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ABSTRACTS

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ABOUT MATHEMATICAL MODEL OF THE PROBLEM OF POWER DISTRIBUTION OF COMMUNICATION CHANNELS

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Many applied problems relate to the distribution of limited resources in hierarchical systems [1]. The main problem here is the formalization of the problem in the form of multi-index transport type problems with constraints in the form of linear inequalities. In this case it is assumed that the system contains three types of elements: source, intermediate (transshipment) points and consumer (subscriber) nodes. These elements and their relations are subjects to the conditions of limited resources that affect the amount of resources circulating in the system. There are "managed" elements that determine the conditions for the "effective" functioning of the system. Each managed item defines binary relationships on a suitable allowable range of resource allocation values. Relationships are determined by the preference (goal) functions formulated for the controlled elements. Thus, in the most general case, the problem of allocating resources in a hierarchical system consists in determining the variant of the permissible resource allocation, in which the target functions of the managed elements take extreme values. Such problems can be formally represented by multi-criteria problems under linear constraints and criteria whose types depend on the type of goal functions. Examples of such tasks are distribution of the load on the data transmission channels of Internet providers and production planning [2].

Conclusion. In this study, the application of the production and transport task is considered to solve the problem of the distribution of the limited capacities of data transmission channels between different nodes of the computer network. A scheme is proposed for reducing the problem to a two-level continuous-discrete optimization problem. The problem of optimal distribution of capacities with a criterion that takes into account the cost parameters of using external channels was solved. Further investigation of the problem of power distribution of data transmission channels is planned to be based on the use of the fuzzy approach.

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THE ANALYSIS/ASSESSMENT OF GERMAN AS A FOREIGN LANGUAGE TEXTBOOKS AND MEANING OF THEIR CRITERIA IN CHOOSING TEXTBOOKS

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There is a wide choice of foreign language textbooks on the Georgian market. Nowadays, the activity of offering foreign language textbooks to different institutions has grown into a business that prevents various institutions from making decisions independently.

The work aims to evaluate the textbooks of German language on the basis of approved criteria and the result must become public to Georgian educational institutions and on one hand this process will foster German teachers to make decisions without any advertising pressure when choosing the proper textbook.

The practical part of the work deals with two German language textbooks „Begegnungen” and „Menschen” and the survey was conducted at Batumi State University where the participants were German language professors. The research was carried out by means of quantitative method. The analysis of above mentioned textbooks was conducted on the basis of its structure, development of speech skills, learning targets and teaching methods [1].

The research has shown that German language textbooks „Menschen” gains more popularity and meets assessment criteria.

The research has also proved that a majority of pedagogues are master at using the textbook as an “instrument” and compiling the materials based on the requirements of listeners.

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SPECIALIZED DICTIONARIES IN TRANSLATORS' SERVICE

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Dictionaries have been written for countless years. Therefore, they have changed the shape, form and structure of the content. Today, when the development of lexicography is interconnected with technologies, printed dictionaries have almost been replaced by online dictionaries that allow for quick access to the word.

Based on today's technological achievements, when serious work is done to provide online text translation, Georgian-Turkish online space is limited to dictionaries such as: translate.ge, Glosbe, targmne.com and etc. Which according to users are more likely to be illogical and misleading. The accumulated lexicographical experiences have altered formed and content structure of dictionaries: In the second half of the 20th century, except for the description and comparison of linguistic systems, dictionaries were found to contain the description of cultural background beyond the language for the purpose of adequate translation.

Unfortunately, Georgian-Turkish lexicography does not have such dictionaries. On the background of the development of modern world lexicography, together with efforts of lexicographers and technologists, taking into consideration the word polysemy and grammar-semantic formalities, it is necessary to develop Georgian-Turkish Cultural electronic dictionaries, which provides convenient conditions of fast and adequate translation.

EFFECT OF WEIGHT FUNCTIONS IN NONLINEAR PART ON GLOBAL SOLVABILITY OF CAUCHY PROBLEM FOR SEMI LINEAR PSEUDO- HYPERBOLIC EQUATIONS WITH STRUCTURAL DAMPING

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We consider the Cauchy problem for the pseudo hyperbolic equation with structural damping

$$u_{tt} - \Delta u_{tt} + \Delta^2 u + (-\Delta)^\alpha u_t = a(x)f(u), \quad t > 0, \quad x \in R^n, \quad (1)$$

$$u(0, x) = \varphi(x), \quad u_t(0, x) = \psi(x), \quad x \in R^n, \quad (2)$$

where Δ is the Laplacian, $(-\Delta)^\alpha = F^{-1} \left[|\xi|^{2\alpha} F[\cdot] \right]$, and F is the Fourier transform, $a(x) \geq 0$, $a(x) \in L_q(R^n)$, $q > 1$, $f(u)$ is a real function and $|f(u)| \approx |u|^p$, $p > 1$.

A sufficient condition for the existence of global solutions is established, and the rate of decay of solutions to the Cauchy problem (1),(2) is found. The nonexistence of global solutions is also investigated.

More precisely speaking, we are interested in the influence of α on the critical exponent p_{crit} in p and q . This critical exponent is the threshold between global existence in time of small data solutions and blow-up behavior for some suitable range of p .

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A FACTORIZATION METHOD FOR THE DETERMINATION OF THE FUNDAMENTAL SOLUTION TO THE LINEAR 1/3-ORDER ELLIPTIC EQUATION

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It is known that factorization method is used to derive some results for the less after high derivative. Here we use this method to obtain fundamental solution from Cauchy-Riemann equation to the linear 1/3-order elliptic equation. The fundamental solution of the first order elliptic Cauchy-Riemann equation

$$(D_2 + iD_1)U(x) = \delta(x). \quad (1)$$

Is in the form [1]

$$U(x) = \frac{1}{2\pi} \cdot \frac{1}{x_2 + ix_1} = \frac{(-1)!}{2\pi} \cdot \frac{(x_2 + ix_1)^{-1}}{(-1)!} = \frac{(-1)!}{2\pi} \cdot \frac{i^{-1}(x_1 - ix_2)^{-1}}{(-1)!}. \quad (2)$$

Then we get the expressions

$$\frac{\partial U(x)}{\partial x_2} = \frac{1}{2\pi} \cdot \frac{-1}{(x_2 + ix_1)^2}, \quad \frac{\partial U(x)}{\partial x_1} = \frac{1}{2\pi} \cdot \frac{-i}{(x_2 + ix_1)^2}. \quad (3)$$

Let's factorize equation (1) as follows

$$\left(D_2^{\frac{1}{3}} - iD_1^{\frac{1}{3}} \right) \cdot W(x) = \delta(x), \quad (4)$$

$$W(x) = \left(D_2^{\frac{2}{3}} + iD_1^{\frac{1}{3}}D_2^{\frac{1}{3}} - D_1^{\frac{2}{3}} \right) U(x). \quad (5)$$

It is known that [2] for any real numbers α and β

$$D^\beta \frac{x^\alpha}{\alpha!} = \frac{x^{\alpha-\beta}}{(\alpha-\beta)!}, \quad (\beta \leq \alpha). \quad (6)$$

Then using formula (6) from (5) we get

$$\begin{aligned} W(x) &= \left(D_2^{\frac{2}{3}} + iD_1^{\frac{1}{3}}D_2^{\frac{1}{3}} - D_1^{\frac{2}{3}} \right) \cdot \frac{(-1)!}{2\pi} \cdot \frac{(x_2 + ix_1)^{-1}}{(-1)!} = \\ &= \frac{(-1)!}{2\pi} \cdot \frac{(x_2 + ix_1)^{-\frac{5}{3}}}{(-\frac{5}{3})!} + i \frac{(-1)!}{2\pi} D_1^{\frac{1}{3}} \cdot \frac{(x_2 + ix_1)^{-\frac{4}{3}}}{(-\frac{4}{3})!} - \frac{(-1)!}{2\pi} D_1^{\frac{2}{3}} \frac{i^{-1}(x_1 - ix_2)^{-1}}{(-1)!} = \\ &= \frac{(-1)!}{2\pi} \cdot \frac{(x_2 + ix_1)^{-\frac{5}{3}}}{(-\frac{5}{3})!} + i \frac{(-1)!}{2\pi} i^{-\frac{4}{3}} \cdot \frac{(x_1 - ix_2)^{-\frac{5}{3}}}{(-\frac{5}{3})!} + i \frac{(-1)!}{2\pi} \cdot \frac{(x_1 - ix_2)^{-\frac{5}{3}}}{(-\frac{5}{3})!} = \\ &= \frac{(-1)!}{2\pi} \cdot \frac{(x_2 + ix_1)^{-\frac{5}{3}}}{(-\frac{5}{3})!} + \frac{(-1)!}{\sqrt[3]{i} \cdot 2\pi} \cdot \frac{(-i)^{-\frac{5}{3}}(x_2 + ix_1)^{-\frac{5}{3}}}{(-\frac{5}{3})!} + i \frac{(-1)!}{2\pi} \cdot \frac{(-i)^{-\frac{5}{3}}(x_2 + ix_1)^{-\frac{5}{3}}}{(-\frac{5}{3})!} = \\ &= \frac{(-1)!}{2\pi} \cdot \frac{(x_2 + ix_1)^{-\frac{5}{3}}}{(-\frac{5}{3})!} \left[1 + \frac{1}{\sqrt[3]{i} \cdot (-i)^{\frac{2}{3}} \sqrt[3]{(-i)^2}} + \frac{i}{(-i)^{\frac{2}{3}} \sqrt[3]{(-i)^2}} \right] = \end{aligned}$$

$$= \frac{(-1)!}{2\pi} \cdot \frac{(x_2 + ix_1)^{-\frac{5}{3}}}{\left(-\frac{5}{3}\right)!} \left[1 + 1 - \frac{1}{\sqrt[3]{-1}} \right] = \frac{3 \cdot (-1)!}{2\pi} \cdot \frac{(x_2 + ix_1)^{-\frac{5}{3}}}{\left(-\frac{5}{3}\right)!}. \quad (7)$$

Theorem. The fundamental solution of the two-dimensional linear $1/3$ - order elliptic equation is in the form

$$W(x) = \frac{3 \cdot (-1)!}{2\pi} \cdot \frac{(x_2 + ix_1)^{-\frac{5}{3}}}{\left(-\frac{5}{3}\right)!}.$$

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ON A SOLUTION OF THE CAUCHY PROBLEM FOR THE DISCRETE EQUATION WITH POWERATIVE-MULTIPLICATIVE-ADDITIVE DERIVATIVES

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It is known that the discrete additive derivative is defined as:

$$f_n^{(I)} = f_{n+1} - f_n, \quad n \geq 0$$

and discrete multiplicative derivative as:

$$f_n^{[I]} = \frac{f_{n+1}}{f_n}, \quad n \geq 0.$$

Since the power operation has two inverses one can define the discrete powerative derivative by the following two ways:

The first definition:

$$f_n^{\{I\}_1} = \sqrt[n]{f_{n+1}}, \quad n \geq 0.$$

The second definition:

$$f_n^{\{I\}^2} = \log_{f_n} f_{n+1}, \quad n \geq 0.$$

Consider the Cauchy problem for the following fractional derivative equation

$$\left(\left(y_n^{\{I\}} \right)^{[I]} \right)^{(I)} = f_n, \quad n \geq 0, \quad (1)$$

$$y_0 = \alpha, \quad y_1 = \beta, \quad y_2 = \gamma, \quad (2)$$

where f_n , $n \geq 0$, α , β and γ are the given constants.

Using the definition of the additive derivative equation (1) may be written in the form

$$\left(y_{n+1}^{\{I\}} \right)^{[I]} - \left(y_n^{\{I\}} \right)^{[I]} = f_n, \quad n \geq 0. \quad (3)$$

If to sum the expressions obtained from (3) for the different values of n we get the relation

$$\left(y_n^{\{I\}} \right)^{[I]} = \left(y_0^{\{I\}} \right)^{[I]} + \sum_{k=0}^{n-1} f_k. \quad (4)$$

If to consider conditions (2) this gives:

$$\left(y_n^{\{I\}} \right)^{[I]} = \frac{\beta \sqrt[I]{\gamma}}{\alpha \sqrt[I]{\beta}} + \sum_{k=0}^{n-1} f_k. \quad (5)$$

Using the definition of the multiplicative derivative multiplying the expressions obtained for the different values of n in (5) we obtain:

$$y_n^{\{I\}} = \alpha \sqrt[I]{\beta} + \sum_{k=0}^{n-1} g_k \equiv h_n, \quad n \geq 1. \quad (6)$$

Finally using the definition of the power derivative solving the equation obtained for the different values of n in (6) one can get the expression.

$$y_n = h_{n-1}^{h_{n-2} \cdots h_1 h_0^\alpha}, \quad n \geq 3. \quad (7)$$

Thus we come to the following.

Theorem. If f_n , $n \geq 0$, α , β and γ are the given constants satisfying $\beta > 0$, $\gamma > 0$, then the unique solution of Cauchy problem (1) - (3) is in the form (7).

ON CONVERGENCE TO CONTINUOUS STATE SPACE BRANCHING PROCESS.

