparation of tests; t_2 - monitoring of tests by the administrator; t_3 - formation and updating of databases by the administrator; t_4 - formation of a table of views; t_5 - formation of a wish table; t_6 - formation of a decision table; t_7 - tests Work and table of recommendations; t_8 - Student's final decision

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MODEL OF DECISION MAKING OF THE SPECIALTY SELECTION

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The essence of the problem is that after completing the general course of the student-bachelor's educational program, the decision to choose a specialty to continue the study in the next course is made.

The environment of the decision-making design system is the higher education system. The design stages of a decision-making support system are: the formation of an operational concept; Defining the functional architecture of the system; Formation of a system dynamics model; Build a working model of the system.

The operational concept, or mission, determines the capabilities and tasks of the system.

The functional architecture of the system includes its functional decomposition; Process Model - Fig. 1. Build with the IDEF (Integrated computer aided manufaqturing DEFinition) tool; Build a process model DFD (Data Flow Diagram) or a data flow diagram.

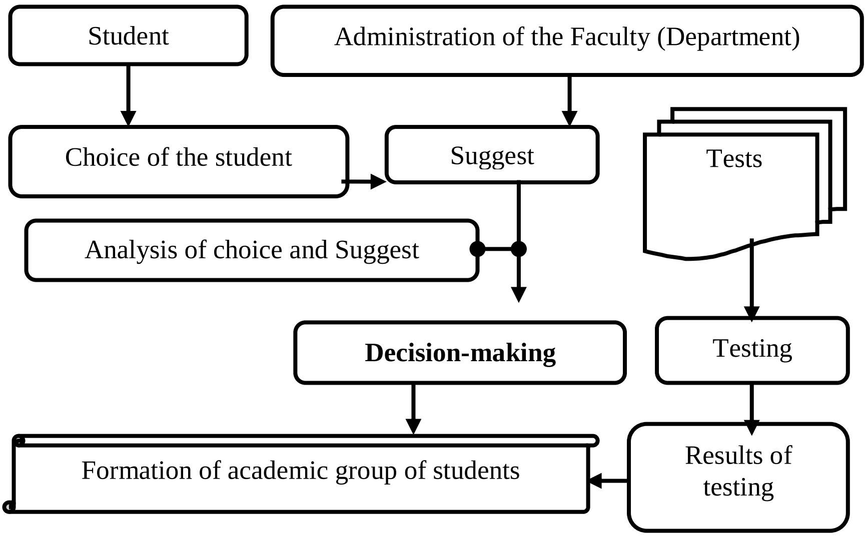

Fig. 1. Process model

The system dynamics model is the first step in building a working model, the general state of which is as follows - Fig. 2.

Fig. 2. Chart of the general state

The state diagram of the transition has the only initial state, and the number of final states is not limited. Two conditions must be met for the final state: 1. The final states must not be interdependent; 2. The final positions will not have output arcs.

The structural scheme of the system dynamics model has the following form - Fig. 3.

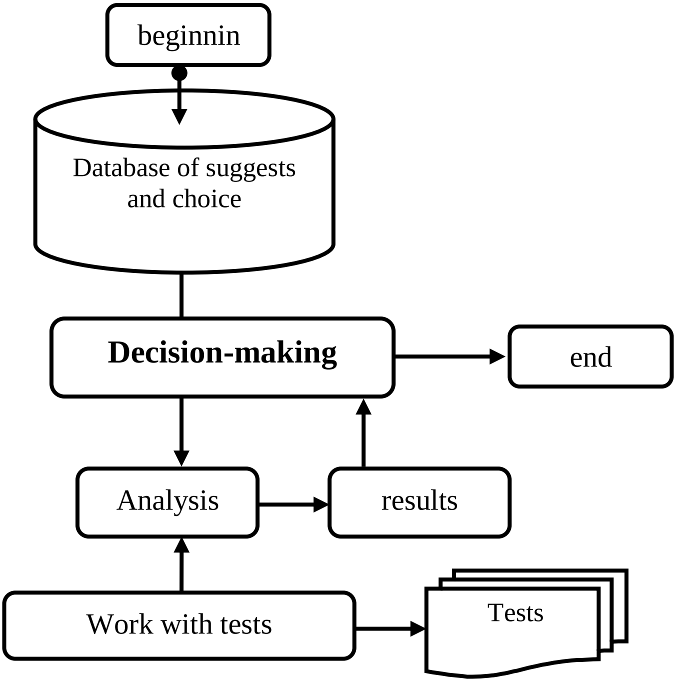

Fig. 3. Structure of the Dynamics Model

NUMERICAL METHODS FOR THE CAUCHY PROBLEM WITH HYPERSINGULAR INTEGRAL ON THE RIGHT SIDE

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Approaches to the creation of quadrature-difference schemes for the numerical solution of Cauchy problems are presented. Equations with singularities on the right side are considered.

$$\begin{cases} z = \omega_V(t) \in L_v(t), \quad t > t_0 : \\ \dfrac{d\bar{\omega}_v(t)}{dt} = \dfrac{1}{2\pi i} \displaystyle\int_{L_v} \dfrac{f(\omega,t)d\omega}{(\omega_v - \omega)^n}, \\ n = 2m+1, m = 1,2,3,\dots \\ \omega_v(t_0) = \omega_{v0} \in L_v(t_0) \end{cases}$$

The function $f = f(\omega)$ have to satisfies the condition

$$\left| f(\omega_1) - f(\omega_2) \right| \le A \left| \omega_1 - \omega_2 \right|^{\lambda}, \ \lambda = \mu + n - 1, \ \ 0 \le \mu \le 1, n = 1,2,3,...$$

It is shown that for approximation and stability of computational schemes, it is important to correctly (in the sense of Koshi-Hadamard) calculate the final value of the discretized integral on the right side of the equation.

The evidence presented in the report makes it possible to use the discrete singularity method (DSM-method for solving singular / hypersingular integral equations [1,2]) for constructing universal computing technologies, the computer implementation of which provides simulation of dynamic processes in real time. It will demonstrated advantages and limitations of using DSM for evolution problems.

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INSURANCE RATE IN CASE OF LARGE PAYMENTS

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In this article we addressed the task of an insurance rate determination in case of factorization model [[1], .248]. The formula for optimal insurance rate has been defined as well. For payments with heavy tails, in particular with Weibull distribution with a parameter $0<\gamma$, γ and the distribution function:

$$F(x) = 1 - \exp(-c_1 x^{\gamma}), c_1 > 0, x > 0$$

Then with these assumptions, for z_0 - optimal insurance rate the following correlation is fair:

$$z_0 \sim \frac{1}{c_1^{1/\gamma}} \cdot \Gamma\left[1+\frac{1}{\gamma}\right] + \frac{\sqrt{\left(\frac{1}{c_1^{1/\gamma}}\right)^2 \cdot \left(\Gamma\left[1+\frac{2}{\gamma}\right] - \left\{\Gamma\left[1+\frac{1}{\gamma}\right]\right\}^2\right)} \left[1+V^2\right]^{1/2} \Psi(Q)}{\left[N - V^2 \Psi^2(Q)\right]^{1/2}}$$

[see [2]], where $0 < Q < 1$ - predefined number, N - amount of insurance contracts, V- variation coefficient of insurance amount for appropriate contract, $\Psi(x)$ - an inverse function to standard normal distribution function.

Also, we considered an asymptotic of insurance rate in case of the payments with Lognormal and Pareto distributions.

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ABOUT REGULARIZED ADAPTIVE EXTRA-PROXIMAL ALGORITHM FOR EQUILIBRIUM PROBLEMS IN HADAMARD SPACES

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One of the intensively developing areas of modern applied nonlinear analysis is the study of equilibrium problems, also known as Ky Fan inequalities, equilibrium programming problems [1]. In the form of an equilibrium problem, one can formulate variational inequalities, mathematical programming problems, and many game theory problems (search of Nash equilibrium). Recently, interest has arisen due to the problems of mathematical biology and machine learning to construct the theory and algorithms for solving mathematical programming problems in Hadamard metric spaces.

In this report, we consider equilibrium problems in Hadamard metric spaces. For an approximate solution of problems, a new iterative regularized adaptive extra-proximal algorithm is proposed and studied. In contrast to the previously used rules for choosing the step size, the proposed algorithm does not calculate bifunction values at additional points and does not require knowledge of information on of bifunction's Lipschitz constants. For regularization of basic extra-proximal scheme, the classic Halpern scheme is used.

For pseudo-monotone bifunctions of Lipschitz type, the theorem on convergence of sequences generated by the algorithm is proved. The proof is based on the use of the Fejer property of the extra-proximal algorithm with respect to the set of solutions of problem and known results on the convergence of the Halpern scheme.

It is shown that the proposed algorithm is applicable to pseudo-monotone variational inequalities in Hilbert spaces and to the problem of training GANs [2].

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INTERACTIVE MULTIMEDIA TOOLS

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At present, we can say that the use of computer technology provides tremendous opportunities for the development of the educational process, which is based on the formation of an educational information environment, including the sources of computer information, electronic libraries, video and audio databases, electronic manuals, video conferencing and other electronic educational applications.

Unlike conventional technical means of education, information and communication technologies not only provide pupils / students with a large number of well-prepared, strictly selected and sorted knowledge, but also contribute to the development of the student's intellectual, creative talents.

Studying any subject with the use of interactive multimedia technologies offers a student to think and actually participate in the creation of lecture elements, what helps to arouse his interest in the studied subject.

During a multimedia lecture course, if a student does not record key points, does not identify and record key information himself, he will easily forget it. The most important thing during a multimedia lecture is not only to watch the slide presentation and to listen to the texts accompanying it, but also to be always in interactive mode with a training system. By this we mean that with the aim of deeply understanding the material under study:

- The teacher should highlight key points, and students should write them down themselves;
- The student should not only view multimedia material, but constantly be in an interactive mode with the training system;
- The student must constantly train on electronic simulators, pass tests, and acquire the necessary skills.

The above mentioned issues are the focus of the present article.

ACADEMIC MOBILITY OF STUDENTS

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We would like to pay attention to the determining factor of studying process and students' mobility – introduction of European system of credits transferring and gaining, as well as practical realization and further development problems.

Due to the importance of students' mobility, its specific features and due problems, it is necessary to work out a theoretical part of optimal solution of students' mobility, to build models related to academic mobility decision, which adequately determines the following:

- Peripeteias and perspectives of entire educational space creation;
- Its positive results and negative outcomes;
- Scientific researches and practical ways necessary for positive results generalization and expansion and eradication of negative outcomes.

In order to create main tools for effective management of students' mobility it is necessary to suggest a new tool for mobility effectiveness evaluation and conclusion making, which is implied in a modern IT sphere. Working out of conception of effective management of students' mobility, first of all, needs specific capacity of intellectual potential, i.e. human resources of an educational institution. Intellectual potential can determine mobility success, which is equal to qualification level of a teaching staff.

For this purpose, in this work, we pay attention to the study and analysis of management of students' academic mobility, the aim of management of students' academic mobility as a modernization of educational process in order to increase its quality and effectiveness, and the management of students' academic mobility as an opportunity to individually shape the educational path within the framework of educational standards in order to determine the quantitative and qualitative indicators of management of students' academic mobility, as well as on forming an optimal management of students' academic mobility.

THE PROCESS OF LEARNING IN ARTIFICIAL NEURAL NETWORKS

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According to its organization and functional purpose, the artificial neural network performs a certain conversion, with several inputs and outputs, to control the output signals of the input stimuli. The number of transformed stimuli equals to *n* number of network inputs, and the number of output signals corresponds to the *m* number of outputs. *n* combination of all possible input vectors of the dimension creates the vector space **X**, the output vectors also create a space marked by a **Y** symbol.

For any given value of the neuronal synaptic weighting coefficients of the network, the function realized by the network is also any. In order to get the required function, a specific weight selection is required. The ordered set of all the weight coefficients of all the neurons can be represented as a *W* vector. The variety of such vectors creates a vector space, called the state space, and is denoted by the ***W*** symbol.

The state in which the network performs its function is called the W * state of the network. The task of teaching is equivalent to constructing the process of transitioning from a formal to a W0 state to an adult state.

It is important to emphasize the distinction between the two types of knowledge - on the one hand, there is the unknowable ”knowledge” that the artificial neural network has memorized, and on the other, the formal ”knowledge” embedded in expert systems.

The difference in the nature of the expert and neuro-cellular systems also makes a difference in their areas of practice.

Expert systems are used in narrow subject areas with well-structured knowledge, and neural networks, in addition to such areas, are used in tasks with less structured information.

Specifically these issues are highlighted in this paper.

EMPLOYMENT PROBLEMS AMONG YOUNG SPECIALIST IN THE REGION

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One of the main tasks of regional management is to train young specialist and create a competitive environment for them in the labor market. This will allow young people to maximize their intellectual abilities. Young specialists, who have completed the full course of higher education, are most striving to build their own careers in the field of acquired knowledge. Therefore, the creation of conditions to protect their interests and promote employment in the labor market is of great importance for economic, demographic, social or political progress in the region and throughout the country, as well as for improvement of the socio-economic environment.

Although our region suffers from a shortage of specialists, most graduates remain unemployed, what definitely affects their lives. The fact that it is difficult for young specialists to enter the labor market and establish their place there, negatively influences their integration into society and the process of applying their knowledge in practice. The non-involvement of young specialists in the development of civil society and their isolation from the labor market should not be regarded as a one-time and temporary event. This process is taking place gradually and in the future will increase the shortage of specialists in the Georgian labor market; at the same time it will facilitate their outflow to other countries or the beginning of unprofessional activity.

Organizations, announcing a competition for the adoption of new personnel, also impose certain requirements that must be met by a competitor. One of the most important requirements that creates a serious obstacle for young graduates is the experience in the relevant field of activity. The practical implementation of these measures will significantly improve the quality of competitiveness of young professionals in the region, which will lead to a reduction of unemployment among youth and increase their civic integration.

The present article deals with all the above mentioned issues.

THE ROLE OF ELECTRONIC MEDIA IN ENGLISH LANGUAGE TEACHING

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The paper deals with the specifics of the use of electronic media and its impact on the English language teaching/learning process. The significance of knowing English has become really immense in the modern world. Educators try hard to think of efficient strategies and techniques to make teaching process productive and up-to-date. Electronic media has become an integral part of our daily life - TV, cinema, Internet, radio made make a great difference. Moreover, the whole political, economic, scientific and sport life is performed in English. English, as an International language, is widely used in technologically mediated contexts. Major parts of the internet pages, computer programs and apps are created and operated in English. In recent years, implementing electronic media into classrooms has become increasingly important which made teaching / learning process more exciting, colourful and emotional experience. Incorporating different types of media: Internet, TV, Radio, Cinema for educational purposes presents us with the new opportunities for authentic texts and materials.

The Internet offers excellent opportunities for collaboration and communication between learners regardless of gender, age, race, language, geographical location and disability. And the communication

is frequently held by games. Games are an increasing part of overall media landscape comprising many genres and subgenres. Visiting cinemas, watching films in a foreign language is a great source of getting acquainted with different cultures, values, civilization, norms of life. Moreover, films deliver moral lessons and have the power to inspire. Through watching films learners improve pronunciation, intonation and enrich vocabulary of the target language in an enjoyable way.

Incorporating the abovementioned media tools in the teaching process in our reality sparks learners' interests and fosters their active engagement which makes learning / teaching process more enjoyable and productive experience.

MARITIME CARGO SHIPPING

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Maritime shipping represents one of the main means of cargo and humans transportation since ancient times, which withstood the test of time and was given to the society through heritage. This traditional and ancient means is still relevant, and it still has got the the functions it has been performing for centuries.

It's obvious that maritime transportation is much cheaper in comparison to other transportation means and meanwhile it can ship the cargo from one continent to another, and besides has capability to ship a huge volume of cargo in one way, which is impossible for any other type of transport.

Maritime transportation accounts for 62% of the world's total turnover, 90% of this is international shipping. Maritime transport has no problem with performing transcontinental shipping.

Currently, maritime transport accounts for about 80% of the world's foreign trade.

The advanteges of maritime transport taviation, pipelines, railways and road transport are clearly evident from the following qualitative data:

- low cost of shipping;
- Using the latest technology advances;
- High freight-carrying capacity;

- High capacity of the vessel;
- Very high quality of cargo security;
- Freight between continents

Despite of above mentioned disadvantages, despite its significant qualitative features, can not overpass it's huge advantages. Consequently, the use of maritime transport, especially cargo shipping, maintains applicability. Therefore, scientific research around the topic is constantly under way, with the main aim of improving or significantly reducing these defective areas. One example of these studies is the present work.

TWO-DIMENTIONAL SECRETARY PROBLEM

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The best choice problem in no-return situation (also known as secretary problem or choosy bride problem) was considered in [1],[2] and was stated as follows. Let One consider random permutation of n objects and tried to guess which one is the best. So, if one looks at k-th object and this object is the best out of all considered before (such objects are called maximal), then it has alternative whether to stop at maximal object or to reject it and to try to find better one out of the rest elements (to pass it in other words). But there is no way to return to previously passed objects. In [1] this problem is solved as case in point of Markov chain optimal stop. It was shown, that the decision, whether to stop or to pass may be made only in maximal point, $f(k)=k/n$, $P_{k,j}=k/(j\cdot(j-1))$, $j=k+1,..,n$, $P_{k,0}=1-k/n$. Then, it was shown, that supporting set consists of all maximal points k, for which $\frac{1}{k}+...+\frac{1}{n-1}\leq 1$. If n is big, then optimal strategy may be described as follows: to pass [n/e] elements and then to stop at first maximal one. At this strategy probability to find the best element is close to 1/e.

In [3] the following generalization of discussed above problem was considered. Let it's possible to return to object, that was considered k steps behind, but the probability to find such object "alive" equals to qk, where 0<q<1 is some probability that may be described as bribe offence rate (the less q, the more offensive bribe is). If q=0 then the problem reduces to considered above no-return situation, if q=1, then the problem turns out trivial and optimal strategy is of course to pass through all of the elements and then to return to the best one without any risk). In this case, as was shown in [3], the problem of finding the best element may be described as two-component Markov process (k,i), where k-number of currently considered elements, i-number of the best element out of k. The stopping rule is defined by such relations:

$$f(k,i) = \frac{k}{n} q^{n-i}, i \le k, \quad V(n,i)=f(n,i)=q^{n-i},$$

$$V(k,i) = \max\left(f(k,i), \frac{k}{k+1} V(k+1,i) + \frac{1}{k+1} V(k+1,k+1) \right),$$

$\Gamma(k,i)=\{(k,i)|V(k,i)=f(k,i)\}$.