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The limit theorems on convergence of Galton-Watson branching processes to continuous state space branching process were obtained in different works.

In the work, the similar results is obtained for Bellman-Harris branching processes.

Bellman-Harris processes differ from Galton-Watson processes only by that from the moment of appearance of particle to its conversion moment passes some random time called lifetime. Distribution of lifetime is the same for all particles and independent on the structure of population.

Let , $m=1,2,\dots$; $t \geq 0$ be a sequence of Bellman-Harris branching process with generating function $F^{(m)}(t; s) = M \left[s^{\eta^{(m)}(t)} \middle| \eta^{(m)}(0) = 1 \right]$ and with lifetime distribution function of one particle $G_m(t) = P\{l_m \leq t\}$.

Denote $a_m = \int_0^\infty t dG_m(t) < \infty$, $A_m = \left. \frac{dF^{(m)}(s)}{ds} \right|_{s=1}$, $F^{(m)}(s) = F^{(m)}(1; s)$.

We assume that there exists such positive constants $b_n^{(m)}$, $n = 0, 1, 2, \dots$ that $\lim_{t/a} \frac{b_{[t/a]}^{(m)}}{b_t^{(m)}} < \infty$ as $n = [t/a], t \rightarrow \infty, m \rightarrow \infty, n(1 - A_m) \rightarrow 0$.

In determined conditions on $F^{(m)}(t; s)$, A_m and a_m , the limit theorem about convergence Bellman-Harris normalized processes $\mu_t^{(m)}(\tau) = \frac{\eta^{(m)}(\tau)}{b_{[t/a]}^{(m)}}$ to continuous state space branching process is obtained.

DEVELOPMENT OF THE DECISION MODEL ON THE PETRI NETS

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A model of automation of the decision-making and adaptive fuzzy control of water pumps based on Petri Nets (PN) is proposed.

Due to the imbalance between the inflowing stream and the throughput, the frequency of turning on and off of the pumps is increased [1]. A system of decision-making and management is necessary, which would not depend on the individual qualities of the staff and would ensure load reduction.

Based on the criteria for the operation of water pumps, respectively to the water levels in the pump well, which are used by a qualified worker, many of the positions and transitions of the Petri Nets are described:

Positions: P1 — sensor of registration; P2 — the water level in the pump well is increased; P3 — the water level in the pump well is decreased; P4 — the water level in the pump well is normal;

Transitions: t1 — input of the data from the registration sensor into the system; t2 — activation of the pump; t3 — shutdown of the pump.

The matrix of input incidents from positions to transitions and the matrix of output incidences from transitions to positions D^+ and D^- are formed as follows:

$$D^+ = \begin{vmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{vmatrix}, \quad D^- = \begin{vmatrix} 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{vmatrix}.$$

On the basis of incidence matrices, a model is built on CPN Tools [2]. Machine experiments of the simulations of the network were carried out and results were obtained in the form of a state space.

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DETERMINING THE COEFFICIENT ON THE RIGHT SIDE OF ELLIPTIC EQUATIONS

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The goal of this paper is to study the well-posedness of an inverse problem of determining the unknown coefficient on the right side of elliptic equations of reaction-diffusion type. The uniqueness theorem for the solution of the considered inverse problem is proved, and the "conditional" stability estimate is obtained.

We consider an inverse problem of determining a pair of functions $\{f(x), u(x, y)\}$ from the conditions

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = f(y)g(u), \quad (x, y) \in D = (a, b) \times (\gamma_1(x), \gamma_2(x)), \quad (1)$$

$$u(x, y) = \varphi(x, y), \quad (x, y) \in \partial D, \quad \int_a^b u(x, y) dx = h(y), \quad y \in [(\gamma_1(x), \gamma_2(x))], \quad (2)$$

by the known functions $g(p)$, $\varphi(x, y)$, $h(x)$, $\gamma_1(x)$, $\gamma_2(x)$.

Theorem. Let

- 1) the function $g^i(p)$ are defined and continuous for any $p \in R$; there exists a constant $c_0 > 0$ such that for all $p, q \in R$ $|g^i(p) - g^i(q)| \leq c_0 |p - q|$; $\varphi^i(x, y) \in C^{2+\alpha}(\partial D)$; $h^i(x) \in C^{2+\alpha}(\overline{D}')$; $\gamma_1(x), \gamma_2(x) \in C^{1+\alpha}(\overline{D}')$.
- 2) the functions $\{f^i(x), u^i(x, y), i=1, 2\}$ are the solution of the problem (1)-(2) and belongs to the following class

$$K_\alpha = \left\{ (f, u) \mid f(x) \in C^\alpha(\overline{D}'), \quad u(x, y) \in C^{2+\alpha}(\overline{D}), \quad |f(x)| \leq c_1, \quad x \in \overline{D}', \right. \\ \left. |D_{x,y}^l u(x, y)| \leq c_2, \quad l = 0, 1, 2, \quad (x, y) \in \overline{D}, \quad c_1, c_2 \text{ are some constant numbers.} \right.$$

Then the solution of the problem (1)-(2) for $(x, y) \in \overline{D}$ is unique and the "conditional" stability estimate is valid:

$$\|f^1 - f^2\|_0 + \|u^1 - u^2\|_0 \leq c_3 \left[\|g^1 - g^2\|_0 + \|\varphi^1 - \varphi^2\|_2 + \|h^1 - h^2\|_2 \right], \quad (3)$$

where $c_3 > 0$ is independent of the data of the problem (1)-(2) and the set K_α .

AN OPTIMAL CONTROL PROBLEM FOR FINANCIAL FLOWS SHOWN WITH STATE OF LINEAR SYSTEMS

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In this paper, the following problem of optimal control of financial flows is considered. The functional needs to be minimized:

$$J_{\alpha}(u) = \beta_0 x(T, u) - y_0^2 R^n + \beta_1 x - y_1^2 L_2^{(m)}(0, T) + \alpha u - \omega^2 L_2^{(m)}(0, T) \quad (1)$$

on the set:

$$U = \left\{ U = u(t) : u \in L_2^{(m)}(0, T), u_{L_2^{(m)}(0, T)} \leq b_0 \right\}$$

under the conditions:

$$\dot{x}(t) = A(t)x(t) + B(t)u(t) + f(t), \quad 0 \leq t \leq T, \quad (2)$$

$$x(t_0) = x_0. \quad (3)$$

Where $T > 0$ –given moment of time; $\alpha \geq 0$, $b_0 \geq 0$, $\beta_0 \geq 0$, $\beta_1 \geq 0$ – given numbers and $\beta_0 + \beta_1 \neq 0$; $\omega = \omega(t) = (\omega_1(t), \omega_2(t), \dots, \omega_m(t))$ – a pre-planned financial flow vector at the time ; $y_0 = (y_{01}, y_{02}, \dots, y_{0n})$, y_{0j} , $j = \overline{1, n}$ –pre-planned financial flow received by the j-client from the bank at time $t = T$; $x_0 = (x_{01}, x_{02}, \dots, x_{0n})$, x_{0j} , $j = \overline{1, n}$ –specified numbers describing the initial state of the financial flow in the enterprise; $u(t) = (u_1(t), u_2(t), \dots, u_m(t))$, $u_i(t)$, $i = \overline{1, m}$ –financial flow of the i -source of finance at the time point t ; $x(t) = (x_1(t), x_2(t), \dots, x_n(t))$, $x_j = x_j(t)$, $j = \overline{1, n}$ –the financial flow received by the j-client from the bank at the time point t ; $y_1 = (y_{11}, y_{12}, \dots, y_{1n})$, $y_{1j} = y_{1j}(t)$, $j = \overline{1, n}$ –pre-planned financial flow received by the j-client from the bank at the time point t ; $A(t) = \{a_{jk}(t)\}$, $j, k = \overline{1, n}$ and $B(t) = \{b_{ki}(t)\}$, $k = \overline{1, n}$, –given matrices; $f(t) = (f_1(t), f_2(t), \dots, f_n(t))$ – given functions. Matrices of $A(t)$ and $B(t)$ and functions of $f(t)$ are determined by the

internal laws of financial process in the enterprise. The elements of matrices of $A(t)$ and $B(t)$ are measurable limited functions and the elements of vector of $f(t)$ are the quadratic integrable functions.

In this paper, the existence and the uniqueness theorems for solving optimal control problem (1)-(3) are proved. The necessary and sufficient conditions for the solution of the problem are shown. It should be noted that the optimal control problem for non-linear financial systems was previously examined in the work [1].

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FOR SOCIOLOGICAL ESTIMATIONS OF DECISION MAKING PROCESSES IN SOCIAL SCIENCES

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The present paper aims to analyze the process of decision making which is the object of interdisciplinary research. The definition of decision making is presented and the stages, limitations and simplification strategies of decision making are also discussed. This paper also deals with the scientific disciplines which examines decision making and with research paradigms widely used in decision making analysis. These paradigms are rational decision making and naturalistic decision making. The paper also gives an overview of approaches to understanding decision making from the point of social science.

The paper outlines that decision-making is the process by which individuals and groups identify, combine, and integrate information in order to choose one of several possible courses of action. In social science, research traditions involve the cognition, affect, and behavior that drive both individual decision-making (including attitudes, beliefs, values, and actions) and group decision-making (including group formation, group preference, performance and influence, social decision schemes, straw poll, social comparison, and groupthink). Although some social philosophers have taken up decision-making as a focused

research interest, social philosophy generally is seen as informing the emerging interdisciplinary areas of the decision sciences [1]. As a topic area within social philosophy, decision-making is not guided by a single theoretical framework that researchers use to organize and guide their work. Rather, a number of theories in which decision-making is either explicit or implicit can be found within symbolic interactionism, exchange theory, rational choice, cognitive consistency theories, and other research on attitudes, beliefs, values, and behaviors. Dissonance theory, for instance, is a comprehensive framework that describes cognition and behavior before, during, and after people make decisions. It is based upon the general proposition that inconsistent cognitions arouse an unpleasant subjective [2]...

The paper discusses that in everyday life - and especially while interacting with others - decision making situations are highly complex and unstructured. For example, if we want to decide how trustworthy or angry a person is, we have to integrate information such as facial expressions, gestures, tone of voice, and the pragmatics of language. The ability to understand and infer other peoples' thoughts, feelings, and intentions is referred to as "social cognition" or "theory of mind". Based on this understanding of the mental states of others, we make predictions about their behavior and adjust our own behaviors in response. Furthermore, we use this ability to make judgments as to whether certain behaviors represent violations of moral or social norms [3].

The paper tells that the ability to experience empathy represents another way we understand and predict other people's behavior. Empathy extends social cognition (cognitive perspective taking) by adding an emotional component: we feel for others. Specifically, when we see somebody in pain we do not only understand his or her situation cognitively, we will also likely share that feeling to a certain degree. We are interested in both the cognitive as well as emotional factors that contribute to social decisions. One of the questions we are currently trying to understand is how individual differences in emotional reactivity or in the ability to cognitively process emotions affects decision making in social contexts. Using some functional philosophical measures, as well as in-house developed social tests that are relevant to everyday life, we are trying to elucidate how and where in the brain of healthy individuals social decisions are processed.

The paper concludes that social workers continually make decisions: which peer reviewers to assign, whether to accept a submission, where

in an issue to place which paper, and more. What can research on the sociology of decision making tell us that might improve the process? Arthur Markman, professor of sociology at the University of Texas, provided some answers. Among his main points were the following. Because exhaustive evaluations of most things are too time-consuming to be feasible, people develop strategies to reach acceptable decisions more simply and quickly. For example, most journal editors cannot thoroughly assess all manuscripts they receive. Therefore, like others, they use strategies that maximize accuracy while minimizing effort, for example, culling papers that seem poor rather than sending all papers for peer review. The magnitude of resources expended can influence decisions [4]. For example, when people have invested considerable time in a project, they tend not to abandon the project even if it is going poorly. When social workers have worked hard to improve a paper, they may feel obliged to publish it even if it still is not very good. In making decisions, people draw largely on the information that comes to mind most easily. Thus, in choosing social workers tend to select repeatedly experts of whom they are most immediately aware. Use of a database of potential reviewers can help to overcome this tendency. When making judgments about items, people consider their similarity to other items in the same class. Papers that deviate from norms are often poorly received by social workers; this tendency can lead to bias against papers that are from other countries and therefore do not conform to usual modes of presentation. Even when successive events are random, people perceive patterns [4]. Therefore, editors and reviewers focus largely on weaknesses rather than strengths; they worry more that they will publish seriously flawed work than that they will reject work that is worthy. That tendency can result in failure to publish innovative work. To help to overcome the tendency, editors can give reviewers instructions that elicit information on the significance and strengths of the work being reviewed.

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ON CONJUGATE TRIGONOMETRIC SERIES

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Below we suppose that $T = [-\pi, \pi]$ and functions $f : R \rightarrow R$ are 2π - periodic. For $f \in L(T)$, by $\sigma[f]$ and $\bar{\sigma}[f]$ we denote Fourier trigonometric series of f and its conjugate series respectively, i. e.

$$\sigma[f, x] = \frac{a_0}{2} + \sum_{k=1}^{\infty} a_k \cos kx + b_k \sin kx, \quad k = 0, 1, 2, \dots$$

$$\bar{\sigma}[f, x] = \sum_{k=1}^{\infty} -b_k \cos kx + a_k \sin kx, \quad k \in N,$$

where $a_k \equiv a_k(f) = \frac{1}{\pi} \int_T (t) \cos ktdt, \quad k \in N,$

$$a_k \equiv a_k(f) = \frac{1}{\pi} \int_T (t) \sin ktdt, \quad k \in N. \quad b_k \equiv b_k(f) = \frac{1}{\pi} \int_T (t) \sin ktdt, \quad k \in N.$$

We imply, that $\bar{f}_n(x) = -\frac{1}{2\pi} \int_{\frac{\pi}{n}}^{\pi} [f(x+t) - f(x-t)] \cot \frac{t}{2} dt, \quad n > 1.$

If $p \in [1, +\infty]$ and the function $f \in L^p(T)$, then

$$\|f\|_p = \left\{ \frac{1}{2\pi} \int_T |f(t)|^p dt \right\}^{\frac{1}{p}}, \quad p \in [1, +\infty].$$

Therefore $L^\infty(T) \equiv C(T)$ and $\|f\|_c = \|f\|_\infty = \sup_{x \in T} |f(x)|.$

Below $A(\alpha)$, $A(p)$, $A(\alpha, p)$ they indicate absolute or positive values, depending only indicated parameters.

Theorem 1. Let, $p \in [1, +\infty[$ and $f \in C(T)$. Then

$$\|t_n^{-\frac{1}{p}}(f) - \bar{f}_n\|_c \leq A(p) \left\{ \omega \left(\frac{1}{n^{\frac{1}{1-\frac{1}{p}}}}, f \right)_c + n^{\frac{1}{p}} \omega \left(\frac{1}{n}, f \right)_p (\ln n)^{1-\frac{1}{p}} \right\}.$$

ON DIFFERENTIAL-DIFFERENCE PURSUIT PROBLEM WITH ONE EVADER AND SEVERAL PURSUERS

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Consider the problem of group pursuit with v pursuers and one evader whose dynamics is describes by the linear differential-difference system in an Euclidean space $\mathbf{R}^{n_i}$:

$$\dot{z}_i(t) = bz_i(t - \tau_i) + u_i(t) - v(t), \quad z_i \in \mathbf{R}^{n_i}, \quad i = 1, \dots, v$$

with the initial condition

$$z_i(t) = z_i^0(t), \quad -\tau_i \leq t \leq 0, \quad i = 1, \dots, v.$$

Here $0 < b < 1$, $\tau_i > 0$.

Permissible controls are Lebesgue measurable functions that take values from compacts U_i and V :

$$U_i = \{u_i \in \mathbf{R}^{n_i} : \|u_i\| \leq 1\}, \quad i = 1, \dots, v, \quad V = \{v \in \mathbf{R}^{n_i} : \|v\| \leq 1 - b\}.$$

The terminal set has a cylindrical form:

$$M_i^* = M_i = M_i^0 = \{z_i \in \mathbf{R}^{n_i} : z_i = 0\}, \quad L = \mathbf{R}^{n_i},$$

π_i - the identity operator.

The Pontryagin's condition uniquely determines the selections $\gamma_i(t) \equiv 0$, $i = 1, \dots, v$.

The guaranteed time of the game termination is found, and corresponding control laws via method of resolving function [1] are constructed. The integral presentation of game solution is based on the time-delay exponential [2].

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TWO- AND THREE STEP METHODS BASED ON THE DECENT METHOD FOR SOLVING SYSTEM OF NONLINEAR EQUATIONS

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Consider the system of nonlinear equations

$$P(x) = 0, \quad P: R^n \rightarrow R^m, n \geq m \quad (1)$$

There are a many of methods for solving (1). In the case of small n , the Newton method and the difference of modifications works efficiently. Unfortunately, in the case of sufficiently large n , efficiency of these methods is significantly reduced. In order to reduce the number of computations and reduce the computational time, we propose the following algorithm.

In two step modification of the descent method, the vector of decay h_k is selected in the form of the same combination, namely:

$$\begin{aligned} v_k &= x_k - \alpha_k \left(P'(x_k) \right)^T P(x_k), \\ h_k &= \lambda \left(P'(x_k) \right)^T P(x_k) + (1 - \lambda) \left(P'(v_k) \right)^T P(v_k), \lambda \in (0, 1) \end{aligned} \quad (2)$$

$$x_{k+1} = x_k - \beta_k h_k,$$

where, coefficients α_k, β_k are chosen from the condition of the monotonic decay of the function $(P(x), P(x))$.

Using three step methods construction scheme, we propose next three step method based of descent method of this kind:

$$\begin{aligned} v_k &= x_k - \alpha_k \left(P'(x_k) \right)^T P(x_k), \\ h_k &= \lambda \left(P'(x_k) \right)^T P(x_k) + (1 - \lambda) \left(P'(v_k) \right)^T P(v_k), \lambda \in (0, 1) \end{aligned} \quad (3)$$

$$u_k = x_k - \beta_k h_k,$$

$$x_{k+1} = \arg \min_{\gamma_k} P(u_k - \gamma_k (u_k - v_k)),$$

The performed practical calculations confirm the effectiveness of the proposed methods, and make fewer computations and iterations to find the solution compared to the method of descent.

ON THE STOCHASTIC PROCESS WITH SUBEXPONENTIAL DISTRIBUTED AND INDEPENDENT COMPONENTS

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In this study we consider a renewal-reward process [3,4]

$$C(t) = \sum_{i=1}^{N(t)} X_i, \quad t \geq 0, \quad \text{where } N(t) = \max\{n: S_n \leq t\} \text{ is a renewal}$$

process, $S_n = \sum_{i=1}^n T_i$ and $\{(T_i, X_i)\}$, $i \geq 1$ is a sequence of independent

and identically distributed random vectors with possibly dependent coordinates. T_1 is non-negative random variable and we will denote its distribution by F and the integrated tail function by F_1

$$F_1(t) = \frac{1}{\mu_1} \int_0^t \bar{F}(x) dx, \quad t > 0, \quad \text{where } \mu_1 \equiv E(T_1) > 0, \quad \bar{F}(t) = 1 - F(t).$$

We denote the classes of stronger subexponential distributions and long-tailed distributions by $\mathcal{S}^*$ and $\mathcal{L}$, respectively. Note that, $F_1 \in \mathcal{S}^*$ implies that F has a finite second moment $\mu_2 \equiv E(T_1^2)$ ([5]).

Theorem. Let F be non-singular, $\lambda_1 \equiv E(X_1) \neq 0$ and $n_{1,1} \equiv E(T_1 X_1) \neq 0$ exist and $|g(t)| \leq M < \infty$ for some $M > 0$, where $g(t) = E(X_1 | T_1 = t)$. If $F_l \in \mathcal{S}^*$ and $G_l \in \mathcal{L}$, where

$$G_l(t) = \frac{1}{n_{1,1}} \int_{x=t}^{\infty} \int_{y=x}^{\infty} g(y) dF(y) dx, \quad \text{then the following asymptotic}$$

relations as $t \rightarrow \infty$ for the reward function $D(t) \equiv E(C(t))$ holds:

$$D(t) = \frac{\lambda_1}{\mu_1} t + \frac{\mu_2 \lambda_1 - 2\mu_1 n_{1,1}}{2\mu_1^2} - \frac{\lambda_1}{\mu_1} \int_t^{\infty} \bar{F}_l(x) dx + O(\bar{F}_l(t)),$$

where $\bar{F}_l(t) = 1 - F_l(t)$.

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ABOUT ALGORITHMS OF WIRELESS NETWORK SECURITY SUPPORTING AUTOMATED SYSTEM

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On the basis of the main tasks of the automated security system, it is necessary to define and develop system algorithms, information security and dialog procedures and create an automated system software complex.

Each algorithmic block should be considered to perform some kind of automated security function. At the stage of system algorithmization it is necessary to analyze each algorithmic block to make the programming process easier.

The algorithmic blocks also include a set of such programs that run various parts of the computer and allow a user to solve the task in a desired way.

The algorithms are built for each method of security automated system and a separate algorithmic block is described by its functional purposes.

The encryption of the image (password or words consisting of symbols) created by a user, its decoding and the corresponding formation of the database occur according to the algorithm of the combined processing of symbol encryption.

The initial stage of the algorithm's work is determined by the information, entered by a user. At the first stage a user's password is written in a special array, where the beginning and the end of a word are defined. Also, the word is separated into symbols and an individual symbol has its own index.

Each symbol is viewed in ASCII (decimal) encoding and receives its own code. For this purpose we introduce an array, that defines the beginning and the end of symbol codes. Then, a code for the individual symbol is determined and recorded in the array of symbol codes. Eventually, we receive the numbers, consisting of the combination of symbol codes, where the individual symbol is defined by its index code.

The article deals with all the above mentioned issues precisely.

TASKS OF WIRELESS NETWORK SECURITY SUPPORTING AUTOMATED SYSTEM

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Development of the main objectives of automated system begins with analysis of manual data processing in order to study and generalize the difficulties that a user faces. Such a research is of a general nature and its aim is to identify the difficulties and not to determine their causes. Initially, there is a general examination of existing management procedures, and subsequently, the tasks of management, that are considered to be automated, are analyzed separately.

The system requires the development of such dialogue procedures, which facilitate the organization of the relationship between a client and the system; it is selected in such a sequence, where such functions, as creating, updating, modifying, applying, reading, processing, exporting, etc. of data, are effectively implemented.

After conducting the above procedures, the automated system software complex and its structure are processed. Classes, constructors, procedures, functions and methods of software complex are created as well.

Considered symbol encryption combined method

The purpose of this method is to convert encrypted symbols into special ones by modified codes. The transformation of the symbol codes occurs in the following way:

The "complicated" word (password) is created by the combination of obtained symbols and additional ones, that are added by numerical values of a date and a time.

Next, the obtained word gets split (the groups are created) according to the parameters set in the system. Then the encoding of each group symbol ASCII (decimal) results in the determining of their relevant codes. After this we receive numbers consisting of combination of group symbol codes, in which an individual symbol is defined by its index code.

The research deals with the all above mentioned issues.

MATHEMATICAL PROBLEMS OF EDUCATIONAL PROCESSES OPTIMIZATION

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Information technologies have opened up possibilities for a radical improvement of the quality and optimization of educational processes. To do this, less important lessons are learned from the curriculum to increase the time to learn more important knowledge. For example, students are no longer forced to pull out the "longest" integrals, because their smartphones with the Wolfram/alpha instantly extract all the most complex integrals from any high school collection of tasks. Optimization of the educational process involves improving the efficiency of the work of teachers and students with the use of electronic textbooks, containing video lectures and making it possible for students to perform numerical experiments. Computational search experiments activate students' creative thinking, curiosity, motivation for intellectual work in search for in-depth knowledge. The main thing here is mastering the important principles of modeling, forecasting and optimization, which begins with the simulation of simple causal relationships, and is further refined in the modeling of increasingly complex dependencies. To create optimized electronic tutorials, WYSIWYG, Illias, CourseLab, ToolBook Instructor, Authorware, etc. are used. An important component of optimized integrated training is the ability to master the methods of finding new knowledge through numerical experiments. Such a process involves three important steps in obtaining new knowledge: the collection of data on the investigated

cause-effect dependence; the choice of an adequate model, and the use of the constructed model for obtaining new knowledge. It is important that the acquisition of new knowledge through simulation is already available in junior classes in the simplest educational games. And this skill is improved in the further extraction of increasingly complex knowledge (throughout life). The report examines the possibilities of efficient use of computer tools for optimization of integrated computerized training.

ACCELERATED ALGORITHMS FOR OPTIMIZING CONTROL PROCESSES WITH COMPLEX PHASE CONSTRAINTS

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In this paper we propose new algorithms for optimizing phase trajectories of controlled processes with complex phase constraints, which are described by systems of algebra-integro-differential equations and/or inequalities with partial derivatives. Such problems arise, in particular, in computerized production processes when introducing technologies for improving the quality of manufactured products, competitiveness, profitability, etc.

Problems of phase trajectories optimization of control processes with distributed parameters described by systems of differential equations and in equalities with partial derivatives are problems of large dimension. However, known algorithms for optimal control based on the use of the Pontryagin maximum principle, the Belman optimality principle, and the known pseudo-spectral algorithms using unified nonlinear programming methods, are capable of calculating optimal trajectories only for controlled systems of comparatively small dimension. This can be explained by the fact that the Pontryagin pi-system of the maximum principle combines the guided system of differential equations and the adjointed system and therefore it is usually an unstable system, and may be nonlinear, with external and/or internal disturbances, and so on. The algorithms for calculating optimized phase trajectories with complex phase constraints proposed by us are based on the use of asymptotic approximations of the optimality criteria, which

depend only on the control functions and do not depend on unknown phase trajectories, and therefore this substantially simplifies the calculation of phase trajectory sequences converging to an extremal phase trajectory.