For the given values of n,q the set of optimal stopping points set matrix may be found with the help of dynamic programming technique. First, the last row elements are always belong to stopping set, then the analysis of whether or not each element is made dynamically, supporting on already known values of V(k,i) and moving from right to left and from bottom to top. For example, for q=0.64, n=9 the stopping set has the matrix is as follows:

$$\Gamma = \begin{pmatrix} 0 & & & & & & & & \\ 0 & 0 & & & & & & & \\ 0 & 0 & 0 & & & & & & \\ 0 & 0 & 0 & 1 & & & & & \\ 0 & 0 & 0 & 0 & 1 & & & & \\ 0 & 0 & 0 & 0 & 1 & 1 & & & \\ 0 & 0 & 0 & 0 & 0 & 1 & 1 & & \\ 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{pmatrix}$$

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DIFFERENTIAL EQUATION FOR EIGENVALUES OF THE STURM-LIOUVILLE OPERATOR WITH RESPECT TO THE VARIABLE END OF THE INTERVAL

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In theory of superconductivity (see, for example, [1]) it is very important to know the energy of the ground state of magnetic Schrodinger operator

$$P_{BA,V,\Omega} = \sum_{k=1}^{n}\left(\frac{1}{i}\frac{\partial}{\partial x_k} + Ba_k(x)\right)^2 + V(x;B),$$

where $A(x) = (a_1(x), a_2(x), \ldots, a_n(x))$ is the real magnetic potential, B is intensity of the external magnetic field, $V(x;B)$ is real electric potential, $x \in R^n$. It is shown in the paper [2] that, the process of finding energy of magnetic Schrodinger operator's ground state is closely related to the variation of eigenvalues of Neumann boundary condition $u'(a) = u'(b) = 0$ for the Sturm-Liouville operator $L = -\frac{d}{dx}\left(p(x)\frac{d}{dx}\right) + q(x)$ with respect to the domain. It is also proven in the paper that, all eigenvalues $\lambda_k(b)$ satisfy the formula

$$\lambda_k'(b) = \phi_{b,k}^2(b)\left[q(b) - \lambda_k(b)\right], \qquad (1)$$

where $\phi_{b,k}(x)$ is an eigenfunction corresponding to the eigenvalue $\lambda_k(b)$.

The main goal of this paper is to prove the invariance of formula (1) relatively arbitrary boundary conditions on the fixed left end of a and boundary condition is Neumann's at the variable end b $(a < b < +\infty)$ of the domain (a,b)

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THE REGULARITY OF SOLUTIONS OF ELLIPTIC AND PARABOLIC EQUATIONS WITH DISCONTINUOUS COEFFICIENTS

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The regularity of generalized solutions of initial- boundary problems for linear elliptic equations with discontinuous coefficients is investigated. The strong solution belong to the generalized Morrey spaces is proved.

NONLINEAR ELLIPTIC EQAUTIONS WITH VMO COEFFICIENTS.

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We obtain in generalized Morrey spaces estimate for weak solution of a boundary value problem for an nonlinear elliptic equations with VMO coefficients in a nonsmooth domains. We are investigated regularity of solutions. The nonlinearity has sufficiently small BMO seminorm and that the boundary of the domain is sufficiently flat.

THE SOLVABILITY OF BOUNDARY VALUE PROBLEM FOR DEGENERATE EQUATIONS

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Boundary value problem for linear and nonlinear degenerate equations with discontinuous coefficients is considered in this work. A unique strong (almost everywhere) solvability of problem in the corresponding weighted Sobolev space is established. Also qualitative property of solutions are investigated.

FORCING THE SYSTEM BY A DRIFT

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We is consider nonlinear elliptic equation of non-divergence type

$$\sum_{i,j=1}^{n} a_{ij}(x,u(x),Du(x))D^2u(x)+f(x,u,Du(x))=0, \qquad (1)$$

where $B_{2r}\subset R^n$ - ball with radius $2r, r\geq 1$. for a.e. $x\in B_{2r}$. The solution $C(\bar{B}_{2r})\cap W^{2,n}_{loc}(B_{2r})$. Here $a_{ij}=a_{ji}$, i. d. $A(x,y,p)$ set of symmetric matrices of size $n\times n$ and $y\in R,\ \ x,p,\xi\in R^n$ coefficients satisfying

$$\begin{cases} \Lambda^{-1}\lambda(p)\omega(x)|\xi|^2\leq & (\xi,A(x,y,p)\xi)\leq \Lambda\lambda(p)\omega(x)|\xi|^2 \\ f(x,y,p)\leq & \dfrac{1}{k}\Lambda(1+\lambda(p))(1+|p|) \end{cases} \qquad (2)$$

for some $\Lambda\geq 1, k>1$ and some continuous mapping $\lambda: R^n\to R_+$.

Under suitable assumptations on the coefficients, we can build a drift to force the system to hit, with a non-zero probability, a prescribed Borel subset of large measure.

THE BEHAVIOR OF SOLUTIONS TO DEGENERATE NONLINEAR PARABOLIC EQUATIONS

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We consider local behavior of solutions to degenerate double nonlinear parabolic equations, where weight function is replaced with a double condition which supports a Poincare inequality. We give Harnack's inequality for certain degenerate of double nonlinear parabolic equations. We used is well known that Moser's technique is essentially based on the combination of a Sobolev and a Caccioppoli type inequalities. We also is established the local Holder continuity of a weak solution is a consequence of the Harnack's inequality. However, due to the nonlinearity of the term $\frac{\partial\left(u^{p-1}\right)}{\partial t}$ when $p \neq 2$, it is not clear for the double nonlinear equations.

REPRODUCTIVE DECISION MAKING: THE RELATIONSHIP BETWEEN MAN AND ANIMAL

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Making decisions - eat, drink, search for prey, go left, right - is the trajectory of life. What does behavioral ecology study? Which solution do we think is the right one? How does the theory of optimal resource allocation explain the decision-making principle?

When we talk about making decisions, including with a person, we are not necessarily talking about some kind of analytical thought process that determines the consequences of certain choices. This is a non-random choice of the available options. Behavioral ecology is a science that tries to explain the diversity of behavior and its evolution. In its terms, decision-making is no more, but no less than a non-random choice of the available options.

The fish in the aquarium selects the most necessary food, and not the one that is numerous, the fish knows which food to choose, this is not a random choice.

The fish does not think to swim left or right, natural selection has long been thought for her.

The right decision is what enhances your fitness. Fitness is the number of copies of genes that we distribute in a population or in a series of generations. In this sense, there is a closed argument: the decision is right because it increases our fitness, and it increases our fitness because it is right. This is the misfortune of the entire modern paradigm, but it is not necessary to abandon it even early.

The central compromise is the choice between reproduction and survival. We can direct time and energy to reproduction, and we can direct it to survival, development, growth, self-maintenance and so on. It is clear that in the framework of the modern paradigm, survival is simply a means of reproduction.

Nevertheless, in this case, this choice suggests that I can refuse breeding now and postpone it for a more favorable time in the future, when it will be more successful. In this way I increase my fitness. Reproductive decisions are decisions about when and how much to invest in reproduction.

The need for decision-making is the principle of the optimal distribution of resources, time and energies. Time and energy are limited, but we do not know how limited they are in a particular interval and episode, but still this is what makes us make the right decision.

It is especially difficult to make decisions in the hibernation process during hibernation, that is, the period of slowing down of life processes and metabolism in homeothermic animals during periods of inaccessibility of food, when it is impossible to maintain activity and a high level of metabolism.

After waking up, they have little time to make decisions. Namely: to multiply and gain fat for subsequent hibernation.

Thus, all compromises should be aggravated, since they sleep 9 months a year.

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ABOUT DIFFUSION HYBRID MODELS OF INFORMATION DISTRIBUTION PROCESSES DYNAMICS

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Within the modern information society, the generation of information flows is usually aimed at a particular consumer, has a clearly defined target orientation, which is determined by the subject area of human interest. The amount of information received significantly exceeds the consumer's capabilities and, as a consequence, different ideas and opinions begin to compete with limited consumer attention. It is clear that under such conditions, special attention is paid to methods that allow us to model the processes of information dissemination dynamics [1].

The substantiation of the correctness of the use of diffusion models for describing the dynamics of information dissemination processes, allows to extend the simulation result by taking into account the hybridity of finite models. It is advisable to consider the hybridity of the structure of the model with tracking the dynamics of the quantitative composition of the target groups, within which the level of information dissemination and impact is monitored.

The dynamics of the dissemination process based on the use of hybrid application models should be considered with the external impact on the process and by observing the quantitative composition of the target groups within which information is disseminated.

This paper proposes an approach to the construction of hybrid mathematical models of the dynamics of information processes propagation in the target population, taking into account and without taking into account the impact on the process of information dissemination by external sources and other means. Formalization is based on the idea of using hybrid mathematical models, which consist of the diffusion (penetration) equation and dynamic models, which describe the processes of change in the size of the contingent of the information dissemination environment. A scalar solution for a one-dimensional representation of a group contingent is considered. Various cases of formalization of external influence on the process of information dissemination are considered.

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BUILDING A GRAPH OF INTERSECTION OF SOCIAL NETWORK AUDIENCES ON ALTERNATIVE DATA

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For any research of social networks, you must have a deep understanding of its structure [1,2]. Under the structure means many users of a social network and the relationship between them. Consider a social network in which the user is represented as a page, and each page, in turn, can monitor any number of other pages. The tracking ratio in this case is not symmetrical. In all social networks, there is a power-law distribution of tracking relationships, so you can generally categorize pages into opinion leaders who have a large audience, and followers who follow many pages.

Theoretically, having information about all leaders and all followers in the form of a social graph, where pages are presented as vertices, and tracking as a relationship between them, any qualitative analysis of information flows can be carried out. However, to obtain such a graph requires a huge amount of time and data, which are often non-public.

An approach is proposed for constructing a graph based on data on the intersection of audiences. The link between two pages is greater when there are more general followers between the pages, and pages are equivalent when their audiences are the same. The tracking relationship is based on the curiosity of a particular page in the content that another page creates. Therefore, we can assume that two pages have more common followers when their content is similar to each other.

The implementation of the approach for the social network twitter is proposed. He conducted an experimental study by developing a system for constructing graphs of similarity of content and comparing the results with the graph of intersection of audiences [3,4].

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APPROXIMATE GUARANTEED ESTIMATES FOR WAVE EQUATION WITH RAPIDLY OSCILLATING COEFFICIENTS

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In this paper, we consider the problem of guaranteed estimating a functional from the solution of a wave equation with rapidly oscillating coefficients. A similar problem for the parabolic equation was considered earlier in [1]. We use observed measurements, containing uncertainties, and produce estimates of unknown variables. The problem is complicated not only by the rapidly oscillating coefficients, but also by the fact that the observation has a superposition operator. At small parameter $\varepsilon > 0$ the existence of solution of original problem is proved using the traditional minimax approach. Transition to homogenized parameter problem allows to us to remove the nonlinearity in the observation. The main result of the paper is to prove that the minimax estimate of the problem with homogenized coefficients is an approximate minimax estimate of the original problem.

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ISSUES OF USING CHARACTERISTICS OF MASS SERVICE SYSTEMS WHILE MANAGING THE DISTANCE LEARNING PROCESS

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In educational space, creating, establishing and managing distance learning is a time-consuming and functionally hard process which covers a wide range of involved parties. Furthermore, it requires the use of information technologies, provision of equipment and software, as well as human resourses. However, as experience has shown, a properly functioning system does work, while the incorrectly planned process does not give desirable results. The ongoing processes in the world have once again shown the need to establish a distance learning process as a system which will be adapted to certain audiences and which will take into account international approaches, recommendations, and experiences of distance learning. I would like to share with you the decisions of a particular school in the process of transitioning to distance learning. When creating the system, the school has used and considered the characteristics of mass service system, which ensured the reliability and stability of the process. The mass service system has its own characteristic features and indicators. Subsystems of different processes are both paralleled and accumulated into a single system, which, in case of the learning process, involves working in the system of information and communication technologies, network and other devices. Extensive development of today's computer networks, informatics and infromational technology provides completely new opportunities. They meet the necessary requirements: speed, reliability, economical characteristics, etc. As a result of the development of such high-level computer technologies, it is possible to create systems which, according to the field requirements, will combine computer tools that will help the parties involved, the interested parties to carry out their activities effectively. The research has shown that using computer systems requires to settle a number of issues, including:

Rational distribution of technological and human resources to ensure the reliability and efficiency of the system;

Ensuring the speed and productivity of operations performed by the system;

Economical issues (minimal expenses);

Besides, there are a number of theoretical and practical issues to be considered, which are responsible for creating and establishing a highly efficient system (in our case, distance learning in our school).

In our particular school, the decision to use the reliability of mass service in the process of creating a distance learning system has yielded positive results, and the process has been carried out effectively. The aim was to provide students with a high quality learning process, which was confirmed based on the criteria of the relevant outcomes. This was achieved by a number of factors: efficient communication between the system components, control over the reliable system operation, processing the data flow already existing and newly-acquired from specific subsystems, the efficient use of the system by the users.

As a conclusion we may mention, that during the creation of remote education system, one matter was underlined specifically _ creation of stable (delay-proof) service system. Which in itself implies the effective use of various necessary equipment, software and other resources.

THE INTERPOLAION OF MANY-VARIABLE FUNCTIONS

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In practice, the approximation of many-variable functions is an actual. In applications, a function is often given its own values, so one of the methods of approximation problem solution is interpolation. Operator interpolation theory are constructed in [1]. For the case of the finite-dimensional Euclidean space E_k that for construction of the unique interpolation polynomial it is necessary that the certain relation between the number of interpolation nodes m and the degree n of the interpolant is fulfilled [2].

The interpolation polynomial $P_n(u)$ in Euclidean space E_k has the form [1]: $P_n(u) = f, \Gamma^+ \sum_{p=0}^{n} (u,u_i)^p \Big|_{i=1}^{m}$, where $(\cdot,\cdot)$ is a scalar product, $u = (u_j)_{j=1}^{k} \in E_k$, $u_i = (x_{i_j})_{j=1}^{k} \in E_k$ is an interpolation node,SW

$$P_n(u_i) = f(u_i) = f_i,\ i = \overline{1,m}, f = (f_i)_{i=1}^{m},\ \ f : E_k \to R_1, \qquad (1)$$

$x, y = \sum_{i=1}^{m} x_i y_i$, $x = (x_i)_{i=1}^{m}, y = (y_i)_{i=1}^{m}$, Γ^+ is the Moore-Penrose pseudo-inverse matrix to the matrix $\Gamma = \sum_{p=0}^{n} (u_i, u_j)^{pm}_{i,j=1}$. Let

$$s_i = \left\{ \left(\frac{j!}{j_1!\, j_2! \ldots j_k!} \right)^{1/2} x_{i_1}^{j_1} x_{i_2}^{j_2} \ldots x_{i_k}^{j_k},\ j_1 + j_2 + \ldots + j_k = j \right\}_{j=0}^{n}, i = \overline{1,m}, \text{ then}$$

the matrix $\Gamma = (s_i, s_j)_{i,j=1}^{m}$ is Gram matrix. Let Π_{kn} is the set of polynomials of variables k of degree n. It is shown that if the interpolation nodes $u_i, i = \overline{1,m}$ for the function $f(u), u \in E_k$ be chosen such that the system $s_i, i = \overline{1,m}$ is linearly independent ($\Gamma^+ = \Gamma^{-1}$), then the interpolation problem (1) on the set Π_{kn} will be invariant solvable and will be have the unique solution in the case $m \le \frac{(n+k)!}{n!k!}$ [3]. The interpolant $P_n(u)$ has a minimum norm generated by a scalar product by the Gaussian measure [1].

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THE ONE SOLUTION OF THE ASYMPTOTIC DISSIPATIVITY PROBLEM OF THE SYSTEM OF VIRUS MULTIPLICATION IN A POPULATION OF MARINE BACTERIA

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The virus multiplication in a population of marine bacteria is determined by the system of differential equations [1, 2]. Taking into account the action of random causes in a form of the Markov process $x(t)$ and influence of internal perturbations on the change of virus concentration in a form of a diffusion perturbed term $\sigma\big(s(t),i(t),p(t)\big)dw(t)$, we obtain the following system [1, 2]

$$\begin{cases} \dfrac{ds(t)}{dt}=\alpha s(t)\Big(1-\big(s(t)+i(t)\big)\Big)-KCs(t)p(t) \\ \dfrac{di(t)}{dt}=KCs(t)p(t)-\lambda i(t) \\ dp(t)=-KCs(t)p(t)dt-\mu p(t)dt+\big(b+x(t)\big)\lambda i(t)dt+ \\ \qquad +\sigma\big(s(t),i(t),p(t)\big)dw(t), \end{cases} \qquad (1)$$

where $s(t)$ – normalized concentration of non-infected bacteria, $i(t)$ – normalized concentration of infected bacteria, $p(t)$ – normalized concentration of virus and $x(t)$ – ergodic Markov process determined in the phase space of states $\{-0.01, 0.01\}$ with stationary distribution $\{0.5, 0.5\}$.

Considering the case of the certain values of each parameter [1, 3] and, in addition, taking $\sigma(s(t), i(t), p(t)) = 1$

$$\begin{cases} \dfrac{ds(t)}{dt} = 1.34s(t)\left(1-\left(s(t)+i(t)\right)\right) - 0.134s(t)p(t) \\ \dfrac{di(t)}{dt} = 0.134s(t)p(t) - 3.3002i(t) \\ dp(t) = -0.134s(t)p(t)dt - 14.925p(t)dt + \\ +\left(45.925 + x(t)\right)3.3002i(t)dt + dw(t). \end{cases} \quad (2)$$

The system above is asymptotically dissipative if the following inequalities are fulfilled

$$\begin{cases} Ai(t) < 6.6004i(t) + 2.546s^2(t) - 0.134p^2(t) - 303.12337p(t) \\ A < 0.268p(t) - 2.68 \\ A < 14.925, \end{cases}$$

де $A > 0, A \epsilon R.$

The obtained conditions are a special case of solution of the asymptotic dissipativity problem of system (2). The dissipativity conditions of system (2) and, in general, system (1) are determined by solving a system of inequalities — conditions that depend on the Liapunov function of the determined system and the convergence of the initial system to the limited one [4].

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SOLVING PROBLEMS OF SYSTEM ENGINEERING IN MODELING ISSUES

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Using of new informational technologies frequently gives us new opportunities. New informational technologies have already proved their positive effects.

Digital transformation in different organizations and industry, distant working and teaching, communication by technologies during pandemics fast changeable and dynamic environment, demand of growth of innovations, recognition and spreading of informal education widely are requirements that made us to make changes in different disciplines.

We can hardly find systemic training centers in Georgia that can help electronic teaching in different subjects separately and integrated.

We suggest our point of view how to settle new disciplines like System Engineering in educational system. That is model of interactive teaching by using of electronic manuals and training issues. Its aim is children to develop their systemic thinking. Learning of the subjects should be conducted by projects that depends on systemic attitude, according to syllabus. This style of learning gives children the chance to require different abilities. These are: to settle the task, conduct the experiment, use instrument of programming, discuss of results and give explanations, introduce different options, observe, discuss and give arguments, use dates to substantiate results and to make presentation with the help of scientific language. It’s important to acquire and develop interdisciplinary abilities. This style of studying means using of following important things: collaborative methods; practical; method of analysis and synthesis; brain storming; Case study; E-learning; Project Based Learning (PBL); collaborative working; cooperative teaching; discussion; demonstrative method.

While learning System Engineering you come across the problem. That is difficulty to solve interdisciplinary issues. The situation of uncertainty is created in the process of forming an abundance of alternatives based on the topics studied in different learning disciplines. Also, it's difficult to choose optimal issue as you have so many alternatives. Aim of optimal decision is to summarize knowledge from different issues; practical thinking and to settle connection between them; to find task solutions with the help of different projects and modern resources: LEGO - Visual Programing and Engineering, Practice Physics and Blink Arduino, Snap Circuits Extreme, Arduino UNO Kit and Blink Coding, Fundamentals of Programming, 3D Printing, Graphic and etc.

AUTOMATED SYSTEM OF MONITORING TIME SYNCHRONIZATION SIGNALS OF ELECTRIC POWER NETWORKS OF SMART-TECHNOLOGIES

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The reliability and accuracy of the time synchronization signal (TSS) generation significantly affect the efficiency of integrated power supply networks of SMART technologies [1]. TSS are used to generate discrete values of time moments of the continuous monitoring of equipment and operating modes of power supply networks. Obviously, a deterioration in the quality of TSS indicators will lead to a distortion of the monitoring data used to make decisions in the operation of electric power networks. Despite this, it is relevant to conduct research on the reliable provision of electric power networks of SMART technologies with TSS of a given quality.

The automated control system (ACS) provides a reception, real-time processing of the digital measurement results of the time characteristics of TSS, and corresponding visualization of the data necessary to make operational decisions based on network monitoring results.

The developed "TIMETER-2pps", the original technical solutions of which are protected by Ukrainian patents, is proposed as a multichannel meter of time characteristics of ACS. We developed a probability-theoretical method for calculating temperature stability of the transient process duration of a sample signal of the device and the requirements for its components - electrical components.

We carried out experimental researches of the created laboratory bench of ACS using the receivers of satellite navigation systems GPS, "TIMETER-2pps" device, and P4000winXP software, developed in the EMBARKADERO environment. The research results have confirmed the obtained theoretical positions and the efficiency of TSS control system use at the electric power networks’ facilities of SMART technologies.

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COMBINATION OF DATA VISUALIZATION METHOD AND MACHINE LEARNING FOR DATA CLASSIFICATION

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In the paper the research investigation on the development of methods for classification and clustering of unstructured textual and graphical information is proposed [1]. Note that modern methods of machine learning allow you to solve problems at a certain level of application in terms of quality. They also allow for the improvement and refinement of existing methods depending on the specifics of the data for which they are used. This suggests that more diverse approaches need to be developed that make fuller use of data informativeness. The constituent elements of informativeness, which are combined on the basis of use, are difficult to detect automatically and require the use of human intellectual abilities. Moreover, the visual presentation of information is the most informative and effective in terms of human processing. Methods of visual analysis allow to conduct data research and implement the process of iterative improvement of machine learning procedures through effective human involvement. It mean that machine learning acquires a hybrid character by effectively integrating the advantages of machine and man in the direction of the implementation of intelligent systems.

This study proposes a method of human integration into the machine learning system in which it is directly involved in the construction and training of the model. To demonstrate the practical implementation of the proposed approach, information technology for classifying text data has been developed. In this technology, model learning is performed by a person using data transformation and transferring the data classification model to the machine level. In the future, the resulting model is used by the machine for further data classification. Studies have shown the effectiveness of the proposed approach.

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ON DETERMINING THE COEFFICIENT OF A SECOND-ORDER HYPERBOLIC EQUATION WITH A NONLOCAL CONDITION

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In the paper considers the problem of determining a pair of functions $(u(x,t),\vartheta(x))\in W_2^1(Q)\times V$ from the conditions

$$\frac{\partial^2 u}{\partial t^2}-\frac{\partial^2 u}{\partial x^2}+\vartheta(x)u=f(x,t),\ (x,t)\in Q=(0,l)\times(0,T), \tag{1}$$

$$u(x,0)=u_0(x), \frac{\partial u(x,0)}{\partial t}=u_1(x), x\in(0,l), \tag{2}$$

$$\frac{\partial u(0,t)}{\partial x}=\frac{\partial u(l,t)}{\partial x}=\int_0^l K(x,)u(x,t)dx,\ (x,t)\in Q=(0,l)\times(0,T), \tag{3}$$

$$\int_0^T R(x,t)u(x,t)dt=\phi(x), \tag{4}$$

$$V=\left\{\vartheta(x)\in W_2^1(0,l):\nu_0\le\vartheta(x)\le\mu_0,\left|\frac{d\vartheta}{dx}\right|\le M,\ almost\ everywhere\ on\ (0,l)\right\} \tag{5}$$

where l, T, ν_0, μ_0, M - are given positive numbers, $f \in L_2(Q)$, $u_0 \in W_2^1(0,l)$, $u_1 \in L_2(0,l)$, $R \in L_\infty(Q)$, $\phi \in L_2(0,l)$ - given functions and $\int_0^l K^2(x)dx < \infty$.

To the problem (1)-(5) is compared the following optimal control problem: it is required to minimize the functional

$$I(\vartheta) = \frac{1}{2}\int_0^l \left[\int_0^T R(x,t)u(x,t;\vartheta)dt - \phi(x)\right]^2 dx, \qquad (6)$$

under conditions (1)-(3), (5), where $u = u(x,t) = u(x,t;\vartheta)$ - the solution of the boundary vaule problem (1)-(3) corresponding to the function $\vartheta = \vartheta(x) \in V$.

In the paper proved the continuously Freshet differentiability of functional (6) and is derivd necessary condition of optimality in the form of a variational inequality.

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ON SOME TYPES OF STABILITY FOR MIXED INTEGER QUADRATIC VECTOR OPTIMIZATION PROBLEMS[1]

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A mixed integer vector optimization problem $Z(P(F,X)$: $\max\{F(z) \mid z \in X\}$, where

$z = (x,y) \in R^{n_1} \times Z^{n_2}, x \in R^{n_1}, y \in Z^{n_2},\ n_1 + n_2 = n,$

$1 < |X| < \infty,\ F(z) = F_1(x) + F_2(y),\ F_k(\cdot) = (f_1^k(\cdot), ..., f_\ell^k(\cdot)), k = 1,2,$

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$f_i^1(x) = \left\langle x, Q_i^1 x \right\rangle + \left\langle p_i^1, x \right\rangle + h_i^1,\ \ f_i^2(y) = \left\langle y, Q_i^2 y \right\rangle + \left\langle p_i^2, y \right\rangle + h_i^2,$

$p_i^k \in R^{n_k}$, $h_i^k \in R$, $Q_i^k \in R^{n_k \times n_k}$, f_i^1, f_i^2 – concave functions, $i \in N_\ell$, Z^{n_2} – set of integer vectors in R^{n_2}, $X = D \bigcap (R^{n_1} \times Z^{n_2})$, D – bounded closed set in R^n, is considered. Problem $Z(P(F,X))$ consists of search of elements set Pareto-optimal solutions. We will define sets: $S\ell(F,X)$ – Slater-optimal, $Sm(F,X)$ – Smale-optimal solutions. Usually under stability of vector problem, consisting of search of Pareto set, understand [1] the discrete analogue of property of semi-continuity from below or/and from above in the Hausdorff sense of a multi-valued mapping, which determines the Pareto function of choice. Qualitative characteristics of three types of stability [2] under perturbations of the vector criterion parameters for problem $Z(P(F,X)$ are obtained. Necessary and sufficient conditions of T_3-, T_4- and T_5-stability of problem $Z(P(F,X))$ are established.

Theorem 1. $Z(P(F,X))$ is T_4-stable $\Leftrightarrow$ $\text{cl}Sm(F,X) = \text{cl}\,P(F,X)$.

Theorem 2. $Z(P(F,X))$ is T_3-stabile $\Leftrightarrow \text{cl}P(F,X) = S\ell(F,X)$.

Theorem 3. $Z(P(F,X))$ is T_5-stable $\Leftrightarrow$
$\text{cl}Sm(F,X) = \text{cl}\,P(F,X) = S\ell(F,X)$.

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SOME PROPERTIES OF PERIODIC SOLUTIONS OF SINGULARLY PERTURBED IMPULSE SYSTEMS

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The report considers the problem of the theory of differential equations with impulse action when the highest derivatives containing a small parameter ε, that is, the system of the form of

$$\begin{cases} \varepsilon \dfrac{dx}{dt} = f(t,x,y), \\ \dfrac{dy}{dt} = g(t,x,y), \quad t \neq t_i, \\ \Delta x\big|_{t=t_i} = \varepsilon I_i(x,y), \\ \Delta y\big|_{t=t_i} = G_i(x,y), \end{cases}$$

investigates the question of existence, the construction of the $T-$ periodic solutions of such systems, investigates the continuous dependence of such solutions on the ε parameter, examines the boundary properties of these solutions in $\varepsilon \to 0$ Assuming that the degenerate system obtained from (1) at $\varepsilon = 0$, have a single $T-$ periodic $\{\bar{x}(t), \bar{y}(t)\}$ solution, we linearize the system (1) by substituting

$$x(t,\varepsilon) = \bar{x}(t) + u(t,\varepsilon) - \mathrm{U}(t)v(t,\varepsilon)$$
$$y(t,\varepsilon) = \bar{y}(t) + v(t,\varepsilon)$$

and reduce it to the system of the form

$$\begin{cases} \varepsilon \dfrac{du}{dt} = B(t)u + F(t,u,v,\varepsilon), \\ \dfrac{dv}{dt} = A(t)v + C(t)u + Q(t,u,v),\ t \neq t_i, \\ \Delta u\big|_{t=t_i} = \varepsilon M_i u + I_i^*(u,v,\varepsilon), \\ \Delta v\big|_{t=t_i} = K_i v + G_i^*(u,v,\varepsilon), \end{cases}$$

where

$$U(t) = \left(\frac{\partial f\left(t, \bar{x}(t), \bar{y}(t)\right)}{\partial x} \right)^{-1} \frac{\partial f\left(t, \bar{x}(t), \bar{y}(t)\right)}{\partial y}$$

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OPTIMAL FLOWS WITH CORPORATE DYNAMICS ON CLOSED SURFACES

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A smooth function on a closed surface generates two vector fields: a gradient field and an screw gradient field. In a typical situation, they specify Morse and Hamiltonian flows, the structure of which is well studied. We consider flows that have a heteroclinic (or homoclinic) cycle between hyperbolic saddle points, dividing the surface into two regions, in one of which Morse and the Hamiltonian dynamics are observed. A flow will be called optimal if it has the smallest number of fixed (singular) points among all flows of this type.

Theorem. A flow with corporate dynamics on a closed oriented surface of genus g will be optimal if and only if it has one source, one sink, one focus, and a 2g + 1 saddle critical point.

On the sphere, all optimal flows have the same structure.

We also investigated the possible structures of optimal flows on the torus. 25 flows with different structures were found: 1 with a heteroclinic cycle of length 3, 10 with a cycle of length 2 and 14 with a homoclinic cycle, including 1,2 and 3, respectively, with Morse and Hamiltonian dynamics.

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MACHINE TRANSLATION AS A MEANS OF TRANSLATION IN THE MODERN WORLD

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XXI century is the epoch of digital technologies. It is impossible to imagine any field of science without IT. Computers are used almost everywhere including science. We would like to focus using computers in translation which has a special role in development of intercultural communication, as it enables to exchange and share information between nations speaking different languages especially within modern globalization since it is impossible for the mankind to exist and develop without active communication.

Nowadays computer based translation is widely used in lots of spheres. Machine translation uses modern achievements of cybernetics, mathematics and linguistics. It is more mechanical rather than creative as computers are based on the information given by humans, that's why it is mostly used for translating easier, scientific-technical and business documents.

Machine translation is an automatic translation from one language into another with the help of computer programs.

Computer based translation has become a study subject since 1940ies.

Earlier systems used more bilingual dictionaries and manually programmed rules. There are direct, indirect and interlingua approaches in machine translation.

While using international auxiliary language interlingua the translation process consists of two main stages: first the analyzer "transforms" the original text into interlingua, and then the generator "transforms" it from interlingua into target language text.

Thus computer based translations are not perfect and it requires to be edited by professional translators.

Although machine translation is used in many fields of human activity, high-quality machine translation without human intervention is still an unattainable goal.

REGULATIONS FOR DECIDING TO OPTIMIZE THE THREATS AND RISKS OF INTEGRATION INTO THE AIRSPACE OF AN UNMANNED AERIAL VEHICLE SYSTEM

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The main challenge in the airspace of Georgia is the threats posed by the increase in the number of drones. The interest in drones is growing day by day. The issue of integration of unmanned aerial systems is still a new, unexplored issue and its coexistence in the civil space has not been addressed; for that reason, we decided to create a system that combines land and air space and provides maximum comfort to the exploitants of this space, informing about the change of all spaces and additional services (flight planning, calculation of possible risks during the flight and the possibility of minimizing these risks). According to the latest standards of modern technology, all operators are being merged. This system uses a unique algorithm that is maximally adapted to the regulations in our airspace and is dynamic in nature.

The unmanned aerial system allows any exploitant, operator or any other interested person in the airspace of Georgia to plan and implement flights through simple procedures, or to receive previous flight information. Through this procedure, the flight plan will be optimal and safe. All of this is a core issue when it comes to airspace capture and flight.

The present system has to be in accordance with the requirements of the legislature of the Georgian airspace and with the safety standards of Air Navigation of the European organization (Eurocontrol). Therefore, we have decided to use unmanned aerial vehicles in the airspace of Georgia, to make them as safe and optimal as possible, which will be in line with the regulations of the European Aviation Safety Agency (EASA).

The system should provide the following for exploitants or operators:

Information about the areas where flights are permitted, prohibited or inadmissible;

Information about the zones: At what height is the restriction or what type of unmanned aerial vehicle can be used;

Information about the permanence or temporality of the prohibition in the given zone and its duration;

Information about previous complete flight;

Opportunity to use the system during operation;

Simplification of flight procedures, maximally comfortable environment for system consumption;

To give the opportunity to the operator or exploitant of the system to the desired setting and etc.

The solution to the tasks, listed above, will be realized by the software, created by us, both on the web platform and on the mobile version. This software algorithm will provide optimization of threats and risks when using unmanned aerial vehicle systems with machine learning algorithms, artificial intelligence logic and other latest information technologies.

MODEL OF COEXISTENCE OF POPULATIONS OF INDIVIDUALS INFECTED WITH THE VIRUSES OF TWO STRAINS WITH REGARD TO REINFECTION

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The model is intended to describe the spread of various strains of the virus (such as pandemic and seasonal influenza). Here we have the compartments which correspond to the subpopulations S , suspectible, I_1 , infected with the first virus strain, I_2 , infected with the second virus strain, R_1, recovered after the first virus strain, R_2, recovered after the second virus strain, Y_1 , re-infected (but the first strain), Y_2, re-infected (but the second virus strain), R, recovered after the double infectioning. That we have the system

$$S' = \mu\left(N - S\right) - \left(\beta_1 I_1 + \beta_2 I_2\right) S,$$

$$I_i' = \beta_i S I_i - \left(\mu + \alpha_i\right) I_i,$$

$$R_i' = \alpha_i I_i - \left(\mu + \sigma_j \beta_j I_j\right) R_i,$$

$$Y_i' = \theta_i \beta_i R_i I_i - \left(\mu + \alpha_i\right) Y_i.$$

Here $i, j = 1, 2$, $i \neq j$, $S + I_1 + I_2 + R_1 + R_2 + Y_1 + Y_2 + R = N$, the constant population size. We have three steady states

$$E_0 = \left(N, 0, 0, 0, 0, 0, 0\right),$$

$$E_1 = \left(S_1^*, I_1^*, 0, R_1^*, 0, 0, 0\right),$$

$$E_2 = \left(S_2^*, 0, I_2^*, 0, R_2^*, 0, 0\right).$$

Here

$$S_1^* = \frac{\mu + \alpha_1}{\beta_1}, I_1^* = \frac{\mu\left(N\beta_1 - \mu - \alpha_1\right)}{\beta_1\left(\mu + \alpha_1\right)}, R_1^* = \frac{\alpha_1\left(N\beta_1 - \mu - \alpha_1\right)}{\beta_1\left(\mu + \alpha_1\right)}.$$

$$S_2^* = \frac{\mu + \alpha_2}{\beta_2}, I_2^* = \frac{\mu\left(N\beta_2 - \mu - \alpha_2\right)}{\beta_2\left(\mu + \alpha_2\right)}, R_2^* = \frac{\alpha_2\left(N\beta_2 - \mu - \alpha_2\right)}{\beta_2\left(\mu + \alpha_2\right)}.$$

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ONE APPROACH TO REPRESENTATION OF THE INTERSECTION OF A FUZZY COLLECTION OF FUZZY SETS

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Assume that fuzzy sets F_j with the membership functions $\varphi_j(x)$, $j \in N$ are defined on a set X, where $N = \{1, 2, ..., n\}$ is the set of their indices and n is the cardinality of the set N. Let $\tilde{N}$ be a fuzzy set on the set N with an arbitrary membership function $\eta(j) \in (0,1]$, $j \in N$. In [1] was proposed the intersection $\tilde{F} = \tilde{\bigcap}_{(j,\eta(j)) \in \tilde{N}} F_j$ of fuzzy sets F_j, $j \in N$ with the fuzzy set $\tilde{N}$ of operands.

The research has confirmed that the decomposition approach is a powerful tool for studying fuzzy sets. The approach leads to a significant simplification of the description of fuzzy sets and operations on them. Further, it gives various representations of fuzzy sets which enable us to analyze them from different viewpoints and facilitate their understanding and interpretation.