CONSTRUCTION OF ACCELERATED METHODS FOR LARGE DIMENSION OPTIMIZATION PROBLEMS

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The efficiency of an optimization algorithm is measured in terms of the work required to compute the iterates required to reach a sufficiently good estimate of a minimizer. Among important characteristics of the efficiency of iterative algorithms for solving large dimension optimization problems there is also the amount of computational work (or calculation time), which is spent on one cycle of the calculation of the improved solution. Given this, numerical optimization methods for large-scale problems are constructed in this paper, in which at each iteration the improvement of not all coordinates of the desired solution is carried out, but only on that part of the coordinate, which, on the one hand, provides the necessary reduction of the minimized functional (criterion optimality), and on the other - requires a relatively smaller amount of computing. The construction of such methods is based on the use of asymptotic approximations of a minimized functional and approximate solutions of dual problems, which facilitates the determination of the subset of coordinates to be updated on the next iteration. Partial cases of such methods are realized as known methods of variations in the theory of control, or as some of the algorithms of group co-ordinate descent. The conducted numerical experiments have confirmed the practical effectiveness of such methods for solving optimal control problems, where it is possible to easily determine the desired most suitable subset of the coordinates of the desired solution to be updated on the next iteration in order to ensure the convergence of the sequence of approximate solutions to the extremal solution. Acceleration of convergence is achieved by implementation of interior-point algorithms using second-derivative information.

ABOUT THE BANKRUPTCY IN THE CASE OF LARGE PAYMENTS

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In real situations, which take place in the insurance market, one has to take into account extreme events, when the size of the payments will be sufficiently large. In particular, these payments can be described by random variables with so-called subexponential distribution, see [1].

Note that the class of subexponential distributions S is wide enough. This class includes such distributions as Log-normal distribution, Pareto distribution, Weibull distribution, Benktander type I and type II distributions.

In particular, the following statement holds true.

Proposition. Consider payments distributed by Benktander type II distribution

$$1 - F(x) = \exp\left(\frac{\alpha}{\beta}\right) x^{-(1-\beta)} \exp\left\{-\frac{\alpha x^\beta}{\beta}\right\}, \quad \alpha, \beta > 0, x > 1,$$

then the asymptotic of the probability of bankruptcy $\phi(u)$ can be presented by the next fraction

$$\phi(u) \sim \rho^{-1} \overline{F}_I(u) \sim \frac{\lambda}{(\alpha c - \lambda(1 + \alpha))} \exp\left(\frac{\alpha}{\beta}\right) \exp\left(-\frac{\alpha u^\beta}{\beta}\right), \quad u \rightarrow \infty.$$

Asymptotics of the probability of bankruptcy for other subexponential distributions is considered in [2], [3].

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ABOUT DSS LOGICAL PATTERNS

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In [1] we consider the abstraction of DSS, an important part of which are following DSS patterns: logic, interaction mechanism, decision making, architectural and data access.

Logical patterns represent the perception of the person deciding the availability of other DSS for his DSS. How exactly this is reached described by patterns of interaction [2].

The following logical patterns are proposed:

- 1) **Mesh interaction**, an appeal to all "neighboring" DSS/expert systems (that are near this DSS). There are 2 cases of the neighborhood. a) The neighborhood of DSS exactly in the sense of the decision maker, but not literally. This set is known to the expert or decision maker (he trusts these resources and, for example, without their "thought" will not make a decision). b) Only neighboring DSS by geographical location are mandatory;
- 2) **family** connections (as an analogue to Law of Demeter in the OOP), in other words, connection with only similar systems. There are following similarities: a) by subject area; b) by protocols for the presentation of decisions that will be decisive for cloud computing DSS;
- 3) **random** connections (by choice of the decision maker);
- 4) through connections **broker** (intermediary). This is actually an indexed database of decisions, DSS, etc. A request to such a database provides a list of resources

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ANALYSIS OF TOOLS FOR BUILDING EXPERT SYSTEMS

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The process of expert systems creation has changed significantly over the last years. Due to the emergence of special tools time of their development was greatly reduced and complexity decreased. But the requirements for the complexity of the process also increased [1]. For many of these processes there is a relevant and important evolutionary adaptation of rules. And it needs a development of appropriate tools which will not only make decision-making possible, but will also reflect the features of the system and allow to work effectively with dynamic input data.

Computational network toolkit (CNTK), an implementation of Computational network that supports both GPU and CPU. For describing arbitrary learning machines, such as deep neural networks (DNNs), convolutional neural networks (CNNs), recurrent neural networks (RNNs), long short term memory (LSTM), logistic regression, and maximum entropy model, that can be illustrated as a series of computational steps. A CN is a directed graph in which each leaf node represents an input value or a parameter and each non-leaf node represents a matrix operation upon its children. We describe algorithms to carry out forward computation and gradient calculation in CN and introduce most popular computation node types used in a typical CN[1].

This tool is very handy. The syntax is simple. Due to the constructed parallelism, you can get significant acceleration in the calculations. Ideal for static tasks with expert systems. But in the case of dynamism, the most time consuming model needs to be recalculated. Also very sensitive to the selection of activation functions. Therefore, in dynamic systems, these functions need to be adjusted as well.

For example 1, simple neural network with one hidden layer and one classification layer with CNTK[2] is:

```
BrainScriptNetworkBuilder = {  
    # sample and label dimensions  
    SDim = $dimension$  
    LDim = 1  
    features = Input (SDim)  
    labels = Input (LDim)
```

```

# parameters to learn
b = Parameter (LDim, 1)  # bias
w = Parameter (LDim, SDim) # weights
# operations
p = Sigmoid (w * features + b)
lr = Logistic (labels, p)
err = SquareError (labels, p)

# root nodes
featureNodes  = (features)
labelNodes    = (labels)
criterionNodes = (lr)
evaluationNodes = (err)
outputNodes   = (p)
}

```

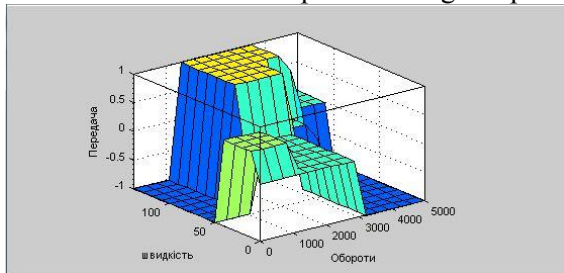
A fuzzy control system is a control system based on fuzzy logic—a mathematical system that analyzes analog input values in terms of logical variables that take on continuous values between 0 and 1. Logical operations are introduced on fuzzy sets, and the notion of a linguistic variable expressed by fuzzy sets is formulated.

Systems based on fuzzy logic use logical laws of type: "If X, then Y"

The operation of fuzzy controllers differs from the work of ordinary controllers. To describe the system, instead of differential equations, expert knowledge is used. This knowledge can be expressed using linguistic variables, which are described by fuzzy sets.

This tool is very useful for management tasks requiring high accuracy based on expert judgment. Provides quick response. Used in many control systems. But need to reconfigure the controller with new rules. And controller take resources for the phasing and defining of variables.

For example 2, visualization of the fuzzy controller to determine the change in transmission based on the speed and engine speed[3]:



pic. 1 - fuzzy controller example

We analyzed different expert tools. Based on this analysis, the strengths and weaknesses of each of the tools were indicated. Therefore using this knowledge, you can choose a tool that is suitable for solving a specific task

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TIME OPTIMAL APPROACH TO PORTFOLIO SELECTION – BASIC RESULTS AND CHALLENGES

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Classic portfolio selection models, following the Nobel prize winning work of Markowitz, require typically that the investor can specify his investment horizon. As a consequence, the duration of the investment is fixed, and risk and return are characterized via the probability distribution of value of the investment portfolio at the given point in time. Time optimal portfolio selection takes an alternative approach, as many investors in real life have difficulty to specify an investment horizon, but can specify their goal in monetary term, like to reach 200 000 Euro from an investment of 100000 Euro. In this case, the essential question is how long it takes the investment to reach the set goal value. As a consequence, risk is not measured based on the probability distribution of value of the investment, but on the probability distribution of the time needed to reach the goal. For risky investments, this time is a random variable, and the resulting probability distribution is a so called first passage time distribution. The talk surveys the concept

as developed by the author, presents some key results, and points out challenges based on recent experimental findings regarding the utility function of investors with respect to goal reaching times.

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DECISION-MAKING WITH THE USE OF OBSCURE LOGICS IN THE PROCESS OF EDUCATION QUALITY CONTROL

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For conducting the education quality control at the higher educational institutions, it is necessary to make the identification due to the specific sign, such as “potential abilities” (p.a.) of graduates and its implementation skills.

For the identification and classification, the quantitative and qualitative characteristics have been reviewed. The quantitative indicator of graduates’ “pt” can be marked as – “distinctive value”. This value gives us the difference in the specialists’ classification. This classification defines the labour market demands towards the graduates of any specialty. All features of specialists are obviously impossible to be formalized only in the education field, and especially, due to the quantitative characteristics of distinctive value. Thus, it is necessary to use the quantitative (individual) characteristics, such as the personal features, risk, communication abilities, innovative decision-making skills, etc. Because the evaluation of qualitative characteristics is very difficult, and in some cases, even impossible, thus, the expert methods

based on the obscure logics theory are mainly used for the evaluation of such kind of characterises. The obscure logics is the basis of the obscure knowledge formalization and is discussed within the artificial intelligence.

For working out the maths methods and algorithms conception of education quality control, the main basis of the obscure logics theory has been discussed as it is operated with the qualitative characteristics of management object. In our case, as it is mentioned above the characteristics of management object are: potential possibility of a prepared specialist, responsibility, communication abilities, innovative decision-making, etc.

The mentioned characteristics are obscure and vague concepts and cannot be perceived unequivocally, however, they include the important information for the management and control implementation. It is obvious that a person does not have the ability to make a right decision, even when it analyses the obscure information, as it is very complex process in the computer management process.

The embarrassment is caused by the deficit of the formalization models of the human's mental abilities. Thus, the unobscured multitudes theory was created for the human ability formalization or its modelling (L. Zadeh).

For defining the unobscured logics theory, its mathematical apparatus has been analysed (Todua T. 2009).

Let's assume we have the following:

$$(U, u, P),$$

where:

U - is a universal multitude,

$u \in U$ - universal multitude element,

$P - u \in U$ property of elements.

Multitude, which elements satisfy with the P property, is described in the following way:

$$U = (u : u, \text{which satisfies } P \text{ property}) \quad (1)$$

The different formalization of the same fact may be the following:

$$U = \{u : \in P(u)\}, \quad (2)$$

where $\in P(u)$ - represents the function characteristic to the attribution, which receives its significance on the $[0;1]$ segment.

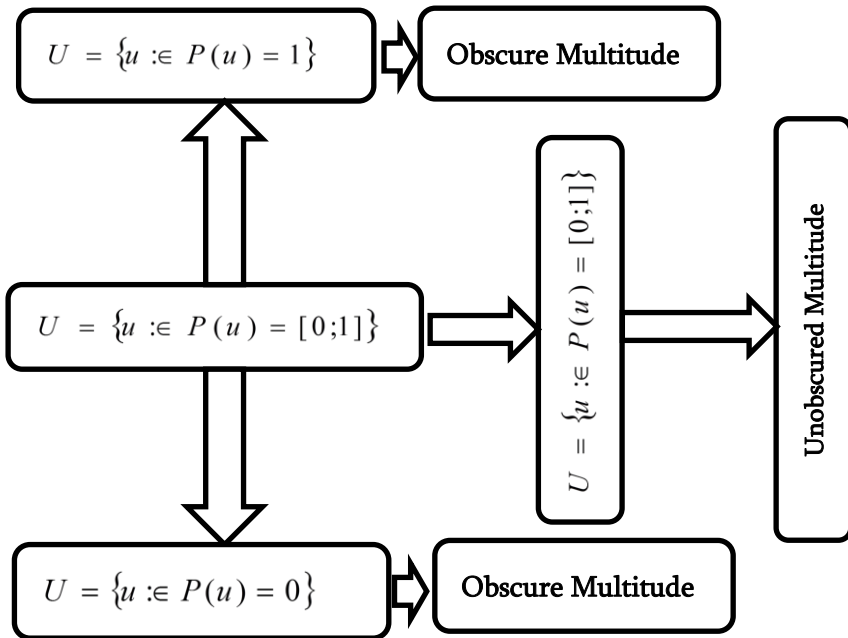
In case of image (2), the function of attribution receives the significance equal to one. This means that U multitude includes the elements, which have P property. For example, U multitude may be the

unity of professors of the university, then the addition to this multitude is the multitude of non-professor personnel. These multitudes can be described (2) in the following way:

$$U = \{u : \in P(u) = 1\}; \quad (3)$$

$$\bar{U} = \{u : \in P(u) = 0\}. \quad (4)$$

(3) image is the following formal note: U multitude is combined with the U elements, which attribution function is $\in P(u) = 1$; and (4) the formalized note is: $\bar{U}$ multitude is combined with the elements, which attribution function is $\in P(u) = 0$. In this case, U and $\bar{U}$ multitude is a clear multitude, pic. 1.



Pic. 1.