In this report, the decomposition approach was applied to studying the operation of intersection of fuzzy sets with a fuzzy set of operands. The result of this operation is a type-2 fuzzy set (T2FS), the mathematical object which is not easy to use and understand. Our findings offer a nice alternative: we decompose the resulting T2FS into a finite collection of usual fuzzy sets, thereby simplifying the construction of this set and giving a clear interpretation. Each of these sets is the intersection of the original sets with a crisp set of operands which is the corresponding α-cut of the fuzzy set of operands. Illustrative examples are given.

We hope that wide possibilities are to be discovered for the use in the theory of fuzzy set of the intersection operation on fuzzy sets with a fuzzy set of operands. Since the normal intersection and union operations on sets are basic in mathematics, it is possible expect also a wider use of their generalization to the case of fuzzy set of operands in the fuzzy set theory and a variety of applied research.

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ONE BOUNDARY PROBLEM FOR EQUATION CAUCHY-RIEMANN IN UNIT SQUARE

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Consider the following problem:

$$\frac{\partial u(x)}{\partial x_2} + i\frac{\partial u(x)}{\partial x_1} = 0, \; x_k \in (0,1), \; k = 1,2, \tag{1}$$

$$\begin{cases} u(x_1,1) + au(x_1,0) = \varphi(x_1), \quad x_1 \in [0,1], \\ u(1,x_2) + bu(0,x_2) = \psi(x_2), \quad x_2 \in [0,1], \end{cases} \tag{2}$$

where $i=\sqrt{-1}$, a,b - are real constants and $\varphi(x_1),\psi(x_2)$ - are continuous functions of their arguments.

Fundamental in the direction of x_2 solution of equation (1) has the form:

$$U(x-\xi)=e(x_2-\xi_2)\delta(x_1-\xi_1-i(x_2-\xi_2)) . \tag{3}$$

From formulas (3) and (1) we obtain the main relation:

$$\int_0^1 u(x_1,1)e(1-\xi_2)\delta(x_1-\xi_1-i(1-\xi_2))dx_1-$$
$$-\int_0^1 u(x_1,0)e(-\xi_2)\delta(x_1-\xi_1+i\xi_2)dx_1+$$
$$+i\int_0^1 u(1,x_2)e(x_2-\xi_2)\delta(1-\xi_1-i(x_2-\xi_2))dx_2-$$
$$-i\int_0^1 u(0,x_2)e(x_2-\xi_2)\delta(-\xi_1-i(x_2-\xi_2))dx_2=$$
$$=\begin{cases} u(\xi), & \xi_k\in(0,1),\ k=1,2; \\ \frac{1}{2}u(\xi), & \xi_1\in[0,1],\ \xi_2=0 \ \textit{или}\ \xi_2\in[0,1],\ \xi_1=0. \end{cases} \tag{4}$$

So $u(t,1)$ and $u(0,t)$ are determined from the boundary conditions (2). If we take into account the boundary conditions, then the solution of the problem (1)-(2) is obtained from the main relation (4).

LINEAR ESTIMATION OF OBSERVATIONS IN THE MATRIX SPACE

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The problem of matrix linear regression under conditions when the elements of observations are matrices that allow small deviations from the calculated ones was studied in the publication [1]. Using the technology of pseudo-inverse operators and the small parameter method, the problem was solved provided that linearly independent matrices are perturbed.

In the report the linear estimation problem in the space of rectangular observation matrices that are subject to small perturbations is considered. The operator equation for the linear estimation parameters is solved by reducing the least squares method to a normal matrix system of equations.

Problem formulation. An approximate solution of the linear estimation problem under the perturbations of the observation matrices $A_k(\varepsilon) = A_k + \varepsilon A_k^1 \in R^{m\times n}, k \in \overline{1,s}$, ε $(0 \le \varepsilon < 1)$ – small parameter is to be obtained. Observations are described by a system of linear equalities $y_k = spXA_k^T(\varepsilon) + \eta_k$, $k \in \overline{1,s}$, where $X \in R^{m\times n}$ – unknown matrix, η_k, $k \in \overline{1,s}$ – random values, for which $E\eta_k = 0$, $k \in \overline{1,s}$. $spXL^T$ – linear function of the matrix elements $X \in R^{m\times n}$ is to be estimated, here $L \in R^{m\times n}$ – known matrix. A linear estimate is given as follows:

$$\overline{(spXL^T)} = \sum_{k=1}^{s} x_k(\varepsilon) y_k(\varepsilon), \tag{1}$$

where $x_k(\varepsilon) \in R$, $k \in \overline{1,s}$ – unknowns.

The algorithm for solving the problem. In order to solve the problem in Euclidean space an operator $\wp(\varepsilon)$ – a linear operator acting from a vector space R^s into a matrix space $R^{m\times n}$: $\wp(\varepsilon)x(\varepsilon) \equiv \sum_{k=1}^{s} A_k(\varepsilon)x_k(\varepsilon)$, $A_k(\varepsilon) \in R^{m\times n}$, $x_k(\varepsilon) \in R^1$, $k \in \overline{1,s}$ is considered, as well as conjugated to it $\wp^*(\varepsilon): R^{m\times n} \to R^s$.

Theorem [1]. For unbiased assessment $\overline{spXL^T}$ in the class of linear estimates (1) it is necessary and sufficient the following conditions are to be satisfied:

$$\wp(\varepsilon)x(\varepsilon) = L, \quad spLY_k = 0, \ k \in \overline{1,m}, \tag{2}$$

where Y_k, $k \in \overline{1,m}$ – linearly independent solutions of the equation $\wp^* Y = 0$.

Equations (2) are a system of linear algebraic equations in which the number of equations significantly exceeds the number of unknowns; therefore, its solution reduces to solving the corresponding normal equation of the least squares method, which has the form:

$$\wp^*(\varepsilon)\wp(\varepsilon)x(\varepsilon) = \wp^*(\varepsilon)L. \tag{3}$$

Operator $\wp^*(\varepsilon)\wp(\varepsilon)$ – a square matrix; if the system is not degenerated, there is an inverse matrix to it, otherwise – pseudo inverse. These matrices are found after calculating the eigenvalues and eigenvectors of the matrix of system (3) by the small parameter method [2].

Conclusion. An unbiased estimate of the observations in the space of rectangular matrices with their small perturbations was obtained in a first approximation. A test case is provided.

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STATISTICAL SIMULATION OF THE SPREADING OF TWO TYPES INFORMATION MESSAGES WITH STOCHASTIC PERTURBATIONS

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We introduce a mathematical model with nonstationary parameters to describe spreading of two types of information messages in the society. This model is the special case of basic model (for example [1]). We assume that the parameters of the internal influence are exposed disturbing influence. Them the model can be written as the system of Ito stochastic differential equations

$$dx_k(t) = \left[\left(a_k(t) + b_k(t)x_k(t)\right)\left(L - \sum_{i=1,2} x_i(t) \right) + \gamma_k(t)(x_k(t) - m_k L) \right] dt +$$

$$+ g_k x_k(t)\left(L - x_1(t) - x_2(t)\right) dw_k(t), t \in (0,T), x_k(0) = x_k^0, k = 1,2.$$

Here $w_k(t), k = 1,2, t \in (0,T)$ are Wiener processes (these processes are represented as a random series for statistical modeling [2]); $dx_k(t)$

and $dw_k(t), k=1,2, t \in (0,T)$ are stochastic differentials of processes $x_k(t)$ and $w_k(t), k=1,2, t \in (0,T)$ (in the sense of Ito).

We use statistical simulation different type of parameters internal and external influence for analysis of dynamics of the system.

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FORMALIZED MODEL OF THE OPTIMAL DECISION ON DELIVERY OF SPECIALISTS ON THE LABOR MARKET

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Nowadays, on a national scale, in connection with problems of implementation of social-economic development programs, one of the key problems is satisfaction of the labor market with qualified personnel having a relevant professional education. The stated problem is not settled in a simply way and is associated with a lot of processes and circumstances which are directly connected with general indicators of reforms being conducted in the educational system of the country.

The issue of training of the professional personnel and their delivery to the labor market requires application of contemporary methods of conducting of scientific researches and making of relevant resolutions. The key problem in the stated researches represents development of the programs which are designed for training of professional personnel and upgrading of their qualification. It is evident that a content of educational themes (topics) which are reflected in the programs should satisfy, primarily, European standards; they should not be deviated from the national spiritual, cultural and educational values and priorities, that had been developed and reinforced in the Georgian public mentality within the long-termed period of the history, mainly for centuries and finally, based on mastering of the program course, a specialist should be competitive on the labor market.

Settlement of the above-mentioned problem is possible by using of the newest innovative information technologies and contemporary theories of making resolutions. Certainly, making a resolution on the stated problem requires determination of the tasks, among which we would prioritize researching of requirements of the internal labor market and its analyzing. All this is based on the analysis of the characteristic features of functionality of the economic, industrial and business sites existing in the country that should make a contribution into processing of the formalized model of training of specialists having a relevant professional education which is focused on the labor market (in the mathematic form).

The focal criteria of construction of the model, or, in other words, a strategy of the resolution-maker is an indicator of demands for specialists having high qualification at the labor market. To develop this model we use a method of a statistic analysis and forecasting and for formation of diversity of alternatives and making of optimal decisions based on such diversity, we apply a super criteria and Pareto method.

To conduct a statistic analysis, to research a dynamics of the educational process we take a previous five year period, and as for the task of making a forecast on training of professional specialists we have taken the next three years as an adoptable period. In this model the time is characterized by discretion.

To estimate the targeted function, to select variables which have an impact on designing parameters of optimization we will pay attention generally on parameters of the demand of the labor markets in the regions of our country. We model a so called “compliance matrix” of coefficients of requirements at the labor market according to the sector and relevant specialty. With the help of the matrix, we resolve the task of forecasting of the demand on the professional cadre and his/her delivery on the computer, in an interactive mode.

Results of practical implementation of the model are in full compliance with a strategic development plan of the country and trends of its economic development for the situation existing in the field of employment.

SURVIVABILITY OF THE CYBERPHYSICAL SYSTEMS FUNCTIONING IN CONDITIONS OF UNCERTAINTY

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A cyber-physical system (CPS) is an elaborate system consisting of various natural objects, artificial subsystems and controllers which allow representing of them as a single whole. A CPS ensures close communication and coordination between computational and physical resources, which demand the creation of two types of models. On the one hand, these are engineering models, and on the other, computer models. The main principle of the CPS is a deep relationship between its physical and computational elements to make decisions regarding the maintenance of the functioning of real objects in conditions of different nature uncertainty. The “brain” of a system is the Internet of Things (IoT) in the form of artificial intelligence and other technologies for analysis, processing of data received from sensors in the real world.

This paper focuses on the engineering and computer models. An attempt was made to improve the quality of the survivability and safety of CPS operation.The engineering models includes of a set of principles, hypotheses, axioms, methods and techniques; a system of sensors at critical points of a physical system that is providing for the data in the course of operation [1]. The IoT becomes a modern tool that includes several stages of interaction with physical systems: collecting data from a specific physical system, bringing this information to the required format, performing calculations based on models, methods and techniques that allow you to make decisions based on information, obtained from physical models. In CPS, it becomes a fundamentally new fact that not only close communication and coordination between computational and physical resources must be ensured, but also the ability to effectively respond to emerging cyber-physical effects due to the interaction of physical objects and computational processes, and the ability to make adjustments to ensure the survivability of the functioning of physical systems.

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THE IDENTIFICATION UNKNOWN PARAMETERS OF STATIC MODEL OF COMPLEX SYSTEM

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The paper deals with the problem for identification of static model parameters of complex system by experimental data. The following algorithm is proposed for score C_r is built on the base interval of variable length:

Step 1: choice of initial time domain $\left[t_{r_0-m}, t_{r_0+m}\right], N = 2m+1$;

Step 2: calculation of vector $x_i = \left[x_i(t_{j-q}) \ldots x_i(t_{j+q})\right]^T$ on the interval $\left[t_{j-q}, t_{j+q}\right]$ $\quad x_i(t) = x_{iicm.}(t) + \delta_i(t)$;

Step 3: calculation of vector of the permanent coefficients, that depends on q, number and type of the chosen functions on condition of the undisplaced estimation, as many times as parameter $x_i(t)$ but cross-correlation connection of error of measuring:

$$b = K_\delta^{-1}\Phi^T\left(\Phi K_\delta^{-1}\Phi^T\right)^{-1}\dot{\phi}, \text{ where}$$

$$K_\delta = \left[K_{lr}\right], K_{lr} = M\left[\delta(t_i)\delta(t_j)\right] = \begin{cases}\sigma_\delta^2, i = j\\ 0, i \neq j\end{cases},$$

$$l = -m,\ldots,m, r = -m,\ldots,m; \Phi = \begin{bmatrix}\phi_0(t_{j-q}) & \cdots & \phi_0(t_{j+q})\\ \phi_1(t_{j-q}) & \cdots & \phi_1(t_{j+q})\\ \phi_p(t_{j-q}) & \cdots & \phi_{1p}(t_{j+q})\end{bmatrix},$$

$$\dot{\phi} = \left[\dot{\phi}_0(t_j)\dot{\phi}_1(t_j)\ldots\dot{\phi}_p(t_j)\right]^T.$$

Step 4: calculation of derivatives $\dot{x}_i(t_j) = b^T x_i$ and formation of a vector of estimations derivatives;

Step 5: formation of a matrix consisting of measurements of parameters $x_j(t)$ and control $u_l(t)$ on the basic interval, the vector of the
coefficients of the linearized system of equations;

Step 6: calculation the closure vector of the equation for the errors measurements and inaccurate external conditions (for example, new Sensors data) of the selected model;

Step 7: choice of weight matrix $W^N = \left(V^N\right)^T V^N$ and computing matrix elements Z_{ij} and vector P_{ij};

Step 8: compute the matrix $Q_{ij}^N = \left[Z_{ij}^T Z_{ij}\right]^{-1}, i = r_0 - m, j = r_0 + m$ to access the measure of its conditionality;

Step 9: determination of score $C_{r_0} = Q_{ij}^N Z_{ij}^T P_{ij}$;

Step 10: determination of dispersive matrix estimation and displacement of the found coefficients;

Step 11: the transients processes are computed by solving the Cauchy problem for the object movement equations system using the obtained estimates of coefficients comparable to the registered in the experiment;

Step 12: evaluating accuracy estimation for validation, deciding on fixing the result to increase or decrease the processing interval or time interval offset by one step Δt. In the case C:

$$C_{r0+\frac{1}{2}}^{N+1} = \left[Q_{ij}^N - \frac{Q_{ij}^n\left(\alpha_{r+m+1}\alpha_{r+m+1}^{\mathrm{T}}\right)Q_{ij}^N}{\alpha_{r+m+2}^{\mathrm{T}} Q_{ij}^N \alpha_{r+m+1}} \right] \cdot Z_{ij+1}^{\mathrm{T}} P_{ij+1} = Q_{ij+1}^{N+!} Z_{ij+1}^{\mathrm{T}} P_{ij+1},$$

$$C_{r0+1}^{N+2} = \left[Q_{ij+1}^{N+1} - \frac{Q_{ij+1}^{n+1}\left(\alpha_{r+m+2}\alpha_{r+m+2}^{\mathrm{T}}\right)}{\alpha_{r+m+2}^{\mathrm{T}} Q_{ij}^N \alpha_{r+m+1} + 1} \right] \cdot Z_{ij+2}^{\mathrm{T}} P_{ij+2} = Q_{ij+2}^{N+2} Z_{ij+2}^{\mathrm{T}} P_{ij+2},$$

$$\alpha_{r+m+1}^{\mathrm{T}} = \left[z_1\left(t_{r+m+1}\right) \ldots z_{n+k}\left(t_{r+m+1}\right) \right]$$

and the average interval point is shifted by a step $\Delta t/2$. Index N changes as long as the estimate of quality criteria do not accept values for the given experiment, or the index size of N.

Step 13: offset time interval by value Δt with calculation C_{r+1}^{N}.

The algorithm for identification of model parameters and accuracy of their calculation allows evaluating change and according to analysis results to change the progress of the experiment for clarification.

STATIONARY REGIME FOR THE M/M/C/C+M RETRIAL QUEUE WITH CONSTANT RETRIAL RATE

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The presentation deals with a research of bivariate Markov process $\{X(t), t\geq 0\}$ whose state space is a lattice semistrip $S(X)=\{0,1,\ldots,c+m\} \times Z_+$. The process $\{X(t), t\geq 0\}$ describes the service policy of a multi-server retrial queue in which the rate of repeated flow does not depend on the number of sources of repeated calls. Such models are used in systems, where the retrial of the customer is controlled. For example, [1] studies the retrial queue model with a constant retrial rate in the application to the CSMA/CD protocol. In [2] authors model TCP traffic using similar models. Constant retrial rate could be interpreted as so-called "calling for blocked customer": when the server is idle, it calls blocked customers one by one. The time for the server to pick a blocked customer could be interpreted as the retrial time.

First, we study the ergodicity conditions. Then obtain a vector-matrix representation of steady state distribution through the parameters of the system. The investigative techniques use an approximation of the initial model by means of the truncated one and the direct passage to the limit.

The application of the obtained results is demonstrated via numerical examples. We calculate some performance measures of retrial queues, using obtained formulas. The blocking probability π_b and the average number of calls in the orbit $E[X_2]$ were chosen among the main integral characteristics of the retrial queues. One can see that these characteristics can be significantly improved if we are able to change or control some of the system's parameters.

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MATHEMATICAL MODEL OF EXTERNAL BALLISTICS FOR THE BODY OF THE STABILIZED FEATHERING

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In this work we study the movement of a feathered mine in the atmosphere using mathematical simulation. The system of ordinary differential equations taken as the basis takes into account the action of aerodynamic forces, as well as the moments of these forces. The system of differential equations is obtained based on the equations of motion of a rigid body, as well as a special choice of coordinate system. As a coordinate system, a semi-mobile system was chosen, the origin of which coincides with the center of gravity of the mine, and the axis x is the axis of symmetry of the mine.

Since in the general case the system of equations is quite complicated, some hypotheses are accepted that allow us to significantly simplify the model. One of the hypotheses is that all the aerodynamic forces acting on a mine are reduced to two forces: the drag force and the lifting force. The moments of aerodynamic forces are defined as the moments of these forces relative to the center of gravity. It is also believed that the angles of attack and slip, as well as some dimensionless expressions containing the components of the instantaneous angular velocity vector, are small quantities.

The system of differential equations describing the model of external ballistics for a feathered mine is written as

$$\frac{dv}{dt} + \omega_z v\alpha = g\sin\theta - kWW_x + k_1(W_y^2 + W_z^2),$$

$$-\frac{dv\alpha}{dt} + \omega_z v = g\cos\theta - kWW_y - k_1 W_x W_y,$$

$$\frac{dv\gamma}{dt} - \omega_y v = -kWW_z - k_1 W_x W_y,$$

$$\frac{d\omega_y}{dt} = \frac{\beta(C_Q \frac{W}{W_x} + a)}{x_\partial (C_Q + a)} W_x W_z + (1 - \frac{I_x}{I})\omega_y \omega_z \, tg\theta \,,$$

$$\frac{d\omega_z}{dt} = -\frac{\beta(C_Q \frac{W}{W_x} + a)}{x_\partial (C_Q + a)} W_x W_y \,,$$

$$\frac{d\theta}{dt} = \omega_z, \quad \frac{d\psi}{dt} = -\frac{\omega_z}{\cos\theta} \,,$$

where $k = \frac{C_Q \rho S g}{G}$, $k_1 = \frac{a \rho S g}{G}$, $\beta = \frac{(C_Q + a)\rho S x_\partial^2}{I}$, G – mine weight, v_x, v_y, v_z – velocity vector components, $\omega_x, \omega_y, \omega_z$ – angular velocity vector components, $\vec{W} = \left(W_x, W_y, W_z\right)$ – vector of the resulting velocity of the center of pressure, α – attack angle, γ – slip angle, θ – pitch angle, ψ – yaw angle, C_Q – drag coefficient, a – lift coefficient, x_∂ – coordinate of the center of pressure, I_x, $I = I_y = I_z$ – moments of inertia relative to the corresponding axes, g – Gravity acceleration, S – cross-sectional area.

For the calculation of inertial moments, specially designed software is used, which takes into account the design features of mines.

Software has been developed that simulate trajectory characteristics under various atmospheric conditions and with different characteristics of weapons. The system of ordinary differential equations is solved using the Kutt-Merson method.

RESEARCH OF IDENTIFICATION METHODS FOR IMPULSE PROCESSES MODELS IN COGNITIVE MAPS WITH STRUCTURAL UNCERTAINTY

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The present report formulates and solves a problem of structural (dimension) and parametric (coefficients) identification of a cognitive map (CM) incidence matrix [1] in a complex system with incomplete measurements of nodes. When a mathematical model of CM impulse process of a semi-structured system

$$\Delta\bar{X}(k+1) = A\Delta\bar{X}(k) \qquad (1)$$

is created, a real dimension of a state vector $\Delta\bar{X}$ is usually unknown. But in any complex system there are some measurable coordinates $\Delta y_i, i = 1,...,m$. Components of a measurement vector $\Delta\bar{Y}(k)$ can be written as

$$\Delta\tilde{y}_i(k) = \Delta y_i(k) + \xi_i(k), \qquad (2)$$

where $\xi_i(k)$ is an error caused by measurements inaccuracy or external unmeasurable disturbances. The only thing known about this error is that its range is constrained

$$|\,\xi_i(k)\,| \le \varepsilon_i, i = 1,...,m. \qquad (3)$$

In this case the identification problem of CM model is solved approximately, because of unknown dimension n of the initial model (1).

In the report we suggest to find an approximate regularized solution of the dimension identification problem for model (1), consistent with accuracy of data (3). This method is based on the ideas of regularization and ensures asymptotical approach to exact solution with decrease of error and increase of data volume. The dimension n of a desired model is a regularizing parameter here. The regularized solution is understood as follows. First, it should have a maximal limit dimension which meets a stability condition. Second, it should be consistent with accuracy of input data (3).

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STATISTICAL MODELLING OF STOCHASTIC INPUT SIGNAL ON THE LINEAR SYSTEM

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We consider a Gaussian stochastic processes with discrete spectrum. These processes are supposed to be as input processes to a time-invariant linear system with real-valued square integrable impulse response function, defined on a domain [0,T]. The response on the system is an output process. The model which approximates the process with given accuracy and reliability in Banach space $L_2([0,T])$ is constructed taking into account the response of the system. For these purposes the methods and properties of Square-Gaussian processes are used.

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ANALISIS OF WARFARE INFORMATION MODEL WITH MARKOV SWITCHINGS UNDER NONCLASSICAL APPROXIMATION CONDITIONS

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We construct and study a continuous model that describes the conflict interaction of two complex systems with non-trivial internal structures. External conflict interaction is modeled by the additional influence of chance. The dynamics of internal conflict are similar to the Lotka-Volterra model, namely the model of information warfare. We interpret the new model of information warfare as the influence of rare events that rapidly change certain ideas of a large number of people. As a result, the number of supporters of different ideas make stochastic jumps that we can see using the Levy and Poisson approximation schemes. We suggest that such a model could be more natural, as important news now has a quick and wonderful impact on audiences through television and the Internet.

In many works on mathematical biology and economics the modelling of population dynamics or economical processes is based on

Lotka-Volterra type equations. As a rule, deterministic continuous models are studied.

We propose a new model of information warfare with an additional influence of chance. That may be interpreted as some kind of rare events that rapidly change some beliefs of large quantities of people. As a result, the quantities of adherents of different ideas make stochastic jumps, that we may see applying Lévy and Poisson approximation schemes

$$dN^{\varepsilon}(t) = C(N^{\varepsilon}(t), x(t/\varepsilon^2))dt + d\eta^{\varepsilon}(t), \qquad (1)$$

where matrix C has a special type

ε is a small series parameter;

$N^{\varepsilon}(t)$ is a two-dimensional vector of solutions, components of which are the quantities of the adherents of different ideas;

$x(t/\varepsilon^2)$ is uniformly ergodic Markov process.

The behavior of our model could not be analyzed obviously for any fixed moment of time as it was done in a classical case. But, as it is usual for stochastic models, we may obtain functional limit theorems that present the behavior on large time intervals. Thus, we obtain averaged limit characteristics of the process and may use them to construct obvious solutions. We hope to obtain recommendations for prevalence strategies in information warfare fights in future.

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VECTOR PROBLEMS DISCRETE OPTIMIZATION: APPLICATION FOR DEFENSE OF INFORMATION NETWORKS

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Information security is now an important aspect of any enterprise or institution. In the literature, the optimal economic indicators of the system are considered from two different positions: the given resources set the maximum level of information security or at a given level of security determine the minimum cost of resources allocated to ensure the security of information technology [1]. For modeling and solving such applications, it is advisable to use mathematical models of combinatorial optimization with fractional-linear criteria functions [2], given that the construction of a comprehensive information security system must be carried out with maximum cost-effectiveness and with minimal cost.

The optimization problem $Z(F,X)$: $\max^{P}\left\{F(x) \middle| x \in X\right\}$ is regarded, where $F = (f_1,\ldots,f_l)$, $f_i = f_i^1 / f_i^2$, $f_i^1 = \left\langle c^i, x\right\rangle$, $f_i^2 = \left\langle d^i, x\right\rangle$, $c^i, d^i \in R^n$, $i \in N_l$, $X = \left\{x \in Z^n \middle| Ax \le b, x \ge 0\right\}$ is a limited set, $X \ne \varnothing$, Z^n is a space integer vectors from R^n, $A \in R^{m \times n}, b \in R^m$.

The solution to the problem $Z(F,X)$ is to find the elements of the Pareto set. To solve this problem, we apply the polyhedral methods of multi criteria optimization [2]. The proposed approach can be applied to a number of problems, in which it is necessary to determine the requirements for information security on the basis of expert assessments on a set of factors: the nature and amount of information and software, the length of stay of information on the information processing object, the structure of the object itself, etc.

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METHOD OF SOLUTION OF LEXICOGRAPHICAL OPTIMIZATION PROBLEMS UNDER UNCERTAINTY

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The complex lexicographical optimization problems

$L(F,X):\max^{L}\left\{F(x)\middle|x\in X\right\}$, where $F(x)=\left(f_1(x),\ldots,f_l(x)\right)$,

$f_i=\left\langle c^i,x\right\rangle, c^i\in R^n,\ i\in N_l=\{1,...,l\},\ X=\left\{x\in R^n \mid g_i(x)\le 0, i\in N_m\right\}$,

with inexact data of the convex functions of constraints are examined. Let the parameters of model $L(F,X)$ be known not exactly but be defined, for example, by the statistical estimation from available observations [1]. Assume that the a priori information on the functions $g_i(x), i\in N_m$, consists in representing of sets G_i such that $g_i\in G_i, i\in N_m$. $G_i, i\in N_m$, are sets of continuously differential functions. Exact and approximate methods of decomposition are developed and proved to search for robust solutions to such problems. The methods are based on on ideas [1, 2] and carry out approximation of initial problems $L(F,X)$ by problems of a simpler structure. They consist in the successive solving of followings subproblems: for $x^j\in R^n, j$=1,…, problem $ML(F,X):\max^{L}\left\{F(x)\middle|x\in\tilde{X}\right\}$,

$$\tilde{X}=\left\{x\in R^n \mid \max_{g_i^j\in G_i}\max_{j\in N_l}\left(g_i^j(x^j)+\left\langle\nabla g_i^j(x^j),x-x^j\right\rangle\right)\le 0, i\in N_m, l=1,2,...,\right\}$$

For the solving of problem $ML(F,X)$ lexicographical simplex method is used.

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MAKING MANAGEMENT DECISIONS BASED ON FORECASTED INTERVALS BETWEEN EPIDEMIES

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The purpose of the study is to continue the work of creating mathematical support to improve the effectiveness of managing epidemic activity in the country.

The formulation of the problem of system optimization [1] of anti-epidemiological activity at predicted intervals between epidemics [2] and its mathematical model is considered.

Let T be a tree of the criteria of the problem. The main goal at the top level of the hierarchy T is the criterion

Let F_0 be responsible for improving the effectiveness of the management of anti-epidemiological activities, which can be decomposed on the second level T into 5 criteria:

F_1 — improving coordination against epidemiological unions during the estimated time of epidemics,

F_2 — reducing human casualties among the population,

F_3 — reduction of economic losses during the epidemic,

F_4 — reducing the costs of eliminating and combating the effects of the epidemic,

F_5 — expanding cooperation with international anti-epidemiological organizations.

Based on [2-4] it is possible to formalize the area of permissible solutions to the problem of system optimization of control of epidemiological activity.

The hypothesis of an exponential distribution of random variables representing the intervals between pandemic acts has been put forward. To test it, the Kolmogorov-Smirnov criterion was used, which is fairly easy to use to analyze poorly prepared data. But the power of this criterion is relatively weak, although it is asymptotically approaching one. Therefore, it was decided to use another , χ^2 -Pearson concurrence criterion for detailed data processing to determine that, indeed, the function of dividing intervals between pandemics as random variables for samples from different geopolitical zones is of exponential type.

As a result of the study of such subject area as the global pandemic, the intervals of pandemics, as random variables, have been thoroughly investigated at the current stage of the planned work, on the example of samples from the "hot spots" of the planet - China, Europe, as well as the USA.

Estimated intervals between pandemics are considered as a model of targets for the system optimization problem.

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COMPARISON OF THE ASSESSMENTS OF SOME BILATERAL APPROXIMATIONS OF THE SOLUTION OF THE CAUCHY PROBLEM

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It is established that the two-sided approximations of the solution of the Cauchy problem constructed according to [1] surely contain it and are much narrower than the approximations obtained by the Moore method [2].

Theorem Let the solution $y(x)$ of the Cauchy problem be continuously differentiable at every point x in the interval $X=[a,b]$ and at this interval $\underline{k}\,x+\underline{m}\le y'(x)\le\overline{k}\,x+\overline{m}$, where $\underline{k},\underline{m},\overline{k},\overline{m}$ are some constants. Then $y(x)\in Y(X)=\{X,\underline{p}_a(x),\overline{p}_a(x)\}$, where $\underline{p}_a(x),\overline{p}_a(x)$ are the piecewise quadratic functions constructed under the algorithm of matching between the functional intervals of the function and its derivatives [1], and the width of this interval

$\omega\left(Y_n(X)\right) \le \frac{n^2}{2} c\, h^2$, where, $X = \bigcup_{i=1}^{n} X_i$, $X_i \cap X_j = \varnothing$, $(i \ne j)$; $h = \max\,(h_1, h_2, \cdots, h_n)$, $h_i = x_{i-1} - x_i$, $x_0 = a$, $x_n = b$, $y_a = y(a)$, $y'_a = y'(a)$; x_i - breakpoints of the interval X, which, in particular, includes all characteristic points from the interval X of all functions of the analytic expression of the function $f(x, y(x))$ of the right-hand side of the differential equation of the given Cauchy problem; $c = \max\,(c_1, c_2, \cdots, c_n)$, $c_i = \overline{k}_i - \underline{k}_i$, $(c_i \ge 0)$; $\overline{g}_i(x) = \overline{k}_i\, x + \overline{m}_i$, $\underline{g}_i(x) = \underline{k}_i\, x + \underline{m}_i$, $(i = \overline{1, n})$ - upper and lower bounding functions of the interval $F(X, Y(X))$ at intervals X_i, respectively.

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ON THE IMPROVING CONVERGENCE ANALYSIS OF METHODS WITH A DECOMPOSITION OF OPERATOR

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We consider the problem of finding an approximate solution of the equation with a decomposition of operator [1-3]

$$H(x) \equiv F\left(x\right) + G\left(x\right) = 0. \qquad (1)$$

Here F and $G: D \subseteq X \to Y$ are nonlinear operators, D is a convex domain, X and Y are Banach spaces. F is a Fréchet-differentiable operator, G is a continuous operator.

Taking into account the properties of operators, for solving the equation (1) we use combined methods. In this work, we consider the Newton-Secant method

$$x_{n+1} = x_n - \left[F'\left(x_n\right) + G\left(x_n, x_{n-1}\right)\right]^{-1} H\left(x_n\right),\ n \geq 0 \qquad (2)$$

and the Newton-Kurchatov method

$$x_{n+1} = x_n - [F'(x_n) + G(2x_n - x_{n-1}, x_{n-1})]^{-1} H(x_n),\ n \geq 0. \qquad (3)$$

We investigate a semilocal convergence of the combined methods (2) and (3) under classical Lipschitz conditions for the first-order Fréchet derivative and divided differences of the first and second order. To study the convergence of methods we use a new technique of the restricted convergence domains [1]. As a result weaker sufficient semilocal convergence criteria and tighter error estimates on $\|x_n - x_{n+1}\|$ are obtained. This way, we extend the applicability of the results obtained in earlier works. Finally, we give numerical examples that confirm theoretical results [2, 3].

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CALCULATION OF STATIONARY DISTRIBUTION IN A MODEL OF RETRIAL QUEUE WITH UNRELIABLE SERVER

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We consider a model of retrial queue with one unreliable server. This server has an exponentially distributed service time with rate μ. One can find main definitions and related results in [1]-[4] and now we consider a case when a Poisson flow of calls has a variable rate λ_k that depends on the number of sources of retrial calls in orbit. The server failure rate is α while server repair rate is β. If the server goes down, the call goes into orbit and becomes a source of retrial calls. Each source of retrial calls, independently on others, generates a Poisson flow of retrial calls with parameter θ. The service process $X(t) = \left(Q(t), A(t)\right)$ is a two-dimensional Markov chain with continuous time, where $Q(t) \in \{0,1,2\ldots\}$ is a number of sources of retrial calls and $A(t) \in \{0,1,2\}$ describes the server state (waiting, working or out of order).

If the limit $\overline{\lim_{k\to\infty}} \lambda_k < \infty$ exists, then stationary distribution also exists and we present a recursive algorithm for its calculating.

If the limit $\lim_{k\to\infty} \lambda_k < \infty$ exists, then a series representing the normalizing constant has an exponential convergence rate.

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STABILITY ANALYSIS FOR FIRST-ORDER NONLINEAR DIFFERENTIAL EQUATIONS WITH TWO-POINT BOUNDARY CONDITIONS

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In this thesis we study stability for the following first-order differential equations with two-point boundary conditions of the type

$$\dot{x} = f(t,x), \quad t \in [0,T] \tag{1}$$

with two-point boundary conditions

$$Ax(0) + Bx(T) = d, \tag{2}$$

where A, B are constant square matrices of order n such that $\det N \neq 0; N = A + B,\ f:[0,T]\times R^n \to R^n$ is a given function, $d \in R^n$ is a given vector.

We establish existence and uniqueness of solution for problem (1)-(2) are obtained by using Banach and Schaufer fixed point theorems.

We also describe different types of Ulam stability: Ulam-Hyers stability generalized Ulam-Hyers stability, Ulam-Hyers-Rassias stability and generalized Ulam-Hyers-Rassias stability [1]. We discuss the stability results providing suitable examples.

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GAME MODELS FOR CONFLICT SITUATIONS

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Human beings often contradict with interests of other people or chaotic forces of nature. Contradiction of interests is called conflict situations. The term ‘conflict situation’ does not belong to mathematical concept categories. Such situations lead to various outcomes depending on various approaches. In such situations, the strategy of opponents (if one side is a researcher and the other is nature) is an important task. The construction of abstract mathematical models for conflict situations and the research of an optimal strategy for each side made up a new important area titled the Game Theory.

This new theory assists human beings to learn and comprehend the surrounding world and its reflections and to select an optimal strategy in decision making. So, the Game Theory covers formal models of optimal decision making under conflict situations. The term ‘conflict’ means events where many sides with various interests can select appropriate decisions. This theory reflects real relationships and processes about active participation of human beings in society. So, our subject point is to describe real relationships and processes rather than relationships out of the real world.

Successful application of the Game Theory into real conflict situations of society heavily relies upon analysis of these situations, social phenomena that create them, and collection of knowledge, talent, theory and science.

The thinking of theoretical game constitutes the modelling of conflict situations of society. The major point is to utilize these opportunities and find scientific methodological ways for intellectual management of society.

SEMI-MARKOV FINITE-VALUED PROCESS WITH DISCRETE TIME

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Semi-Markov discrete process ζ_k $(k = 0,1,2,...)$ can be obtained as a special case of a semi-Markov random process $\zeta(t)$ with continuous time, assuming that the jumps $\zeta(t)$ can occur at moments *t=k* $(k = 0,1,2,...)$ only. Assume that $\zeta_k = \zeta(k+0)$ $(k = 0,1,2,...)$.