The unobscured multitude is the multitude, which includes even one element, which attribution function satisfies the condition:

$$0 < \in P(u) < 1. \quad (5)$$

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CONCEPT OF INFORMATION TECHNOLOGY FACILITATING TO MAKE A DECISION OF SCHOOL EDUCATION QUALITY MANAGEMENT

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Main contents of Processing the Concept of Information Technology of School Education Quality Management are:

- ❖ Development of Information Communication Technology Strategy of Education Quality Management.
- ❖ Theoretical-practical recommendations of using analogy of Concept of teaching quality management information technology.
- ❖ Electronic production of school documents using information-communication technology;
- ❖ informative Communication Technologies, Electronic system of lessons Classification
- ❖ Electronic System of Quality assessment.

Complex work to modernize the education system of Georgia dictate us the necessity to identify the sphere, Trends, goals, tasks, contents, designing methods and methods, priority directions and prospective development plans of using modern information-communication technologies. An innovative approach is the main thing in management of general education quality, which means modern informational communication technologies.

Our research and analysis cleared the Information-communication factors for promoting education quality management and Strategy of its effective use in the educational process in the informative program frameworks.

Theoretical-practical recommendations of using analogy in the concept of information technology of teaching quality management is processed.

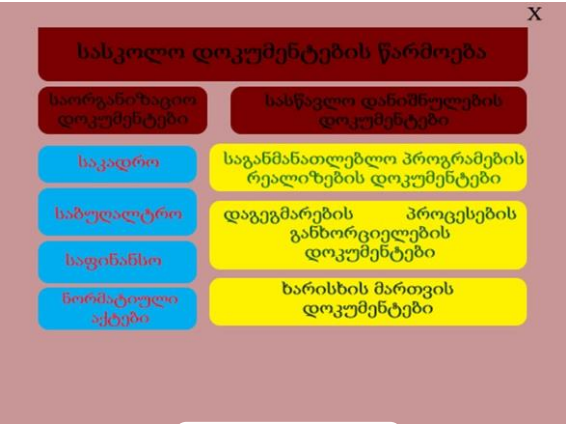
Examples of introduction the Information Technologies of Quality management and control of teaching at school are presented in the interactive mode of working with information technologies of Decision Maker (School Director, Manager, Head of Quality Service or any member, Teacher, Pupil, etc.).

Main Menu **Window 1**, as a rule, is the decision maker's desktop control menu, its general purpose is to open and call the

required programs, documents, folders, and etc. there is a content of information bases - **Window 2**.



Window 1



Window 2

Lessons are classified as a main type
Using information-communication technologies, dialogic **window 3**.



Window 3

There is a fragment of the electronic system of quality evaluation-
window 4.



Window 4

ABOUT DETERMINATION AN OPTIMAL INSURANCE RATE

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Let us assume that we are in F-model conditions [1, p.248]. Also, we assume that insurance contracts' claims are big and can be described by subexponential distributions [2]. Then for Pareto distribution with parameters $a > 0$ (j, k) the next relation holds for an admissible insurance rate z_0 ([3]):

$$z_0 \sim \frac{\lambda}{a-1} + \frac{\sqrt{\frac{a\lambda^2}{(a-1)^2(a-2)}}[1+V^2]^{1/2}\Psi(Q)}{[N-V^2\Psi^2(Q)]^{1/2}}$$

where $0 < Q < 1$ is a prescribed number, N is an amount of insurance contracts, V is a correlation coefficient of insurance amount for appropriate contract, $\Psi(x)$ is an inverse function to standard normal distribution function.

It is important to notice that in the case when $V=0$, this result is reduced to the classical one from [1, p.238].

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NEGLECTING PECULIARITIES OF THE SOLUTE PROPAGATION IN A DRY POROUS MEDIUM DURING PERMEATION GROUTING

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Several decades are an ordinary duration of a large construction project. Often at the start of such the undertaking there is need in constructing a tunnel in a ground that is not going to experience heavy loads subsequently. In such the case, before the excavation it is worthwhile to stabilize it to make sure that the shaft will not crash later due to additional weight trees that will grow anew will create. In this case, the permeation grouting should be used to reduce the cost through preserving the structure of the treated soil. In this technique, cement grout is injected in the ground at pressure that does not ruin the structure of the treated medium. It is expensive and time consuming. Its regime is determined by the evolution of the cement concentration distribution in the soil. Hence, modeling this evolution is valuable.

The attempt to carry it out is the numerical modeling [1] that is conducted in the framework of the two-dimensional problems with free moving boundaries, which set ups correspond to *in situ* grouting. In one of them, it is assumed that a long trench is made under injector foundation. The astringent infiltrate is pumped in such the injector at the constant pressure. In each case, the injection front is a free surface and its evolution in time and space needs to be found. However, the chosen models correspond to the phase field regime of the grouting process. The aim of this work consists in estimating the duration of the time frame after which one can neglect the peculiarities of the solute propagation in a dry porous medium.

In what follows,

$$\varepsilon_1'(t_0) = \frac{\varepsilon_1(t_0 + \tau) - \varepsilon_1(t_0)}{\tau} \quad (1)$$

where $\tau \ll t_0$. As for $\varepsilon_1(t_0)$, it is the uncertainty in the final injection front position obtained in the framework of the calculation #1 [1] when one assumes that the initial position of the injection front is the location of the free surface after time equal to t_0 elapses since the beginning of the evolution calculated under the assumption that one chooses the initial position of the free surface as close to the injector as modern

computers allow, however, according to *in situ* conditions. From Table 1, it follows that ε'_1 decreases on the interval from $t_0 = 4$ sec to $t_0 = 104$ sec slower than it does on the interval from sec to $t_0 = 180$ sec. However, one can ignore this observation due to the following. The curvilinear grid the calculations are performed on in [1] can have chaotic disposition of its nodes on some time layers [2]. Moreover, it is likely that such the disposition occurs on the early stages of the evolution when the numerical free surface has regions of high gradients. Nevertheless, from Table 1 it follows that the rate of the decrease of ε'_1 with t_0 starts diminishing when $t_0 = 180$ sec. The analysis of the solution of the one dimensional model indicates that this disturbance could correspond to vanishing corrections due to the peculiarities of the solute propagation in a dry porous medium [3].

Table 1. The dependence of ε'_1 on t_0 .

n	t_0 , sec	ε'_1 , %/sec	$\frac{\varepsilon'_{1,n} - \varepsilon'_{1,n-1}}{t_{0,n} - t_{0,n-1}}, \frac{\%}{\text{sec}^2}$
1	4	0,01802	
2	104	0,01694	$-1,1 \cdot 10^{-5}$
3	180	0,01589	$-1,3 \cdot 10^{-5}$
4	300	0,01481	$-9,2 \cdot 10^{-6}$
5	400	0,01390	$-9,0 \cdot 10^{-6}$
6	480	0,01322	$-8,5 \cdot 10^{-6}$

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MODIFIED EXTRAGRADIENT METHOD WITH BREGMAN DIVERGENCE FOR SOLVING VARIATIONAL INEQUALITIES^a

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A new method of extra-gradient type for the approximate solution of variational inequalities with pseudo-monotone and Lipschitz-continuous operators acting in a finite-dimensional linear normed space is proposed. This method is a modification of the subgradient extra-gradient algorithm [1-4] using the Bregman divergence instead of the Euclidean distance. Like other schemes using Bregman divergence [5], the proposed method can sometimes effectively take into account the structure of the feasible set of the problem. A theorem on the convergence of the method is proved and, in the case of a monotone operator, non-asymptotic estimates of the effectiveness of the method are obtained.

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THE JACOBSTHAL-CIRCULANT-HURWITZ SEQUENCES^b

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Deveci and Karaduman defined [1] the Jacobsthal-circulant sequences of the first, second and third kind respectively by:

$$\begin{aligned} J_n^1 &= -J_{n-1}^1 + J_{n-2}^1 - 2J_{n-3}^1 \text{ for } n > 3 \text{ where } J_1^1 = J_2^1 = 0 \text{ and } , \\ J_n^2 &= J_{n-2}^2 - 2J_{n-3}^2 - J_{n-4}^2 \text{ for } n > 4 \text{ where } J_1^2 = J_2^2 = J_3^2 = 0, J_4^2 = 1 \\ \text{and} \\ J_n^3 &= -2J_{n-3}^3 - J_{n-4}^3 + J_{n-5}^3 \text{ for } n > 5 \text{ where } J_1^3 = \dots = J_4^3 = 0 \text{ and} \\ &J_5^3 = 1. \end{aligned}$$

In this work, we define the Jacobsthal-circulant-Hurwitz sequences of the first, second and third kind by using of the Hurwitz matrices which are obtained from the characteristic polynomials of Jacobsthal-circulant sequences of the first, second and third kind. Then we obtain miscellaneous properties of these sequences.

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THE DOUBLE PELL SEQUENCES AND THEIR APPLICATIONS

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In this paper, we define the double Pell sequences in groups and rings. Then we examine these sequences in finite 2-generator groups and rings. Also, we obtain the periods of the double Fibonacci sequences in the group and the ring for the generating pairs (a,b) and (b,a) as applications of the results obtained.

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CREDIT SYSTEM MODEL IN HIGHER EDUCATION SYSTEM

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As it is known, 60 credits, adapted to the European credit system, represent a student's annual workload. This means that during the year a student must collect 60 European credits. Based on this amount of annual load, it is easy to calculate how many working hours are compatible with 1 credit. In order to calculate this, we should divide the number of hours by 60 credits and get 22, 5 academic hours of student training activities (loading).

In the process of credit distribution, it is necessary to define the credits of each subject as a whole. This issue can be solved using the existing credit framework.

Let's consider an example that proves and makes a credit principle much easier: particularly, analyze a case when the study of a subject *S* requires 1 lecture, 2 practical and 2 laboratory working hours.

If the semester lasts 15 weeks (it is meant only for sessions week), there will be 15 lectures, 30 practical and 30 laboratory hours in the semester. In addition, the student must work independently.

If the semester lasts 15 weeks (we mean only a lecture, not sessional week), then it consists of 15 lecture, 30 practical and 30 laboratory hours. Moreover, a student must work independently.

So, if we take 10 credits for the presented subject, then we need to add 65 hours: $10 \times 25 - 185 = 65$ hours.

This ratio is placed in credit frames, the hourly distribution satisfies the subject's study requirements. Therefore, the above mentioned S subject requires 10 credits.

The research deals with the all above mentioned issues.

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ABOUT PROGNOSIS OF SPECIALISTS' REQUIREMENT

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There are a lot of attempts to make prognosis, what professional staff is necessary and in which fields. Thus, this prognosis is based only on the results of analysis of social inquiries and they use neither strategic development plan nor statistic methods. The result is that, according to the prognosis, it is not mentioned, what amount of professional staff will be needed to employ in different fields.

The improving of difficult situation in the employment field of course depends on the accelerated development of the region's economy. To accelerate the development, it's necessary to establish and consider the reasons, which interfere local entrepreneurs in business and in creating new workplaces. The majority of interviewee said that the preparation of the low-quality professional staff and bad management interfere employment.

We wrote out interesting specialties for our research from these branches, we will make notices once again and build the matrix of correspondence and the list of basic fields and professions, which will be in demand in the nearest years. We will build the matrix of correspondence.

By building the matrix of correspondence, we will receive the most demanded professions in the regions, in the labour market according to our prognosis.

The same method may be used to build the matrix of correspondence for the existing reality, which allow us to make analysis and correspond

real data to prognosis data.

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THE ROLE OF COMPUTER TRAINING SYSTEMS IN MODERN EDUCATIONAL PROCESS

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Informatization of education represents a significant area among the priority directions of the informatization process. The concept “informatization of education” implies implementation of new information technologies and facilities in educational system.

The development of civilized society is significantly related to the process of creating and developing training computer systems on the basis of educational modern information technologies.

Although computer technologies are being actively used in educational process, we should always remember that they are only modern auxiliary didactic means. Similarly to the traditional education process, where a teacher was a leading figure, in the modern classrooms equipped with computer technologies a teacher still retains the leader. Moreover, a teacher appears as a creator of innovative pedagogical technologies. Therefore, he/she is a teacher-technologist.

In the traditional educational process a teacher is a main source of information transfer for a student. This process is characterized by availability of feedback, which is quite successful as a rule.

An entirely different picture emerges when we use computer technologies in educational process. The main feature, that distinguishes this process from the traditional one, is an opportunity to organize an effective communication between a person and a computer through interactive programs.

All the above issues are discussed in the present work.

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SELECTION OF ADAPTIVE ARTIFICIAL NEURAL NETWORKS LEARNING SPEED

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The standard algorithm for the reverse transparency of learning artificial neural network has included a problem of choosing the desired speed, which is aimed at increasing the intensity of the algorithm and ensuring convergence. The fast access algorithm can be used for selection adaptive learning speed α . According to this algorithm, the learning speed for each iteration of neural network learning for each layer should be selected so that the mean square network errors is minimized:

$$\alpha(t) = \min E(y_j(t+1)),$$

where, $j = \overline{1, m, m}$ - the number of neurons in the last layer of the network.

The value of j -th neuron solution depends on the activation function of the neuronal elements, and can be defined as follows:

$$w_{ij}(t+1) = w_{ij}(t) - \alpha(t) \frac{\partial E}{\partial w_{ij}(t)}, \quad (1)$$

$$T_j(t+1) = T_j(t) - \alpha(t) \frac{\partial E}{\partial T_j(t)}. \quad (2)$$

The mean square network error is: $E = \frac{1}{2} \sum_j (y_j - t_j)^2$.

Then, to find $\alpha(t)$ (solution), we need to solve the following equation:

$$\frac{\partial E}{\partial \alpha(t)} = \frac{\partial E}{\partial y_j(t+1)} \cdot \frac{\partial y_j(t+1)}{\partial \alpha(t)}$$

Above mentioned issues are focused in our work.

TASKS AND ALGORITHMS OF WIRELESS NETWORK SECURITY

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The attention is paid to the following tasks:

- Analysis of different communication channels in wireless networks and development of new methods to enhance security;
- Administration and management of remote work places (local or regional offices) using wireless networks;
- Building and realization of automated system.

On the basis of the main tasks of the automated security system, it is necessary to define and develop system algorithms, information security and dialog procedures and create an automated system software complex.

After conducting the above procedures, the automated system software complex and its structure are processed. Classes, constructors, procedures, functions and methods of software complex are created as well.

The efficiency of the solution of security supporting automated system depends on the system algorithmic support. For the optimal solution of this issue, a security task is allocated by separate algorithms for each method [1].

The algorithmic blocks also include a set of such programs that run various parts of the computer and allow a user to solve the task in a desired way.

The algorithms are built for each method of security automated system and a separate algorithmic block is described by its functional purposes.

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STEVEDORE SERVICE OF THE VESSEL
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In the World practice of trading navigation a stevedore service (stevedoring service) is a complex of services offered to the vessels while berthing at the ports.

The concept of service, in this case, is widely understood and implies to the following:

- ❖ Activities for the vessels and cargo in order to provide a variety of services, including navigational support;
- ❖ Pilot and towage service;
- ❖ Berth Provision;
- ❖ Storage and Stowage Operations;
- ❖ Fuel and Water Supply;
- ❖ Material-technical and food supply;
- ❖ Repair Work between the Voyages;
- ❖ Sanitation-quarantine measures;

The majority of above mentioned services are performed directly by the port services or with their active participation.

The main objective of the project is to perform calculations and analytical studies related to the planning, organizing and analyzes of the ship's stevedore service, based on the preliminary calculation-analytical information obtained from the reference literature.

The importance of shipping and technological characteristics of cargo is important for calculating the loading capacity of the vessels. Cargo transportation characteristics are a combination of the characteristics of the cargo, which establishes its shipping, reset and storage technology and method.

Learning of transport-technological characteristics of the cargo gives the possibility to calculate the optimal version of its loading capacity. The main characteristic of the cargo is its volume-mass characterization and cohesion.

Above mentioned issues are focused in our work.

SYSTEM OPTIMIZATION PROBLEM WITH THE FUZZY SET OF INDEXES OF CONSTRAINTS

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The paper deals with the problem of system optimization (SO) [1] with a fuzzy set of indices of constraints [2] that determine the domain of admissible solutions D_0 . Let D_0 be a fuzzy set and has the following form:

$$D_0 = \left\{ \begin{array}{l} x: g_l(x) \leq 0, \\ l \in Q = \{1, \dots, m\}, \\ x = \{x_j, j \in J = \{1, \dots, n\}\}; \\ \mu_{D_0}(g_l(x)) \leq \alpha, l \in Q = \{1, \dots, m\} \end{array} \right\}, \quad (1)$$

where the membership function denoting $\mu_{D_0}(g_l(x))$ denotes the membership degree of the restriction $g_l(x), l \in Q = \{1, \dots, m\}$ to D_0 , and $\mu_{D_0} \in [0, 1]$. The set of criteria f :

$$f = \left\{ \begin{array}{l} f_i(x) \rightarrow \max, i \in I_1, f_i(x) \rightarrow \min, i \in I_2, \\ I_1 \cup I_2 = I = \{1, \dots, M\} \end{array} \right\}, \quad (2)$$

where x – vector of solutions of dimension n ; m – number of restrictions; I_1 – set of maximized criteria indexes; I_2 – set of indexes of minimized criteria, M – number of criteria.

The condition for the emergence of the SO problem is the incompatibility of the requirements of the decision maker G with the model of the organizational system D_0 : that is $G \cap D_0 = \emptyset$.

In this paper, an algorithm for determining a clear set of indices of essential constraints that are violated at G is developed. Further, the solution of the problem of SO is carried out according to the algorithm outlined in [1], that is to create a new admissible domain D_1 (in accordance with the primary domain D_0 and an allowable range of parameter variations), in which $G \cap D_1 \neq \emptyset$, and there will be solutions with the values of the criteria f is not worse than the values of G .

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LIMITED THEOREMS IN BACKGAMMON STRATEGIES

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Backgammon is a popular board game of both luck and skill. An important element of such game is so-called "doubling cube", which gives players the right to double the bet in such way. If the player estimates his chances to win as good, he can to call out "double" before his move and his rival has a dilemma, either to surrender and to lose a single bet or to go on the game with the double bet. A beginning of the game each player has a right to double the bet. Then, if one of the players doubles and the other accepts, then the player who accepts a double is called "cube owner" and only he has the right to make a double in turn.

It turns out, that the optimal strategy is to double the bet as players chances to win equals to 0.8. In this case, the player's average winning equals to 1, no matter his rival accepts or rejects the double.

If both "rational but risky" players double the bet at 0.8 threshold and always accept the double, then winning of each player in such zero-sum game is generated by random value ξ , where

$$P(\xi = 2^k) = P(\xi = -2^k) = \frac{3}{8} \frac{1}{4^{k-1}}, k \in N.$$

Let $(\xi_k)_{k \in N}$ be the sequence of independent copies of ξ . Then

$$\frac{\xi_1 + \dots + \xi_n}{a_n} \rightarrow N(0,1), \text{ where } a_n = \sqrt{3(n \cdot \log_2(n))/2}.$$

Also, some other results and limited theorems, concerning backgammon game were obtained.

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THE PARALLEL ALGORITHM FOR THE ADAPTIVE SOLVING OF ELASTICITY PROBLEMS

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Adequately reflect the actual behavior of structures requires new methods and approaches for the construction and study of new multi-scale computer models and the reliability of the results. At the present stage of computing the transition from single-core processor computers, the possibility of increased productivity are already exhausted, computers with multicore processors, which also can be many. Creating high performance computing technologies closely related to the use of multi-core and multiprocessor computer systems. Correspondence between algorithmic software and technical means of multi-core and multiprocessor computers determine the effectiveness of such technologies. The highest performance of such systems is achieved using algorithms and programs with parallel organization of calculations. Domain decomposition algorithm for solving problems of elasticity based on parallel computing is considered. The global system of equations for the entire domain is not formed and is represented by local matrices and vectors for subdomains using Boolean matrices of connectivity. The originality of this approach lies in the fact that parallelization occurs at all stages of solving the problem: setting input, building the mesh of finite element method (FEM), solving the systems of linear equations, analysis of the results. Domain decomposition method with isoparametric quadrilateral approximations of FEM in each of the subregions is used. We built an adaptive algorithm based on a comparison the solutions of FEM and DBEM obtained in parallel. For solving the systems of linear equations, the parallel algorithm based on the method of conjugate gradients is developed. The algorithm is implemented with program C ++ library using parallel execution Message Passing Interface.

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THE STUDY OF THE BEHAVIOR OF DEEP ENERGY CENTERS IN A STRONG ELECTRIC FIELD

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The article deals with the investigation of the DC's behavior in a strong electric field, their influence on the volt-ampere characteristic and the capture of electrons.

The Experiment. At $T = 77\text{ K}$, the first S-shaped portion of the VAC (Volt-Ampere Characteristic) is determined by the impact ionization of the center with an activation energy of 0.066 eV . The N-shaped portion begins to form ($Y = 20\text{ mA / dev}$, $X = 0.1\text{ V / dev}$) at an electron energy of the order of 0.544 eV . As the power applied to the sample increases, the threshold current of the beginning of the N-type portion formation of the negative differential conductivity (NDC) increases. The N-shaped portion continues its formation. At an electron energy of 0.676 eV the increase in the current of the onset of the N-type portion of the NDC stops, and the energy absorbed by the center is expended on the final formation of the N-shape. The transition from position 1 to 2 contains a field with an increased conductivity and is accompanied by the energy absorption of 0.13 eV . The transition from position 2 to 3 consumes 0.03 eV [1,2].

The conclusion. It is shown that at 77 K the deep centers change their properties due to the magnitude of the external electric field intensity by localizing the energy and becoming the centers of dispersed scattering and electron capture with decreasing symmetry.

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APPLICATION OF THE FRACTAL ANALYSIS OF MEDICAL IMAGES IN DIAGNOSIS OF CANCER

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The fractal dimension has been employed as a useful tool in the diagnosis of various diseases - doctors around the world successfully diagnose tuberculosis and bone diseases on the basis of X-ray images, cardiovascular diseases on the basis of ultrasound imaging analysis, etc. The main objective of this study was to investigate the effect of cancer disease on the buccal epithelium cell structure with the usage of fractal and multifractal analysis technics. The goal to achieve was to explore existing methods and to develop our own methods for finding fractal characteristics of images. To achieve this goal, there was created the software which can process the medical images and output the arrays of fractal dimension and fractal spectra of them.

The objects of this research were cell images of people with the breast cancer, fibroadenomatosis and control group of people without having these diseases. It was proven that fractal characteristics of cell images of healthy subjects are significantly different from characteristics of cell images of those who has disease. Also, it was shown that multifractal analysis is the powerful tool, that we can use to describe complex distribution of color intensities of medical images. The paper confirms that the distance between multifractal spectra of different groups of images is significantly more than the distance between multifractal spectra of similar groups. There was also suggested the classification algorithm, which may be useful in any other medical image analysis to classify the diseases based on fractal characteristics of images.

THE BOUNDARY PROBLEM FOR THE ELLIPTIC EQUATIONS IN GENERALIZED WEIGHTED MORREY SPACES

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For the a weak solution Dirichlet boundary problem uniformly elliptic equations of higher order in generalized weighted Morrey spaces in a smooth bounded domain $\Omega \subset R^n$ a priori estimate is obtained. Weight function from in the Macenhout class A_p .

THE SOLVABILITY OF PROBLEM DIRICHLET FOR NONDIVERGENT DEGENERATE ELLIPTIC EQUATIONS

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In the present work boundary value problem for second order nondivergent degenerate elliptic equations is considered. The solvability of Dirichlet problem is proved. Let Ω be a bounded domain in R^n with smooth boundary, $Q_T = \Omega \times (0, T)$, $T > 0$. We consider the initial boundary value problem

$$\frac{\partial u}{\partial t} - \sum_{i,j=1}^n a_{ij}(x,t) \frac{\partial^2 u}{\partial x_i \partial x_j} - \psi(x,t) \frac{\partial^2 u}{\partial t^2} = 0, \quad (1)$$

$$u(x,t) = f(x,t), \quad (x,t) \in \Gamma = \partial\Omega \times (0,T), \quad (2)$$

$$u(x,t) = h(x), \quad x \in \Omega. \quad (3)$$

For any $(x,t) \in Q_T$ and $\xi \in R^n$ the following inequality is true

$$\gamma \omega(x) |\xi|^2 \leq \sum_{i,j=1}^n a_{ij}(x,t) \xi_i \xi_j \leq \gamma^{-1} \omega(x) |\xi|^2, \quad (4)$$

$\gamma \in (0,1]$, $\psi(x,t)$ - the weighted function, $\omega(x)$ - the weighted function which satisfy Macenxoupt condition.

THE SOLUTIONS OF DEGENERATE QUASILINEAR ELLIPTIC NONDIVERGENCE EQUATIONS

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Let we is considered in some ball $B_{2r} \subset R^n$ with radius $2r, r \geq 1$, a solution $u(x)$ in $C(\overline{B_{2r}}) \cap W_{loc}^{2,n}(B_{2r})$ of nonlinear elliptic equation of non-divergence type

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

for a.e $x \in B_{2r}$. Here $a_{ij} = a_{ji}$, i.d. $A(x, y, p)$ set of symmetric matrices of size $n \times n$ and $\forall y \in R, \forall x, p, \xi \in R^n$ coefficients satisfying

(2)

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

We study qualitative property of solution this problem. For this is used the method of Stochastic Differential Equations.

THE OPTIMAL IRRIGATION UNDER WATER USE DECISIONS.

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We find optimal quantity of water for irrigation. Results demonstrate effects of water availability and irrigation technology decisions. Economic benefits can be compared to cost of operational charges, probability of hydrologic events and programs to increase supply reliability for agricultural areas. In practical relation the most rational in such a regime of periodic irrigation, quantity and speed irrigation following. Due to the prevention of surface runoff and the economical flow of water.