This is possible only in the case when intensities $q_{js}(t)$ are determined through the Dirac δ-functions, which are equal to zero for $t \neq k$ $(k = 0,1,2,...)$. Suppose that

$$Q(t) = \sum_{k=1}^{\infty} Q(k)\delta(t-k)\,,\quad Q(k) = \left\| q_{js}(k) \right\|_{j,s=1}^{n} \qquad (1)$$

The intensities $q_{js}(k)$ $(j,s = 1,...,n;\, k = 1,2,...)$ of transition from state θ_s at the time *t=k* fulfill conditions:

$$q_{js}(k) \geq 0\,;\quad \sum_{k=1}^{\infty} q_{js}(k) = \pi_{js} \quad (j,s = 1,...,n)$$

$$q_s(k) = \sum_{j=1}^{n} q_{js}(k)\,;\quad \sum_{s=1}^{n} q_s(k) = 1 \quad (s = 1,...,n) \qquad (2)$$

We introduce the functions $\psi_s(k) = \sum_{j=k+1}^{\infty} q_s(j)\,;$ $\psi_s(0) = 1$ $(s = 1,...,n;\, k = 0,1,2,...)$

$$\psi_s(k) = P\left\{\zeta_j = \theta_s \mid \zeta_0 = \theta_s\right\} \quad (j = 0,1,2,...;\, k,s = 1,...,n) \quad (3)$$

The transition probabilities matrix $\Phi(k)$ such that

$$P(k) = \Phi(k)P(0) \quad (k = 0,1,2,...) \qquad (4)$$

is to be found.

At the same time, it is assumed that for *k=0* the random process ζ_k has a jump.

Let the semi-Markov process ζ_k has jumps at moments $k = k_j$ $(j = 0,1,2,...)$, $k_0 = 0$, $k_0 < k_1 < k_2 < ...$. The following equalities are true for the semi-Markov process

$$P(k_j + s) = \Phi(s)P(k_j) \quad (s = 0,1,2,...) \tag{5}$$

that is, any moment of the jump can be taken as the initial one. For the values of vector $P(k_j)$ $(j = 0,1,2,...)$ at the moments of jumps of the random process ζ_k following equalities are true

$$P(k_{j+k}) = \Pi P(k_j) \quad (j = 0,1,2,...), \quad \Pi = \left\| \pi_{js} \right\|_{j,s=1}^{n}$$

We write down matrices

$$\Phi(t) = \sum_{k=0}^{\infty} \Phi(k)\eta(t-k), \quad \Psi(k) = \sum_{k=0}^{\infty} \Psi(k)\eta(t-k) \tag{6}$$

where is indicated

$$\Psi(k) = \left\| \psi_s(k)\delta_{js} \right\|_{j,s=1}^{n} \tag{7}$$

Systems of equations

$$\Phi(k) = \Psi(k) + \sum_{j=1}^{k} \Phi(k-j)Q(j) \quad (k = 0,1,2,...) \tag{8}$$

lead to equalities

$$\begin{aligned} &\Phi(0) = \Psi(0) = E, \\ &\Phi(1) = \Psi(1) + \Phi(0)Q(1), \\ &\Phi(2) = \Psi(2) + \Phi(0)Q(2) + \Phi(1)Q(1), \\ &\Phi(3) = \Psi(3) + \Phi(0)Q(3) + \Phi(1)Q(2) + \Phi(2)Q(1), ... \end{aligned} \tag{9}$$

The system of equations (8), (9) can be taken as the definition of a semi-Markov, discrete-time, random process.

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KEY ASPECTS OF CORPORATE LEARNING MANAGEMENT DECISION MAKING

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The process of decision-making in corporate teaching management is a goal-oriented and result-oriented action that serves to minimize the situation of uncertainty and to carry out purposeful interactions of the subjects involved in the process. This interaction is seen as a transaction between individuals and their partners, where the corporate internal organization norms, rules, and educational requirements are met.

Interactive technologies and methods are the most effective methods in the decision-making process in corporate learning management. The main methods of these methods are business games and the creation of a professional environment for teaching - in our case, foreign language teaching.

In the process of decision-making in corporate learning management, the main focus is on standard and traditional models of decision-making. These models include the main stages of the process, such as determining the purpose of the decision, developing decision criteria, developing alternatives, and comparing them in different ways, and finally making the appropriate decision.

In terms of creating and organizing a database of foreign language teaching-learning materials, it is important to classify situations according to some sign. In our case the classification can be carried out mainly in two directions:

1. Situations used at the initial stage of foreign language learning, where the foreign language learner is given the opportunity to engage in more or less free speech activities and is limited to the general task in the given situation. By these tasks we mean the creation of situations that can be accomplished through a single simple speech action. Such situations can even be given a standard look, where any dialogue involving a small number of replicas will be used.

2. Situations used in the second stage of foreign language learning, where the language learner will create a situational environment where the spoken texts will be conditioned, the situational field and the task of the speaker, which is directly involved in the activities of the corporation and subsequently language skills as a corporate employee. As a condition himself.

The second direction of classification is in agreement with the most important feature of the communicative method, according to which situation is necessarily recognized not only for the development of skills, but also for the formation of habits.

The situation is a condition for the development of skills. The need to convince someone of something can naturally arise only when the situation is not given side by side, but is the result of events in which the co-participants are interlocutors. The wider and deeper the connection to the whole activity of a given situation, the easier it is for a motive to emerge. A very good context for the activity can be given by special films. It should be saturated with events, interesting (content) interesting, communicative direction (considering the field of communication), methodical films in nature.

During the decision-making process during the role play, the following signs are always taken into account:

The situation should be as close as possible to the functioning of the corporation;

The roles selected for foreign language learners should best match their job responsibilities and reflect the situation. Different role goals should be considered.

Foreign language learners participating in the role-playing game must make a decision in an imitative-interactive mode with the computer in a tandem, and the action in an ambiguous situational environment must be carried out in groups - collectively.

MATHEMATICAL MODELS OF MAKING DECISION IN ASSORTMENT AND INVENTORY MANAGEMENT

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Today, the management of the assortment of goods and inventory management have been considered independently by domestic and foreign researchers. This article (work) describes the model which shows to the enterprise the product names which are beneficial and their volume.

For construction of the model the task was: on the first stage - to find the optimal range of goods and level of their volumes, which is delivering an optimum to one or to another criterion of the optimal functioning of the enterprise; on the second stage – to define optimal strategy of management supplies determine the optimal inventory management strategy with an account of the found range of goods and their volumes.

Determining the optimal assortment of goods

For the normal functioning of the commercial enterprise, it is necessary that its income from the sale of goods not only covers all the current costs of storing and selling goods, but also makes profit. Otherwise, the trade organization will not ensure its effective development, and therefore its purpose in providing modern goods to the population. Consequently, from the many options for the assortment of goods, it is necessary to find one with the efficient use of available resources which would ensure excess demand of the population and bring the enterprise maximum profit.

Obviously, the company will not receive income if there isn`t enough goods and will suffer losses if the number of goods exceeds demand. The losses consist of the costs of their acquisition, storage, clearance sales and write-offs if the expiry date is reached.

Then we can assume that the expected profit from the sale of goods is equal to the expected income minus the costs of the enterprise, minus the expected loss.

Expected income of the company from the sale of the j-th product will be:

$$p_j r_j \text{, if } r_j \le x_j \text{,}$$

$$p_j x_j \text{, if } r_j \ge x_j \text{,}$$

where, x_j - the volume of *j*-th product or the group of products; p_j – retail price of *j*-th product, r_j – demand for the *j*-th product or the group of products. Let`s say, that x_j and r_j $(j = \overline{1,n})$ are continuous.

The expected income of enterprise from realization of all commodities will be:

$$F=\sum_{j=1}^{n}(p_j\int_{-\infty}^{x_j}r_j f\left(r_j\right)dr_j)+\sum_{j=1}^{n}(p_j x_j\int_{x_j}^{\infty}f\left(r_j\right)dr_j)-\sum_{j}^{n}c_j x_j-$$

$$-\sum_{j=1}^{n}\left(\pi_j\int_{x_j}^{\infty}\left(r_j-x_j\right)f\left(r_j\right)dr_j\right)+$$

$$+\sum_{j=1}^{n}\left(\lambda_j p_j\int_{-\infty}^{x_j}\left(x_j-r_j\right)f\left(r_j\right)dr_j\right)$$

The analysis of the inventory management problem showed that many situations of inventory management can be considered as a mass service problem, which takes into account the probabilistic nature of demand for inventories and in which the costs of the inventory management system includes losses associated with stock shortages, are minimal.

Let the goods that enter the mass service system act as requirements, and the consumers of goods are the serving devices. If there is no request for goods - stocks increase and form a queue. If the demand for goods exceeds supply, so there is a shortage and the consumers of goods are not served. Knowing the intensity of demand for goods, it is necessary to determine the optimal intensity of replenishment.

When the inventory level decreases to the critical level (“the point of the order”) P, the quantity of goods is ordered equal to Q units, so that $P+Q=M$, where M is the maximum level of goods (a predetermined maximum quantity of goods that a pharmacy can accept). To be defined either the point of the order P or the quantity of lot Q.

$$F=C_1\frac{\mu}{M-P}+C_2\frac{\mu^{P+1}}{\left(\mu+\lambda\right)^P\left[\mu+\left(M-P\right)\lambda\right]}\frac{\lambda}{\mu}\times$$

$$\times\left[\frac{1-\left(\frac{\mu+\lambda}{\mu}\right)^P\left(P+1-P\frac{\mu+\lambda}{\mu}\right)}{\left[1-\frac{\mu+\lambda}{\mu}\right]^2}+\left(\frac{M\left(M+1\right)-P\left(P-1\right)}{2}\right)\times\left(\frac{\mu+\lambda}{\mu}\right)^P\right]$$

The optimal value of the critical stock level is found from the necessary optimality conditions. Equating the derivative of the objective function F from P to zero, we obtain the nonlinear equation. Solving this equation numerically, we can find the optimal value of the critical stock level *P*, and from the equation - the optimal order size Q.

The presented model will allow finding the optimal assortment and strategy for replenishing stocks, numerically evaluate costs, setting various cost indicators and the intensity of demand and replenishment.

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APPLICATIONS OF TIME SERIES MODELS AND HILBERT-HUANG TRANSFORM FOR STOCK PRICE FORECASTING

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Technologies continue to have an increasingly significant impact on how stocks are traded in today's markets. Models that were proposed years ago are outdated if ones do not use some extra capabilities like NLP technologies for news, or other economic indicators for a particular company.

In this paper, previous time series models are improved with new exogenous variables without using any additional information about the company. The time-frequency analysis is used for our time series, and it is showed how much the usage of Hilbert-Huang transform outperforms usage of other transforms. In particular, the comparison of our model was made with other time-series models that use another kind of exogenous variables, such as the Fourier transform, and with Facebook's Prophet package, which uses the short-time Fourier transform. In all cases, the output of each transform is used as exogenous variables.

Besides the empirical results and plots for real stock data, the web-service for stock price forecasting was developed. Such an instrument can be a useful tool for stock traders in their daily routine. In addition to models that were used for comparison in this paper, web-service also has an integration with the TradingView website, which allows traders to add well-known indicators to make their trading strategy more reliable and efficient. Developed service use continuous integration techniques for time-series models' re-evaluation, to keep models updated to the real data. For each stock, service has several processes that simultaneously try to improve model results on the current data. Service provides fast and reliable work even for newly come data, known as the cold start problem, and the initial parameters are chosen from the previous models' results. When a trader wants to get a new forecast on any available stock, service takes the best parameters at that time from the database, reconstructs the time-series model on the fly to provide the most updated forecast.

Web-service is implemented using Python language with the Django web framework. Continuous development techniques (GitHub, Jenkins) are used to make service updated. All models' prototypes were written in Python but later were re-implemented in C++ for better performance.

INVESTMENT ASSETS PORTFOLIO CONSTRUCTION

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During the investment strategy formation, an extensive search and an assessment of alternative investment solutions are carried out, which most closely correspond to the Company’s image and the objectives of its development.

The process of strategic management of the Company’s investment activities is detailed in its tactical management through the Company’s investment portfolio construction.

The mutual investment fund faces the task of determining the structure of the optimal investment portfolio, this task can be solved by means of the Analytic hierarchy process, which provides the decomposition of the problem into simpler component parts. This determines the relative significance of alternatives that are studied for all hierarchy criteria. Relative significance is expressed as priority vectors.

The most significant elements of the problem are identified at the first stage, and the best way to check the test results and assessment of the elements at the second stage, the next stage is the decision analysis and assessment of its quality.

The process can be performed over a sequence of hierarchies. In this case, the results obtained in one of them are used as input data in the next.

In case of the pair-wise comparison of criteria is used the degree of their significance, alternatives according to the criteria, the degree of attractiveness. The ratio scale is used in both cases.

In this task are taken the following criteria of importance for the mutual investment fund: KI - risk degree; K2 – income value; K3 - risk hedging possibility; K4 - liquidity; K5 - tax advantages; K6 - minimum investment amount.

To compare the criteria and alternatives in pairs according to the criteria is used the scale from 1 to 9.

Comparing the alternatives concerning the criterion, the attractiveness alternatives for mutual investment fund are accepted, the effect of each criterion: A_1 - bank deposit; A_2 - money market instruments; A_3 - treasury bond; A_4 - ordinary shares; A_5 - precious metals; A6 - real estate.

The homogeneity of judgments is estimated by the homogeneity index (*HI*) or the homogeneity relation (*HR*):

$$HI = \left(\left(\lambda_{ma} x - n \right)^n \right) \Big/ \left(\left({}^n n - 1 \right)^n \right)$$

$$HR = \frac{HI}{M\left(HI\right)} \; ;$$

Where $\lambda_{ma} x$ is the largest eigenvalue of the pair-wise comparisons;

M (*HI*) – the average value (expected value) of *HI*.

For the matrix of the solvable task, (n = 6) M (*HI*) =1, 24.

The implementation of this model (DSM package, Optimal Multicriteria section) gives the following results:

Alternatives	Priority vector	Global priority					
	KI	K2	K3	K4	K5	K6	
A1	0.3489	0.0749	0.3776	0.4121	0.4392	0.4991	0.2788
A3	0.3739	0.4164	0.2818	0.2096	0.0671	0.2105	0.3344
A3	0.1048	0.1517	0.1682	0.1984	0.1457	0.0793	0.1438
A4	0.0965	0.2719	0 1071	0.1007	0.2812	0.1365	0.1653
AS	0.0382	0.0511	0.0362	0.04	0.0268	0.0426	0.0417
A6	0.0377	0.0341	0 0292	0.0350	0.0400	0.0360	0.0360
Priority / Homogeneity of	0.3303	0.3303	0.1340	0.1340	0.0416	0.0298	
λmax	6.4294	6.2336	6.4767	6.1135	6.2856	6.3152	
HI	0.0859	0.0467	0.0953	0.0227	0.0570	0.0630	
HR	0.0693	0.0377	0.0769	0.0183	0.0446	0.0508	

All *HR* assessments are <0.1, that tell us about the homogeneity of judgments. By this means, it can be concluded that the most attractive alternative for the investor during the diversified portfolio construction is money market instrument (priority 0,3344). Less attractive is bank deposit (priority 0,2788) and, finally, completely unattractive - precious metals (priority 0,0417) and real estate (priority 0,0360).

THE NECESSITY TO DEVELOP DIGITAL COMPETENCIES IN FUTURE TEACHERS

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The future of education is basically defined by modern information technologies. The whole world, especially developed countries, are trying to implement the establishment of information technologies in various fields, including education. Technical progress requires the education system to keep up with the novelties. Therefore, the education system is actively trying to develop information technology skills for children at an early age that enables them to live beneficially in this environment and to contribute to their development. Considering the national goals and general requirements of the society, the emergence of digital competences for the younger generation has been on the agenda. Digital literacy is the same as computer literacy.

Why is the formation of digital competence important for teenagers? Information and communication technologies promote creative and innovative approaches to the development of the students, the students' harmonious integration into the information society, increasing motivation, the formation of the skills and desire to study, helping them to master the knowledge and allowing the learner to identify and develop the skills, such as understanding the purpose; active reproduction of previously acquired knowledge.

The introduction of information technology in the educational process allows teacher: a qualitative change in teaching content, teaching methods and approaches, methods and organizational forms, the teaching of creative approaches, humanize the educational process, individualization, intensification which will result in improving the education quality.

The paper will discuss the activities that computer technology helps us to implement and are taught by future teachers in the teacher training program. Improvement of teaching-learning quality, motivation, and involvement of the students in the teaching process are possible only if first all, teachers will manage to improve and develop their competencies and skills.

SOLUTION OF SOME SEMANTICS PROBLEMS WITHOUT USING THE STANDARD LIBRARY

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Typically, artificial intelligence problems, in particular semantics, relate to recognition, which requires finding a of a certain standard in the database. Modeling these problems as combinatorial optimization problems allows you to describe the subject area fairly strictly and to show that the search for the corresponding standard in the database is done in two ways: by the primary characteristics that describe the searched object and by the given object. But there are problems in which the input data must be divided into segments, with subsequent determination of the similarity of the obtained parts. In this case, the input data contains both the object to be recognized and the standard against which it is compared. The problem is solved without a standard library. For example, the problem of segmenting an input signal is that it is necessary to set its periodicity or non- periodicity. In the first stage, the signal by certain rules is divided into segments. Of the second stage compares the adjacent segments and establishes their similarity with the subsequent determination of the periodicity or non-periodicity of the signal.

There are problems in which the standard information can be set analytically or algorithmically. Then, for comparison, it is enough to model the input data according to the same rules as the information that plays the role of the standard. This approach allows you to fully automate the process of solving a particular problem. For example, when using speech recognition, they use the phonemic approach [1]. According to certain rules, segments of the speech signal that correspond to the elements of phonetics are modeled: phonemes, diphons, triphons. Input information (a signal transmitted by a word or sentence) is divided into segments that correspond to the elements of phonetics. Recognition is made of individual sounds, which correspond to part of the word.

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THE CURRENT STATE OF DEVELOPMENT OF DISTANCE LEARNING IN UKRAINE AND ESTIMATION OF THE QUALITY OF TEST CONTROL OF KNOWLEDGE

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Informatization of education in Ukraine is one of the most important tasks that determines the main directions of modernization of the education system. An important role is given to methods of active knowledge, self-education, distance learning programs. Distance learning (DL) is a well-organized and controlled self-education using computer technology and communication networks.

At the National Academy of Statistics, Accounting and Audit (NASAA), the introduction of DL technologies in the educational process began in 2007. In the last few years, for the organization and technical support of DL most domestic higher education institutions have switched to the free open educational platform Moodle (https://moodle.org). Now the Moodle system is integrated into the information and educational environment of NASAA, in particular, fully synchronized databases of teachers and students, each of which has a personal profile on the site, which gives them access to the academic, educational, methodological, regulatory and information resources of the academy. The analysis of the experience of implementation and use of DL in NASAA showed that the blended form of DL based on the Moodle platform is the most adequate to the requirements of Ukraine's development in the framework of European education [1].

Criteria-based pedagogical tests are used in the learning process organized by NASAA - that is, those that measure the level of knowledge of the individual in relation to the full amount of knowledge, skills and abilities that students must master when studying the course. Students are tested on the Moodle platform. Some characteristics of the test quality are calculated inside the Moodle environment: average, median, standard deviation, asymmetry, excess, and so on. However, these indicators do not allow us to assess the complexity of test tasks.