HOLDER ESTIMATES OF SOLUTION DEGENERATES PARABOLIC NONLINEAR EQUATIONS

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Let we are considered in cylindrical domains $Q_T = \Omega \times (0, T)$, where $\Omega \subset R^n$, $n \geq 2$ is a bounded Lipschitz domain, $T > 0$ degenerate non-linear parabolic equations

$$u_t - \operatorname{div}(\omega(x)|Du|^{p-2} Du) = 0 \quad (1)$$

$$u|_{\Gamma(Q_T)} = h \quad (2)$$

$\Gamma(Q_T) = (\bar{\Omega} \times \{0\}) \cup (\partial\Omega \times [0, T])$ denote the parabolic boundary of Q_T ,

$h: Q_T \rightarrow R$ continuous function, $\omega(x)$ Makenxoupt weight function.

In weighted space $C_\omega^2(Q_T)$ we show, that solution problem (1), (2) belonging to Holder space.

STRUCTURAL AND PARAMETRIC OPTIMIZATION ALGORITHM AND THEIR USE IN ACCELERATIVE AND FOCUSING SYSTEMS ENGINEERING

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Mathematical methods of stability and optimization are used extensively in problems of complex dynamic systems engineering. Nevertheless, development of specific algorithms for practically significant systems requires additional theoretical studies resulting in new mathematical problem definitions and improvement of algorithms to solve them.

For example, numerous algorithms are necessary to determine optimal areas of practical stability to calculate capture of particles' area in acceleration process. Area optimality is studied either in specified structure (sphere, ellipsoid, generalized ellipsoid) or in such structures

that are maximal by volume. Then one of the most essential tasks of particles' area capture in acceleration is the one of practical firmness in optimization definition [1].

The particularity consists in: from one side – mathematical definitions connected with studies of parameter systems' practical stability; from the other side – obligatory creation of constructive algorithms to solve them. The majority of applied problems of modelling, analysis and optimization are reasonable to study in structured forms.

Such approach gave possibility to simplify complicated problem of beam control to finally measured and to conduct accelerators' parameter optimization at physically realized conditions. Some algorithms are offered for disconnected dynamic systems' nondifferential optimization, minimization of maximum function by initial conditions and independent variable.

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STUDY OF SUSTAINABILITY IN PROBLEMS OF NEURODYNAMICS OF ARTIFICIAL INTELLIGENCE

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The report deals with dynamic processes in the problems of neurodynamics. A mathematical model of neural network dynamics proposed by Hopfield is considered.

The procedure for finding solutions in AI problems can be either "instantaneous" or "iterative", i.e. multistep. One of the directions in the theory of artificial intelligence is the theory of neural networks [1]. The model of a neuron, represented as an approximation of an electrical circuit in the form of a distributed transmission line of a biological dendritic neuron, is considered in [1].

$$C_i \frac{dv_i(t)}{dt} = -\frac{v_i(t)}{R_i} + \sum_{j=1}^n \omega_{ij} x_j(t) + I_j.$$

The system of differential equations can be reduced to the form

$$\frac{dv_i(t)}{dt} = -a_i v_i(t) + \sum_{j=1}^n w_{ij} \varphi(v_j(t)) + K_j.$$

Conditions for the convergence of dynamical processes for the system

$$\dot{x}_i(t) = -a_i x_i(t) + \sum_{j=1}^n \omega_{ij} F_j(x_j(t)), \quad F_j(x_j(t)) = \varphi_j(x_j(t) + y_j^0) - \varphi_j(y_j^0),$$

$i, j = \overline{1, n}$ have the following form. We introduce the notation:

$$c_{ii} = h_i(a_i - L_i \omega_{ii}), \quad c_{ij} = -\frac{1}{2}(h_i L_j \omega_{ij} + h_j L_i \omega_{ji}), \quad C = \{c_{ij}\}, \quad i, j = \overline{1, n}$$

Theorem. Let there exist constants $h_i > 0$, $i = \overline{1, n}$, under which a symmetric matrix C will be positively defined. Then the zero-equilibrium position is asymptotically stable.

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APPLICATION OF DECISION-MAKING EXPERT SYSTEMS IN THE EVALUATION OF SECURITY RISKS OF LOADS IN TRANSPORTATION

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Some problems of the different fields of science and technology that cannot be solved by any precise algorithms and methods. To solve these problems, it is necessary to involve professional specialists with wide experience and knowledge. Among such issues the control of technical units, diagnostics of devices and security of loads in the transportations may be noted. In this work a set of special programs called expert systems that assist in decision-making is developed and applied to investigate the above mentioned cases.

The set of programs include a special database that contains necessary information about the field where the considered problems belong (subject matter). The systems that assist in decision-making process and expert systems allows us to study and solve the problems

with fuzzy formulations. It is also possible to modify the existing database and control their development.

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OPEN TEACHING SYSTEM WITH TECHNOLOGIES

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Education informatization is an efficient development process that involves the use of educational technologies, including information-communication techniques, special software, information and methodological support in the learning process to improve its effectiveness (when the teacher uses short stories, audio and TV programs on the lesson Video materials to deliver specific content to the students, the bottom line - it develops the culture of listening to its listeners, concentrates attention, develops awareness and correct understanding skills".

Technical means should be used to enrich the learning process. Therefore, before integrating them into the learning process, it is important to think about how to facilitate technical information and information in a thorough study.

There are several strategies to show in the classroom, most of which are based on the use of pause. Before the movie is released, the teacher makes a short presentation (the phase of determination):

- a) connection to the subject of the movie and
- b) the film itself, as a work (genre, author, period of creation, etc.).

The same task can be accomplished by enabling pupils, eg Fast Internet Investment (if the Internet is available). Pupils can view the web site dedicated to the movie itself or other related information.

Prior to the movie, the teacher tells students to stop showing the screen several times and during these pauses they will have to think, discuss, note, and so on.

Students will have to answer special questions. Effective conduct of this type of session requires the preparation of preliminary questions by the teacher. Of course, the questions depend on different factors. First of all, it's about the movie genre. As modern young generation has more time to deal with media outlets, media aims to transform this relationship as a positive experience based on the development and extent of the person and cognitive sphere.

GENERATING SETS OF THE COMPLETE SEMIGROUPS OF BINARI RELATIONS DEFINED BY 4-ELEMENT CHAINS

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In work we consider semigroups $B_X(D)$, defined by 4-element chains $D = \{Z_1, Z_2, Z_3, Z_4\}$ with nonempty minimal element, i.e. $Z_1 \subset Z_2 \subset Z_3 \subset Z_4$ and $Z_1 \neq \emptyset$.

It is shown, that every element of the set $B = \left\{ \alpha \in B_X(D) \mid \left| V(X^*, \alpha) \right| = 4 \right\}$ is external element of $B_X(D)$. It is proved also that if $X \neq \bar{D}$, then for every $\beta \notin B$ have $\beta = \gamma \circ \delta$, where $\gamma, \delta \in B$, i.e. B is the irreducible generating set of the semigroup $B_X(D)$.

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THE METHOD OF FINDING TARGET EXPORT STRUCTURE

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Let U_{tn}^k – the regional export of (commodity) group k (the groups are classified according to the Harmonized System), SU_{tn}^k – the share (%) of a given group in total regional export:

$$U_{tn}^k = WU_{kn}^t \times E_k^t = WU_{tn}^k \times (SW_t^k \times E_t^0),$$

where E_t^k – the world export of group k for the year t , WU_{tn}^k – the share of regional export relative to the world export in a given group, SW_t^k – the share of group world export relative to the total world export E_t^0 : $U_{tn}^k \sum_{k=1}^{99} TSU_{tn}^k = U_{tn}^0 = \sum_{k=1}^{99} U_{tn}^k = E_t^0 \sum_{k=1}^{99} WU_{tn}^k \times SW_t^k$, where

TSU_n^k – the target value of share SU_{tn}^k . The algorithm of finding the target attainable values of TSU_{2016n}^k to maximize total regional export for $t=2016$ consists of the following steps.

Step 1. Renumber the groups $j=1, \dots, 98$: $SW_{2016}^j > SW_{2016}^{j+1}$.

Step 2. Set $T = 100$.

Step 3. Set $TSU_{2016n}^j = ASU_n^j = \max_t SU_{tn}^j$, $j=1, \dots, 99$.

Step 4. If , then set $T = T - 1$ and compute $TSU_{2016n}^T = \min_t SU_{tn}^T$.

Step 5. If $\Delta_n = \sum_{j=1}^{99} TSU_{2016n}^j - 100 > 0$, then return to Step 4,

else go to Step 6.

Step 6. Compute $TSU_{2016n}^T = ASU_n^T - \Delta_n$ and stop.

MOBILE LEARNING IN EDUCATIONAL PROCESS

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Mobile devices and mobile technologies have already become an integral part of all the everyday aspects of our lives. The developing educational trend Mobile Learning has all the chances to become an educational mainstream. QR-codes (Quick Response) are the big advantages in the work of teachers. There are numerous ways to use QR codes in the educational process: from conducting games to creating a resume. The easiest way is to print and place QR-codes on information sheets or posters for more information about planned events, competitions, educational sites, etc. There are five main areas where mLearning can be widely used: self-education, school, university, distance and corporate education. Since the mechanism of working with QR codes is simple enough, this mobile technology can be used for the convenience of the educational process: QR codes with links can be added to sources in presentations, books and textbooks, QR codes can be applied to real objects in classrooms (for example, posters, boards).

On the one hand, it makes educational process modern and technological, and, on the other hand, the quality of the lectures dramatically increases: information, coming to a person simultaneously through different channels (visual, auditory, tactile), is perceived more extensive and is better remembered. In education QR codes allow to use the maximum of perception channels.

Teachers can use QR-codes for learning foreign languages through games. The point is that a teacher encrypts the questions into QR codes, and the students respond to them and leave their answers on the paper strips next to the printed and attached to the board / wall QR codes. According to the survey QR codes are useful in teaching languages from the viewpoint of the psychology of learning: reading of questions with QR codes motivates students, makes them to be concentrated and helps memorize the material. The use of information and communication technologies by a teacher in various activities contributes to improving the efficiency of the educational process, raising the level of methodical and research work.

THE FIBONACCI-CICULANT LENGTHS OF THE SEMIDIHEDRAL GROUP^d

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It is well-known that the semidihedral group SD_{2^m} , ($m \geq 4$) is defined by presentation

$$SD_{2^m} = \langle x, y \mid x^{2^{m-1}} = y^2 = e, yxy = x^{-1+2^{m-2}} \rangle.$$

The Fibonacci-circulant orbits of the first and second kind of a group were defined by Deveci et al. (see [1]). In this work, we obtain the lengths of the periods of the Fibonacci–Circulant orbits of the first and second kinds of the semidihedral group SD_{2^m} .

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ON INTEGRABLE NON-LOCAL MULTICOMPONENT NLS EQUATIONS

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We will present nonlocal extensions of multi-component Nonlinear Schrodinger (NLS) and Derivative Nonlinear Schrodinger (DNLS) types of equations with PT and CPT-symmetries [1,2]. All these types of PDEs appear to be integrable by the Inverse Scattering Method. The types of (nonlocal) reductions leading to integrable equations invariant with respect to C- (charge conjugation), P- (spatial reflection) and T-

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(time reversal) symmetries are described. The corresponding constraints on the fundamental analytic solutions and the scattering data are derived.

Based on examples of multicomponent NLS equations related to **A.III** (Manakov vector NLS) and **BD.I** (Kulish-Sklyanin model) types of symmetric spaces [2], the properties of different types of 1- and 2-soliton solutions are discussed. It is shown that these equations may have regular multi-soliton solutions for some specific choices of the soliton parameters as well as soliton solutions blowing up in a finite time. Furthermore, we will present briefly nonlocal multi-component generalizations of DNLS equations related to **A.III** symmetric spaces [1]. This includes equations of Kaup-Newell (KN) and Gerdjikov-Ivanov (GI) types.

Finally, we will outline briefly similar results for integrable discretisations of the NLS equation of the Ablowitz-Ladik form [3].

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GENERALIZED LINEAR MODELS IN LIFE INSURANCE USING R

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This paper focuses on the calculation and differentiation of insurance tariffs Application of the GLM (generalized linear models) in R language and environment be used. The aim of this article is to analyze

and determine the cost of sold products. Today, many types of products and sub-categories insurance products are sold. It is crucial to know the exact cost of the insurance products. There are even cases when insurers sell them at a price lower than market value or sell too much without knowing any insurance product, resulting in the refusal of the insurer to buy that product or to buy it unwillingly. This model can also calculate net recipe for excess of loss reinsurance.

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LIMIT THEOREM FOR A SEMI-MARKOVIAN RANDOM WALK WITH NORMAL DISTRIBUTED INTERFERENCE OF CHANCE

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In this study, a semi-Markovian random walk $(X(t))$ with a normal distributed interference of chance has been investigated. Under some conditions, it is shown that this process is ergodic. Additionally, the weak convergence theorem for the normalized process $Y_a(t) \equiv \frac{X(t)}{a}$ is proved by using the basic identity for the random walk, the principle of Dynkin and Milne theorem. Finally, the limit form of the ergodic distribution has been obtained, when $a \rightarrow \infty$. It is clearly seen that, the limit distribution of the process $Y_a(t)$ is an uniform distribution.