Item Response Theory (IRT), in contrast to classical test theory, allows you to evaluate test assignments regardless of the level of preparation of each student in the sample; the level of preparation of students regardless of the set of test tasks used. We used a one-parameter logistics model Item Response Theory by G. Rush:

$$P_j(\theta) = \frac{e^{1,7\left(\theta-\beta_i\right)}}{1+e^{1,7\left(\theta-\beta_i\right)}}, \qquad (1)$$

where P_j - the probability of a successful answer to the i-th test task; θ - the level of readiness of the test subject; β_i - the level of complexity of the test task.

The proposed method of organization of test control of knowledge allows to estimate a set of test tasks invariantly to the level of preparation of students, level of mastering by students of a theme not on the basis of total number of correct answers, and on the basis of the set of test tasks [2,3].

The dual form of education is a tool for bridging the gap between the content of educational programs, curricula and the real needs of the labor market. NASAA has many years of experience in using distance learning for students who combine study with work. Now NASAA has created the preconditions for the introduction of a dual form of education [4].

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OPTIMAL CONTROL OF INPUT FLOW FOR RETRIAL SYSTEMS WITH QUEUE

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A significant part of the queueing theory is the results on of systems with repeated calls. These systems are considered in detail in [1],[2]. Within the framework of those models, qualitative characteristics of the stochastic system performance may be evaluated and optimal controlled problems be set and solved.

In retrial systems with queue, a call that has entered the system and finds all service devices busy is placed in a queue of limited length. If all the places in the queue are occupied, then the call leaves the system for some random time, and then again tries to get into the service queue.

It is believed that the call repeat until it takes its place in the service queue.

The paper deals with queueing system with repeated calls and queue in the case of unbounded queue of repeated calls. Such a system can be denoted by a symbol $\left[M|M|m|m+n\right]$, in which a rate of primary call flow λ_j depends on the loading of the system, i.e. on the number of calls in the line to be served. Every retrial sourse generates Poisson flow with the rate ν . Servise times at the each of *m* servers are independent exponentially distributed random values with the rate μ. The existence condition and the formulae for stationary distribution of the number of calls in the system are obtained in the case of bounded and unbounded line of repead calls.

The variable rate of the input flow in the $\left[M|M|m|m+n\right]$ - models allows to consider and to solve optimization problems in framework of the models. For threshold control strategies the optimization problem of the total income of the system was stated and solved. We deal with the consequences of result obtained for the case of one server and one place in the queue.

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THE CONVERGENCE OF FINITE ELEMENT METHOD FOR NUMERICAL SOLUTION OF EVOLUTIONARY PROBLEM

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The numerical solution of dynamic problems of mass transfer of pollutants remains an open question and requires effective ways of solving it. Therefore, the study is devoted to a numerical solution of a class of evolutionary problems describing the spread of inactive contaminants in the surface layers of agrilandscapes, which contamination occurred immediately in the initial time. This problems have models of the following form:

$$Zu \equiv \frac{\partial u}{\partial t} + Lu = -\lambda u_0 \varphi(x)\delta(t-0),$$

$$u(x,0) = 0, \quad x \in \Omega,$$

$$L_1 u\big|_{x\in\Gamma} = k \cdot \cos(\alpha(\Gamma)) c_0 q_0(x),\ t \in [0,T],$$
$$L_1 u\big|_{x\in\partial\Omega\backslash\Gamma} = 0,\ t \in [0,T],$$

in $Q = \Omega \times (0 \le t \le T)$, $\Omega \subset R^2$ with piecewise smooth boundary $\partial\Omega$, λ – decomposition, $\varphi(x)$ – the function describing the surface Γ, u_0 – surface contamination, k – conductivity coefficient for surface Γ, $\alpha(\Gamma)$ – the slope of the segment of Γ, q_0 – the flow of water coming from precipitation with a substance concentration c_0.

Differential operator $Z(u)$ is linear, not symmetric, not positively defined operator in $L_2(Q)$ and *H*, $\|u\|_H = \left(\int_Q \left[u_t^2 + \sum_{i=1}^{2} \left(\frac{\partial u}{\partial x_i} \right)^2 \right] dQ \right)^{1/2}$. Using $\|u\|_{L_2(Q)} \le \hat{c} \|u\|_H, \hat{c} = const > 0$, $\|Zu\|_{H^{*-}} \le c\|u\|_H$, $(Zu,u)_{L_2(Q)} \le c\|u\|_H^2$, $c = const > 0$ for any $u \in H$ [1], triangulation T_h (the set of elements e with the diameter h, $\Omega_h = \bigcup_{e\in \mathrm{T}_h} e$), approximation nodes a_i^e on each $e \in \mathrm{T}_h$ for second-order elements, functions $\{w_i\}_{i=1}^{n_e}$ (with small carriers) of orthonormal basis in $L_2(\Omega)$ we have approximate solution as $u_n^e(t,x) = \sum_{i=1}^{n_e} \alpha_i^e(t) w_i^e(x)$ and $V_h = \{u_n \in C^1(\Omega_h) : u_{n|_e} \in P_e\ \forall e \in \mathrm{T}_h\}$, $V_h \subset H^1(\Omega)$ for each $t \in (0,T)$.

Given the construction of Finite Element Method [2, 3] for any $v_n \in V_h$ and a fixed $t \in (0,T)$, we have $\left(Zu_h - f, v_h\right)_{L_2(\Omega)} = 0$. To obtain a convergence of this method, it must be shown that for any solution $\hat{u} \in L_2(Q)$ of problem the sequence is convergent to it on every finite element e under condition $h \to 0$, i.e. $\|Zu_n - f\|_{H^{*-}} \to 0, \|u_n - \hat{u}\|_H \to 0,$ $u_n \in V_h$.

To do this, for any $u_n^e \in V_h$, $v \in L_2(\Omega^e)$ for fixed $t \in (0,T)$ we consider on $W_2^1(\Omega)$ the bounded functional $g(u) = \int\limits_{\Omega^e} \sum\limits_{i=1}^{2} \frac{\partial}{\partial x_i}(u - \hat{u}) v d\Omega^e$, which gives the restriction of $\|u_n - \hat{u}\|_{L_2\Omega)}$. We have $|g(u)| \le \underline{C}' h \|\hat{u}\|_{W_2^1(\Omega^e)} \|v\|_{L_2(\Omega^e)}$ and $\left| \int\limits_{\Omega^e} (\sum\limits_{i=1}^{2} \frac{\partial}{\partial x_i}(u - \hat{u}))^2 d\Omega^e \right|^{1/2} \le \underline{C}' h \|\hat{u}\|_{W_2^1(\Omega^e)}$.

Extending $u = u_n^e$ with zero outside the Ω^e had justice $\|u - \hat{u}\|_{L_2(\Omega^e)} \le hC' \|\hat{u}\|_{W_2^1(\Omega^e)}$, $C' = const > 0$. Taking into account preliminary estimation obtained $\|u - \hat{u}\|_{W_2^1(\Omega^e)} \le h\hat{C} \|\hat{u}\|_{W_2^1(\Omega^e)}$, $\hat{C} = \max\{C', \underline{C}'\}$. Using from $\|(u - \hat{u})_t\|_{L_2(Q)} \le \hat{c} \|u - \hat{u}\|_{L_2(Q)}$ achieved $\|(u - \hat{u})_t\|_{L_2(Q)}^2 \le \int\limits_0^T h^2 (c')^2 \|\hat{u}\|_{W_2^1(\Omega)} dt$ and obtained $\|u - \hat{u}\|_H^2 \le h^2 \int\limits_0^T \|\hat{u}\|_{W_2^1(\Omega)} dt$. Considering $\|Zu\|_{H^{*-}} \le c\|u\|_H$ we get convergence of this method.

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NUMERICAL MODELING OF THE INTERCONNECTED PROCESSES MOISTURE AND HEAT AND MASS TRANSFER IN TWO-LAYER SOIL

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The interconnected processes are considered of moisture and heat and mass transfer in horizontal non-saturated two-layer soil mass.

The mathematical model of this problem in generally adopted specifications may be described by the following boundary value problem:

$$\frac{\partial}{\partial x}\left(D\left(c,\Theta,T\right)\frac{\partial c}{\partial x}\right)-v\ (c,\Theta,T)\frac{\partial c}{\partial x}-\gamma\left(c-C^{*}\right)+\frac{\partial}{\partial x}(D_{T}\frac{\partial T}{\partial x})=\frac{\partial(\Theta c)}{\partial t},$$

$$\frac{\partial}{\partial x}(K(c,h,T)\frac{\partial h}{\partial x})-\frac{\partial}{\partial x}\left(\upsilon\frac{\partial c}{\partial x}\right)-\frac{\partial}{\partial x}\left(\upsilon^{T}\frac{\partial T}{\partial x}\right)+f=\mu(h)\frac{\partial h}{\partial t},$$

$$\frac{\partial}{\partial x}(\lambda_{T}\frac{\partial T}{\partial x})-\rho C_{\rho}v\frac{\partial T}{\partial x}=C_{T}\frac{\partial T}{\partial t},\quad x\in(0;l),\ t>0,$$

$$v=-k(c,h,T)\frac{\partial h}{\partial x}+\upsilon\frac{\partial c}{\partial x}+\upsilon_{T}\frac{\partial T}{\partial x},\ x\in(0;l),t>0,$$

$$c(x,0)=C_{0}(x),\ l_{1}c(0,t)=C_{1}(t),\ l_{2}c\left(l,t\right)=C_{2}(t),\ x\in(0;l),t>0,$$

$$h(x,0)=H_{0}(x),\ h(0,t)=H_{1}(t),\ h(l,t)=H_{2}(t),\ x\in(0;l),\ t>0,$$

$$T(x,0)=T_{0}(x),\ T(0,t)=T_{1}(t),\ T\left(l,t\right)=T_{2}(t),$$

$$\left[h\right]=\left[v\right]=\left[c\right]=\left[T\right]=0,$$

$$\left[vc-D\frac{\partial c}{\partial x}\right]=\left[\rho C_{p}vT-\lambda_{T}\frac{\partial T}{\partial x}\right]=0$$

The numerical solution of this problem is found by a method of finite differences using the homogeneous difference scheme. Software was created on the basic of developed algorithms and a series of numerical experiments were done. As a result of the programming implementation on Python of the problem the distribution was found of the field of the concentration of salt and heat and moisture solutions.

MATHEMATICAL MODELING OF A ONE-DIMENSIONAL DEMOGRAPHIC PROCESS

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In this regard population migration processes in a one-dimensional case. We will use diffusion-convection models for modeling these processes. In particular mathematical model of this problem in a one-dimensional case in conventional notation can be described by the following boundary value problem[1-3]:

$$\frac{\partial}{\partial x}\left(D(x)\frac{\partial u}{\partial x}\right)-v(x)\frac{\partial u}{\partial x}+\gamma_1 u+\gamma_2 u=\frac{\partial u}{\partial t}, \qquad (1)$$

$$\mu(\varphi)\frac{\partial \varphi}{\partial t}=\frac{\partial}{\partial x}\left(K(x,u,\varphi)\frac{\partial \varphi}{\partial x}\right), v=K(x,u,\varphi)\frac{\partial \varphi}{\partial x}, \qquad (2)$$

$$u(x,v)=\tilde{U}_0(x), x\epsilon(0,l), \qquad (3)$$

$$l_1 u(0,t)=\tilde{U}_1(t), t>0, \qquad (4)$$

$$l_2 u(l,t)=\tilde{U}_2(t), t>0, \qquad (5)$$

$$\left[D(x)\frac{\partial u}{\partial x}-v(x)u\right]\Big|_{l=l_i}=0, \qquad (6)$$

$$\left(D(x)\frac{\partial u}{\partial x}-v(x)u\right)\Big|_{x=l_i+0}=\left(D(x)\frac{\partial u}{\partial x}-v(x)u\right)\Big|_{x=l_i-0}=r_i[u] \qquad (7)$$

where *u=u(x,t)* is density and population flows; $v(x)$ $\mathrm{V}(\mathrm{x})$ is population migration speed; $D(x)$ – population diffusion coefficient; (2) – determines the initial condition for population density; $\varphi(x,t)$ $\varphi_{(\mathrm{x,t})}$ – the potential of the attractiveness of the population; $\gamma_1(x,t)\gamma_{1(\mathrm{x,t})}$ – birth rate; $\gamma_2(x,t)$ – the mortality rate at point x at time t; l_i , $\mathrm{i}=1,2$ – operators which determines boundary conditions for density u at the ends of the segment $(0,l)$.

The boundary value problem (1) - (7) is a problem with discontinuous coefficients, since the diffusion coefficient $\mathrm{D}_{(\mathrm{x})}$, population flow rate, *v(x)* and coefficients $\gamma_{1(\mathrm{x,t})}$, $\gamma_{2(\mathrm{x,t})}$ $\gamma_{2(\mathrm{x,t})}$ tolerate discontinuities at points $x_i=l_i, i=\overline{1,n}$:

$$v(x)=v_i(x), x\epsilon(l_i,l_{i+1}), D(x)=D_i(x), x\epsilon(l_i,l_{i+1}), \qquad (8)$$
$$\gamma_k=\gamma_k^i, \quad x\epsilon(l_i,l_{i+1}), \quad i=\overline{0,n-1}, \quad k=1,2.$$

For the task (1) - (7) it is constructed monotonic difference scheme by integro-interpolation method and founded its numerical solution

[2,3]. We can improve the quality of analysis of the state of the migration system, to model and predict population migration based on the proposed model of studies of migration processes.

The software implementation of the corresponding computational algorithm is made in Python. Numerical experiments were carried out on the basis of software implementation to obtain population density at any time.

Thus, the constructed mathematical model (1) - (7) makes it possible to predict population migration processes in the region at different moments of time for different boundary conditions, as well as for different potentials of potentials φ_1 at points $x_i = l_i$.

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MATHEMATICAL MODELING OF THE PROSSES OF NON-ISOTHERMAL MOISTURE AND MASS TRANSFER DURING MICROIRRIGATION IN HORIZONTAL LAYERED SOILS

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The mathematical model of this problem in generally adopted specifications in domains $\Omega_i\left(t\right),\ i=\overline{1,\text{n}}$ may be described by the following boundary value problem:

$$\frac{\partial\left(D_T\left(c_i\right)\frac{\partial c_i}{\partial x}\right)}{\partial x}-v_i\frac{\partial c_i}{\partial x}-\gamma_i\left(c_i-C_i^*\right)+D_{T_i}\frac{\partial^2 T_i}{\partial x^2}=\frac{\partial\left(\Theta_i c_i\right)}{\partial t}\ , \tag{1}$$

$$\mu_i\left(h_i\right)\frac{\partial h_i}{\partial t}=\frac{\partial}{\partial x}\left(k_i\left(c_i,h_i,T_i\right)\frac{\partial h_i}{\partial x}\right)-\upsilon_i\frac{\partial^2 c_i}{\partial x^2}-\upsilon_i^T\frac{\partial^2 T_i}{\partial x^2}\ , \tag{2}$$

$$\lambda_i\frac{\partial^2 T_i}{\partial x^2}-\rho_i v_i c_p^i\frac{\partial T_i}{\partial x}=c_T^i\frac{\partial T_i}{\partial t}\ , \tag{3}$$

$$v_i=-k_i\left(c_i,h_i,T_i\right)\frac{\partial h_i}{\partial x}+\upsilon_i\left(c_i\right)\frac{\partial c_i}{\partial x}+\upsilon_i^T\frac{\partial T_i}{\partial x}, \tag{4}$$

$$\mathrm{c}_1\left(0,\mathrm{t}\right)=C_1\left(t\right),\mathrm{c}_n\left(l,\mathrm{t}\right)=C_2\left(t\right),\mathrm{c}_i\left(x,0\right)=C_0^i\left(x\right), \tag{5}$$

$$h_i\left(x,0\right)=H_0^i\left(x\right),\ h_1\left(0,\mathrm{t}\right)=H_1\left(t\right),\ h_n\left(l,\mathrm{t}\right)=H_2\left(t\right), \tag{6}$$

$$T_i\left(x,0\right)=T_0^i\left(x\right),\ T_1\left(0,\mathrm{t}\right)=T_1\left(t\right),\ T_\mathrm{n}\left(l,\mathrm{t}\right)=T_2\left(t\right). \tag{7}$$

Pairing conditions at the boundaries of layers:

$$\left[h\right]=\left[v\right]=\left[c\right]=\left[T\right]=\left[vc-D\frac{\partial c}{\partial x}\right]=\left[\rho c_p\upsilon T-\lambda\frac{\partial T}{\partial x}\right]=0, \tag{8}$$

On the humidity front $x=l\left(t\right)$, the conjugation conditions (8) and the following are specified:

$$h=-x=-l\left(t\right),\theta\frac{dl}{dt}=-k\frac{\partial h}{\partial x}+\upsilon\frac{\partial c}{\partial x}-\upsilon^T\frac{\partial T}{\partial x}. \tag{9}$$

MATHEMATICAL MODELING OF INFLUENCE OF HEAT AND MASS TRANSFER IN NON-STATIONARY STRESS-STRAINED STATE OF SOIL MASSIF WITH FREE SURFACE

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We considered the soil massif with a free surface in the conditions of heat and mass transfer in it. The soil massif has a thickness l and the free surface is at level l_1 (see Fig. 1).

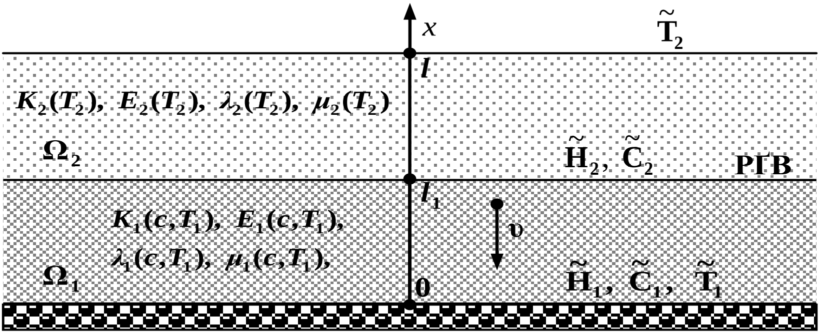

Fig. 1. The scheme of a soil massif with a free surface

The mathematical model of the set problem in general accepted notation can be described as the next one-dimensional boundary value problem (1)-(8) [1-2]:

Lame equation describing the stressed-strained state of the soil massif for displacement $U(x,t)$ with account for the heat and mass transfer in it:

$$\left(\lambda_i(c,T_i)+2\mu_i(c,T_i)\right)\frac{\partial^2 U_i}{\partial x^2}+\frac{\partial\left(\lambda_i(c,T_i)+2\mu_i(c,T_i)\right)}{\partial x}\frac{\partial U_i}{\partial x}-\left(\frac{\partial\left(\lambda_i(c,T_i)+2\mu_i(c,T_i)\right)}{\partial x}T_i+\right.$$
$$\left.+\left(\lambda_i(c,T_i)+2\mu_i(c,T_i)\right)\frac{\partial T_i}{\partial x}\right)\alpha_T^{(i)}+X_i=\frac{\partial^2 U_i}{\partial t^2},\ i=1,2,\ \ x\in(0,l),\ t>0, \quad (1)$$

where component of mass force is calculated by the formula

$$X_i = \begin{cases} \gamma_{зв} + \dfrac{dp}{dx}, & i = 1, \\ \gamma_{пр}, & i = 2, \end{cases} \quad (2)$$

the equation of convective diffusion in the presence of heat and mass transfer for the water-saturated area of the soil massif

$$\frac{\partial}{\partial x}\left(D(c,T_1)\frac{\partial c}{\partial x} \right) - \upsilon\frac{\partial c}{\partial x} - \gamma(c - C_m) + \frac{\partial}{\partial x}\left(D_T \frac{\partial T_1}{\partial x} \right) = n_p \frac{\partial c}{\partial t}, \quad x \in (0; l_1), \quad t > 0, \quad (3)$$

the convective heat transfer equation in both areas of the soil massif

$$\frac{\partial}{\partial x}\left(\lambda_T^{(i)} \frac{\partial T_i}{\partial x} \right) - \rho c_\rho \bar{\upsilon} \frac{\partial T_i}{\partial x} = c_T^{(i)} \frac{\partial T_i}{\partial t}, \; i = 1, 2, \quad x \in (0, l), \; t > 0, \quad (4)$$

the strain and stress are calculated by the formulas

$$\varepsilon_i = \frac{\partial U_i}{\partial x}, \quad \sigma_i = \left(\lambda_i(c,T_i) + \mu_i(c,T_i) \right)\left(\varepsilon_i - \alpha_T^{(i)} \bar{T}_i \right), \; i = 1, 2, \quad x \in (0, l), \quad t > 0. \quad (5)$$

The boundary conditions on the boundaries of the soil massif and the conditions for conjugation of the ideal contact for displacements have the form

$$l_1 U_1(0,t) = 0, \; l_2 U_2(l,t) = 0, \; t > 0, \quad (6)$$

$$U_1(l_1) = U_2(l_1),$$

$$E_1(c,T_1)\frac{\partial U_1(l_1)}{dx} - \alpha_T^{(1)}(T_1 - T_0) = E_2(T_2)\frac{\partial U_2(l_1)}{dx} - \alpha_T^{(2)}(T_2 - T_0), \quad (7)$$

$$U(x,0) = \tilde{U}_0^{(1)}, \; \frac{\partial U(x,0)}{\partial t} = \tilde{U}_0^{(2)}, \; x \in (0, l) \quad (8)$$

and with appropriate boundary conditions on the boundaries of the soil massif and the conditions for conjugation of the ideal contact for temperature, as well as the boundary conditions for the piezometric pressure and the concentration of salts on the boundaries of the water-saturated soils.

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TWO-DIMENSIONAL MATHEMATICAL MODEL OF CONTAMINANT TRANSPORT IN UNSATURATED CATALYTIC POROUS MEDIA

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The process of contaminant transport (e.g., fertilizers, pesticides, radionuclides etc) in layer of soil is considered (fig. 1).

The mathematical model of the corresponding process in unsaturated catalytic porous media in the nonlinear case can be described by the following boundary-value problem [1, 2]:

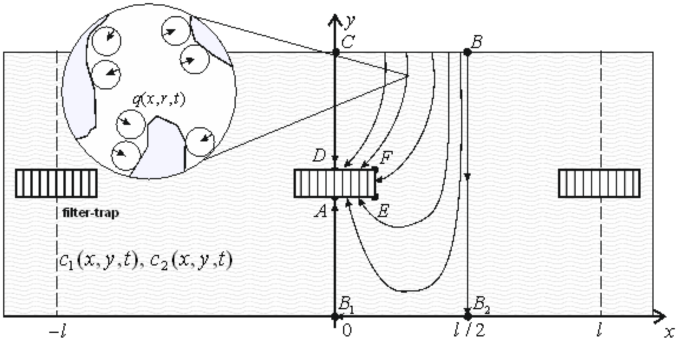

Fig. 1. Two-dimensional schematic illustration of the process

$$\frac{\partial\left(D_2(c_2)\dfrac{\partial c_2}{\partial x}\right)}{\partial x}+\frac{\partial\left(D_2(c_2)\dfrac{\partial c_2}{\partial y}\right)}{\partial y}+\gamma_1 c_1-\gamma_2 c_2-\theta_0\left.\frac{\partial q}{\partial r}\right|_{r=R}=\frac{\partial c_2}{\partial t},\quad (1)$$

$$\mu(h)\frac{\partial h}{\partial t}=\frac{\partial}{\partial x}\left(K(h,c_1)\frac{\partial h}{\partial x}\right)+\frac{\partial}{\partial y}\left(K(h,c_1)\frac{\partial h}{\partial y}\right)-$$
$$-\frac{\partial}{\partial x}\left(\nu_c\frac{\partial c_1}{\partial x}\right)-\frac{\partial}{\partial y}\left(\nu_c\frac{\partial c_1}{\partial y}\right)+f,\quad (2)$$

$$\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2 D_0(q)\frac{\partial q}{\partial r}\right)=\frac{\partial q}{\partial t}, \quad (3)$$

$$\upsilon_x=-K\left(h,c_1\right)\frac{\partial h}{\partial x}+\nu\frac{\partial c_1}{\partial x},\ \upsilon_y=-K\left(h,c_1\right)\frac{\partial h}{\partial y}+\nu\frac{\partial c_1}{\partial y}, \quad (4)$$

$$h\big|_{CB}=H_1,\ h\big|_{AEFD}=H_2,\ \frac{\partial h}{\partial n}\bigg|_{AB_1B_2B\cup CD}=0, \quad (5)$$

$$\frac{\partial q(x,y,r,t)}{\partial r}\bigg|_{r=0}=0,\ q(x,y,r,t)\big|_{r=R}=\frac{k_f\cdot c_2(x,y,t)^{\beta}}{1+\eta\cdot c_2(x,y,t)^{\beta}}, \quad (6)$$

$$l_1c_1\big|_{CB}=\tilde{C}_1^1(t),\ l_2c_2\big|_{CB}=\tilde{C}_2^1(t),\ \frac{\partial c_1}{\partial n}\bigg|_{\Gamma}=\frac{\partial c_2}{\partial n}\bigg|_{\Gamma}=\frac{\partial c_3}{\partial n}\bigg|_{\Gamma}=0, \quad (7)$$

$$\Gamma=BB_2\cup B_2B_1\cup B_1A\cup AE\cup EF\cup FD\cup DC, \quad (8)$$

$$c_1\big|_{t=0}=\tilde{C}_1^0(x,y),\ c_2\big|_{t=0}=\tilde{C}_2^0(x,y),\ q\big|_{t=0}=\tilde{Q}^0(x,y,r) \quad (9)$$

where c_1, D_1 are concentration and coefficients of convective diffusion of contaminant in the filtration flow respectively; c_2, D_2 are concentration and coefficient of molecular diffusion of contaminant in water connected with soil skeleton; $q(x,r,t)$, D_0 are concentration and diffusion coefficient of contaminant in particles with radius R, which located in soil skeleton; $K\left(h,c_1,T\right)$ is coefficient of moisure expansion; $\mu\left(h\right)$ is coefficient of moisture capacity; k_f,β,η are adsorption isotherm coefficients; θ_0 is coefficient of micro- or nanoparticle mass transfer influence on mass transfer near the ground skeleton; υ is moisture velocity; γ_1, γ_2 are mass transfer coefficients; ν is coefficients of chemical osmosis; x,y are coordinates; l_i, $i=\overline{1,2}$ are differential operators for boundary conditions; t is a time, $0<t<t_1$, r is radius (radial variable) $0<r<R$.

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EXISTENCE AND UNIQUENESS OF SOLUTION OF OPTIMAL CONTROL PROBLEM WITH A BOUNDARY FUNCTIONALS FOR A SCHRÖDINGER EQUATION WITH A SPESIAL GRADIENT TERMS

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We consider the problem of finding the minimum of functional

$$J_\alpha(v) = \|\psi - y\|^2_{L_2(S)} + \alpha\|v-\omega\|^2_H \qquad (1)$$

on the set of admissible controls

$$V \equiv \Big\{ v = v(x,t) = \big(v_0(x,t), v_1(x,t)\big),$$
$$v_m \in W_2^{1,1}(\Omega), \left|v_m(x,t)\right| \le b_m, \left|\frac{\partial v_m(x,t)}{\partial x_k}\right| \le d_m,$$
$$\left|\frac{\partial v_m(x,t)}{\partial t}\right| \le r_m, k = \overline{1,n}, m = 0,1, \overset{0}{\forall}(x,t) \in \Omega \Big\}$$

under conditions:

$$i\frac{\partial \psi}{\partial t} + \sum_{j,p=1}^{n} \frac{\partial}{\partial x_j}\left(a_{jp}(x)\frac{\partial \psi}{\partial x_p}\right) + i\sum_{j=1}^{n} b_{1j}(x,t)\frac{\partial \psi}{\partial x_j} - \quad , \qquad (2)$$
$$-a(x)\psi + v_0(x,t)\psi + iv_1(x,t)\psi = f(x,t), \ (x,t) \in \Omega$$

$$\psi(x,0) = \varphi(x), \ x \in D, \left.\frac{\partial \psi}{\partial N}\right|_S = \sum_{j,p=1}^{n} a_{jp}(x)\frac{\partial \psi}{\partial x_p}\cos\left(\nu \wedge x_j\right) = 0, \qquad (3)$$

where $i = \sqrt{-1}$ imaginary unit, $T > 0,\ b_m > 0, d_m > 0$, $\mathrm{r}_m > 0, m = 0,1,\ \alpha \ge 0$ are given numbers, $D \in R^n$ is a bounded domain, $x = (x_1, x_2, ..., x_n) \in D,\ 0 \le t \le T,$ $\Omega_t = D \times (0,t)$, $\Omega = \Omega_T, S \equiv \Gamma \times (0,T)$, Γ-is boundary of domain D, ν - exsternal normal of boundary Γ; $\psi = \psi(x,t)$ is wave function;

$a_{jp}\left(x\right), j,p=\overline{1,n}, a\left(x\right)$, $\mathrm{b}_{1j}(x,t), j=\overline{1,n}$ are measurable bounded real-valued functions that satisfy the conditions:

$$\mu_0\sum_{j=1}^{n}\left|\xi_j\right|^2 \le \sum_{j,p=1}^{n} a_{jp}\left(x\right)\xi_j\overline{\xi}_p \le \mu_1\sum_{j=1}^{n}\left|\xi_j\right|^2, \forall\xi_j\in\mathbb{C}, j=\overline{1,n}, \overset{0}{\forall} x\in D,$$

$$\mu_0,\mu_1 = const>0; \qquad (4)$$

$$\left|\frac{\partial a_{jp}\left(x\right)}{\partial x_k}\right| \le \mu_2\, j,p,k=\overline{1,n}, \overset{0}{\forall} x\in D \quad \mu_2=const>0; \qquad (5)$$

$$0<\mu_3\le a(x)\le\mu_4, \ \overset{o}{\forall} x\in D, \ \mu_3,\mu_4=const>0; \qquad (6)$$

$$\left|b_{1j}(x,t)\right|\le\mu_5, \ \left|\frac{\partial b_{1j}(x,t)}{\partial x_k}\right|\le\mu_6, \left|\frac{\partial b_{1j}\left(x,t\right)}{\partial t}\right|\le\mu_7, j,k=\overline{1,n}, \overset{0}{\forall}\left(x,t\right)\in\Omega,$$

$$b_{1j}\Big|_S=0, \ \mu_5,\mu_6,\mu_7=const>0; \qquad (7)$$

$\varphi(x)$, $f\left(x,t\right)$, $\mathrm{y}\left(\xi,t\right)$ are given complex-valued functions satisfying the conditions:

$$\varphi\in W_2^2(D), \frac{\partial\varphi}{\partial N}\Big|_\Gamma=0 \ ; \ f\in W_2^{0,1}\left(\Omega\right) \ ; \ y\in L_2\left(S\right) \ ; \qquad (8)$$

$\omega\in H$ is a given element, $H\equiv W_2^{1,1}\left(\Omega\right)\times W_2^{1,1}\left(\Omega\right)$ and the symbol $\overset{0}{\forall}$ means "for almost everywhere".

In this paper, in first the existence and uniqueness of solution of initial-boundary value problem (2), (3) for $\forall v\in V$ is investigated. Next, the existence and uniqueness theorems of the solution of the considered optimal control problem are proved [1,2].

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RENEWAL EQUATION IN NONLINEAR NORMALIZATION

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Consider renewal equation

$$X^{\varepsilon}(t) = A^{\varepsilon}(t) + \int_0^t F^{\varepsilon}(du) X^{\varepsilon}(t-u),$$

where $t \ge 0,\ \varepsilon > 0,\ \ A^{\varepsilon}(t),\ X^{\varepsilon}(t)$ - family of nonnegative matrix function and $F^{\varepsilon}(dt)$ - family of nonnegative matrix measures.

F^{ε} can be represented in the next form

$$F^{\varepsilon} = F + \delta_1(\varepsilon)B^1 + \delta_2(\varepsilon)B^2 + ... + \delta_n(\varepsilon)B^n,$$

where $B^1,..., B^n$ - matrices, $\delta_1(\varepsilon) \to 0,..., \delta_n(\varepsilon) \to 0,$ when $\varepsilon \to 0.$

The purpose of this work is to find the nonlinear normalization function for this renewal equation.

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STATISTICAL ANALYSIS OF LARGE SAMPLES UNDER UNCERTAINTY

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The principle of building empirical features a large array of data that are influenced by factors $A_1, \ldots, A_k$ based as well as to a random variable. All observations are divided into groups relative factors that affect them. The aim of this work is to find empirical distribution functions of random variables in each group.

Let factor affects the random variables factor affects the random variables and so on. $A_1 x_{11},\ldots,x_{1k} A_2 x_{21},\ldots,x_{2m}$ Find the number of segments in the group using factor A_1
formula:

$$v_1(x)=\sqrt{\max(x_{11},\ldots,x_{1k})-\min(x_{11},\ldots,x_{1k})}$$

where - the number of observations in the first leg. n_1

The relative frequency will look like:

$$\omega_i=\frac{n_{1i}}{n_1}$$

Based on this empirical distribution function is:

$$F_1(x)=\begin{cases}0, x<x_{11}\\ \dfrac{x_{11}}{n_1}, x=x_{11}\\ \ldots\\ 1, x=x_{1k1}\end{cases}$$

For the rest of the segments in the group factor A1 empirical distribution function constructed similarly

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A NUMERICAL METHOD FOR CALCULATE OF SOLUTION OF THE CAUCHY PROBLEM OF 2D LINEAR HYPERBOLIC EQUATIONS IN A CLASS OF DISCONTINUOUS FUNCTIONS

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In this study we develop a higher order sensitive finite differences schema for practical calculation of the Cauchy problem for 2D scalar advection equation with constant coefficient

$$u_t(x,y,t)+Au_x(x,y,t)+Bu_y(x,y,t)=0\#$$

Here, *A* and *B* are given constants.

In order to calculate the numerical weak solution we introduce the following as called an auxiliary problem

$$\frac{\partial}{\partial t}\int_a^x\int_c^y u(\xi\ \eta,t)\,d\xi d\eta + A\int_c^y u(x\ \eta,t)\,d\eta - -B\int_a^x u(\xi\ y,t)\,d\xi = H(x,a,y,b,t), \qquad (1)$$

$$u(x,y,0) = u_0(x,y). \qquad (2)$$

Here $H(x,a,y,b,t) = A\int_c^y u(a\ \eta,t)\,d\eta + B\int_a^x u(\xi\ c,t)\,d\xi,\quad u_0(x,y)$ is a known function having in Q some lines of discontinuity of first type.

For obtaining the numerical solution of problem (1),(2)

$$U_{i,j,k+1} = (1-\tau h_1 A - \tau h_2 B)U_{i,j,k} + \tau h_1 A\sum_{\mu=1}^{j} U_{0,\mu,k} + \tau h_2 B\sum_{\nu=1}^{i} U_{\nu,0,k} - \sum_{\nu=1}^{i-1}\sum_{\mu=1}^{j-1} U_{\nu,\mu,k+1} - U_{\nu,\mu,k} - \tau h_1 A\sum_{\mu=1}^{j-1} U_{i,\mu,k} - \tau h_2 B\sum_{\nu=1}^{i-1} U_{\nu,j,k} \ \#(3)$$

$$(i = 0,1,2,....N;\quad j = 0,1,2,...,M,\quad k = 0,1,2,...,)$$

is proposed. The initial condition for (3) is

$$U_{i,j,0} = u_0(x_i, y_j),\qquad (i = 0,1,2,....N;\quad j = 0,1,2,...,M).$$

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THE ADVANTAGES OF USING TECHNOLOGY IN TEACHING ENGLISH LANGUAGE TO MARITIME CADETS.

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Technology in the classroom within educational centers is the present of education. The use of new technology in language learning has become the perfect complement in reaching proficiency and fluency, and English courses accompanied by technological support are the most effective and attractive for cadets at the maritime academy who want to be successful in their learning.

It is well known that our new life is highly affected by the era of information technology, and educational technology plays an important role in today’s human society development. Based on this fact, it is essential to take advantage of the modern technological facilities in aiding the task of English language education. Cadets at the maritime academy trying to learn English as a second language need further language support.

Educational technology includes communication techniques for language teaching in which the personal computer plays a central role. There are, however, other technological tools that can be utilized in language learning besides computers.

In conclusion, we may say that Educational technology is indivisible part of education in the twenty-first century. When used correctly in the classroom, technology can allows students to experience situations and circumstances that the students of 20 years ago could only dream about. Through technology, books and figures can suddenly become alive and applicable to the real world. In addition, information technology provides an even greater avenue for interaction between teacher and students. At the English lessons different videos, exercises, games, listening may be done. Educational technology makes learning English available to a wider range of learners as well, and using technology in learning has become a real necessity nowadays. This paper has reviewed briefly how technology can be utilized in developing English language skills of the learners. Different methods for using technology in improving English language skills were discussed.

NOTE

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