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ON THE INITIAL-BOUNDARY VALUE PROBLEM FOR THE LINEAR NONSTATIONARY QUASI OPTICS EQUATION WITH A SPECIAL GRADIENT TERMS

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We consider the initial-boundary value problem for the linear quasi optics equation with a special gradient terms of finding the function $\psi = \psi(x, t, z)$ from the conditions:

$$i \frac{\partial \psi}{\partial t} + ia_0 \frac{\partial \psi}{\partial z} - a_1 \frac{\partial^2 \psi}{\partial x^2} + ia_2(x) \frac{\partial \psi}{\partial x} + a(x)\psi + \quad (1)$$

$$+ v_0(x, t, z)\psi + iv_1(x, t, z)\psi = f(x, t, z), \quad (x, t, z) \in \Omega,$$

$$\psi(x, 0, z) = \varphi_0(x, z), \quad (x, z) \in \Omega_L \equiv (0, l) \times (0, L), \quad (2)$$

$$\psi(x, t, 0) = \varphi_1(x, t), \quad (x, t) \in \Omega_T \equiv (0, l) \times (0, T), \quad (3)$$

$$\psi(0, t, z) = \psi(l, t, z), \quad (t, z) \in Q_{TL} \equiv (0, T) \times (0, L), \quad (4)$$

where $i = \sqrt{-1}$ imaginary unit, $l > 0, T > 0, L > 0, a_0 > 0, a_1 > 0$ are given numbers, $0 \leq x \leq l, 0 \leq t \leq T, 0 \leq z \leq L,$

$\Omega_{\tau_z} = (0, l) \times (0, t) \times (0, z), \Omega = \Omega_{TL}, \psi = \psi(x, t, z)$ - is wave function,

$a(x), a_2(x), v_0(x, t, z), v_1(x, t, z)$ are measurable real-valued functions that satisfy the conditions:

$$0 \leq a(x) \leq \mu_0, \quad \forall x \in (0, l), \quad \mu_0 = \text{const} > 0; \quad (5)$$

$$|a_2(x)| \leq \mu_1, \quad \left| \frac{da_2(x)}{dx} \right| \leq \mu_2, \quad \forall x \in (0, l), \quad \mu_1, \mu_2 = \text{const} > 0; \quad (6)$$

$$|v_0(x, t, z)| \leq b_0, \quad \left| \frac{\partial v_0(x, t, z)}{\partial t} \right| \leq b_1, \quad \left| \frac{\partial v_0(x, t, z)}{\partial z} \right| \leq b_2, \quad \forall (x, t, z) \in \Omega; \quad (7)$$

$$|v_1(x, t, z)| \leq d_0, \left| \frac{\partial v_1(x, t, z)}{\partial t} \right| \leq d_1, \left| \frac{\partial v_1(x, t, z)}{\partial z} \right| \leq d_2, \forall^0(x, t, z) \in \Omega, ; \quad (8)$$

$\varphi_0(x, z), \varphi_1(x, t), f(x, t, z)$ are given complex-valued functions satisfying the conditions:

$$\varphi_0 \in W_2^{0,2,1}(\Omega_L), \quad \varphi_1 \in W_2^{0,2,1}(\Omega_T), \quad f \in W_2^{0,1,1}(\Omega) ; \quad (9)$$

the symbol $\forall^0$ means “for almost everywhere”.

In this paper, the theorem of existence and uniqueness of solutions of first initial-boundary value problem (1)- (4) is proved. To prove the theorem applies method of Galerkin [1, 2].

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THE PADOVAN p -CIRCULANT SEQUENCES

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Deveci and Karaduman defined [1] the Padovan p -numbers as shown:

$$pap(n + p + 2) = pap(n + p) + pap(n)$$

for any given and $n \geq 1$ with initial conditions $pap(1) = pap(1) = \dots = pap(p) = 0$, $pap(p + 1) = 1$ and $pap(p + 2) = 0$.

In this work, we define Padovan p -circulant sequences by using of circulant matrices which are obtained from the characteristic polynomials of the Padovan p -numbers. Then, we obtain miscellaneous properties of these sequences.

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MULTIPURPOSE MANUFACTURING PROCESS AND MANAGEMENT

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It is known that determining the best division of national income is one of the main problems of economic policy. The algorithm for determining of the optimal investment in the multi sectors of the economy should be considered below. The results obtained should be applied to the real economy.

Each sector utilizes two factors - capital and labor force for production function:

$$Y_j = F_j(K_j, L_j), j=1,2,...,n$$

Here, $K_j(t)$ – j is the sum of capital in the sector and $L_j(t)$ is the labor used in this sector.

Bellow studded the management and optimization issues of the multi-sector neo-classical economic growth model are investigated. Explains the features of multi-sectoral production management within the terms of the Neoclassical Growth Model. At the same time, the most realistic version of the optimal management problem is explained in the multicomparative production process and explains ways to address these issues. The results obtained are separately specified and their application areas are displayed. Algorithm of optimal capital investment has been given to the sectors of the economy and the impact of investment on capital growth in each sector has been analyzed. The optimal management of investments for the acquired model has been studied and the conditions for optimal capital investment have been determined. In addition, the question of correlation of the received problem was also studied.

MATHEMATICAL MODELS OF DECISION MAKING FOR "ATTACK-DEFENSE" GAMES

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A mathematical model of the "attack-defense" system is considered. The "attack" and "defense" subsystems are considered in a complex unit interrelated model of the "attack-defense" system, taking into account the multicriteria nature of the problem with possible alternatives to the development of events, a numerical algorithm for optimal solution and simulation of scenarios are created. The effectiveness of the system includes economic rationality, technical reliability and reliable performance of functions by means of attack and defense.

The analysis of the main objectives of the attack and physical security of the objects is given. The attack and defense act against one another and for this purpose they use various means, for the acquisition, of which certain expenses are incurred. The resources of both the "attack" and "defense" subsystems are considered to be limited. The interaction of subsystems is expressed in the form of the maximin problem of the "attack-defense" game model

$$W(x, y) = \prod_{i=1}^k \{ 1 - \prod_{j=1}^m [1 - (1 - \rho_{ij})^{x_i}]^{y_j} \} \rightarrow \max_x \min_y$$

on the set

$$V = \left\{ (x, y) : \sum_{j=1}^m x_j = N, \sum_{i=1}^l y_i = M, x_i \geq 0, y_j \geq 0, i = 1, 2, \dots, m; j = 1, 2, \dots, k \right\}.$$

Subsystems "attack" and "defense" with their main criteria's: economic rationality, technical reliability, the degree of reliable performance of functions of funds are considered. These criteria's are not only often faced in practice, they are independent and interrelated. In creating real security systems, these requirements must be combined and coordinated with all other criteria and problems facing in practice. Results of numerical calculations and simulation of scenarios will be analyzed.

NUMERICAL METHODS FOR SOLUTION OF "ATTACK-DEFENSE" GAMES

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Numerical methods for the mathematical model of the "attack-defense" games are considered. The "attack" and "defense" subsystems are considered in a single interrelated model of a complex "attack-defense" games, taking into account the multicriterial nature of the problem with possible alternatives to the development of events, a numerical algorithm for optimal solution and simulation of scenarios with an assessment of the efficiency of subsystems and the whole system. The effectiveness of this system, including economic rationality, technical reliability, as well as reliable performance of its functions by means of attack and defense, is estimated.

The analysis of the main objectives of the attack and security of the objects is given. The attack and defense act against one another and for this purpose they use various means, for the acquisition, of which certain expenses are incurred. The resources of both the "attack" and "defense" subsystems are considered to be limited. Winning an attack is a loss of protection and vice versa. Numerical calculations carried out within the framework of the MATLAB package. The multicriteria problem by linear convolution of criteria's is reduced to one criterion problem

$$F(y) = \alpha_1 \sum_{j=1}^n \sum_{i=1}^m c_{ij} y_{ij} - \alpha_2 \sum_{j=1}^n \sum_{i=1}^m q_{ij} y_{ij} - \\ -(1 - \alpha_1 - \alpha_2) \prod_{i=1}^m \left\{ 1 - \prod_{j=1}^n [1 - (1 - p_{ij})^{y_{ij}}] \right\} \rightarrow \min$$

on the set Y .

The accuracy, convergence rate, degree of uncertainty, decision making and other properties of numerical calculations are analyzed.

OPTIMAL CONTROL PROBLEM FOR A NONLINEAR SCHRÖDINGER EQUATION WITH A SPECIAL GRADIENT TERMS AND WITH COMPLEX POTENTIALS

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We consider the problem of finding the minimum of functional

$$J_{\alpha}(v) = \|\psi(., T) - y\|_{L_2(D)}^2 + \alpha \|v - \omega\|_H^2 \quad (1)$$

on the set of admissible controls

$$V = \left\{ v = v(x, t) = (v_0(x, t), v_1(x, t)) : v_m \in W_2^{0,1}(\Omega), |v_m(x, t)| \leq b_m, \right. \\ \left. \left| \frac{\partial v_m(x, t)}{\partial t} \right| \leq d_m, m = 0, 1, \forall (x, t) \in \Omega \right\}$$

under conditions:

$$i \frac{\partial \psi}{\partial t} + a_0 \Delta \psi + ia_1(x, t) \nabla \psi - a(x) \psi + v_0(x, t) \psi + iv_1(x, t) \psi + \quad (2)$$

$$+ a_2 |\psi|^2 \psi = f(x, t), (x, t) \in \Omega,$$

$$\psi(x, 0) = \varphi(x), x \in D, \psi|_S = 0, \quad (3)$$

where $i = \sqrt{-1}$ imaginary unit, $d_m > 0$, $m = 0, 1$, $a_0 > 0$, $\alpha \geq 0$ are given numbers, $D \in R^3$ is a convex bounded domain, $x \in D$, $0 \leq t \leq T$, $\Omega_t = D \times (0, t)$, $\Omega = \Omega_T$, $S \equiv \Gamma \times (0, T)$, Γ - is boundary of domain D , $\psi = \psi(x, t)$ is wave function, a_2 - is a complex number that satisfy the conditions:

$$a_2 = \text{Re} a_2 + i \text{Im} a_2, \text{Re} a_2 < 0, \text{Im} a_2 > 0; \text{Im} a_2 \geq |\text{Re} a_2|; \quad (4)$$

$a(x)$, $a_1(x, t)$ are measurable bounded real-valued functions that satisfy the conditions:

$$0 \leq a(x) \leq \mu_0, \forall x \in D, \mu_0 = \text{const} > 0, \quad (5)$$

$$|a_1(x,t)| \leq \mu_1, \quad \left| \frac{\partial a_{1j}(x,t)}{\partial x_k} \right| \leq \mu_2, \quad \left| \frac{\partial a_{1j}(x,t)}{\partial t} \right| \leq \mu_3, \quad j, k = \overline{1,3}, \quad ; \quad (6)$$

$$\overset{o}{\forall} (x,t) \in \Omega, \quad \mu_1, \mu_2, \mu_3 = \text{const} > 0$$

$\varphi(x), f(x,t), y(x)$ are given complex-valued functions satisfying the conditions:

$$\varphi \in W_2^0(D), \quad f \in W_2^{0,1}(\Omega) ; y \in L_2(D) ; \quad (7)$$

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

In this paper, the existence and uniqueness of solution of considered optimal control problem is investigated and a necessary optimality condition in variational inequality form for its solution is obtained [1].

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DECISION-MAKING FOR THE WEB-PAGE CLASSIFICATION ACCORDING TO THE OBJECT-ORIENTED FEATURES

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According to the classification or regulation theory, the decision has been made in the web-page projecting process, its classification was conducted due the object-oriented characteristics.

The analysis has showed that the presented web-pages in the internet space have not been classified and structured. It is visible that the functionally completely different organizations have the identical structure and design web-page. Such kind of information space obviously creates the inferiority of receiving the information for users. In order to solve the problem, we have decided to create the united web-page, where the web-pages will be classified according to the object-oriented features. The classification of web-page makes its use easier, the information gathering becomes more effective, information is reliable and movement on the web-page is convenient and comfortable.

The web-pages have been divided into classes due to the distinguished characteristics, and classes into sub-classes.

The classes and sub-classes are distinguished from each other as with structure, as information. During the web-page projecting, the main attention is paid to the structural part. The structure should consider receiving the desired information by users in a simple and convenient way. The structure should be worked out so that makes the adaptation process easier for users. For working out the structure, the main attention is paid to home page. According to our research, there is defined that the majority of users receive information only from home page, and do not move to the following pages. Therefore, the home page should be informative and brief. At the same time, it is desired to have the feeling of information deficit, which pushes to move to the following page in order to receive complete and important information, which are distributed on each page of site. For this reason, the links to the important information are necessary for obvious and simple navigation. The simplicity and informationality principles should be considered during the web-page projecting relevant to the modern standards and tendencies.

The first that a user positively perceives is the visuals or design while visiting the web-page. During working on the web-page, the accurate and unirritating colours. All the pages of the web-page should be decorated in one style way that does not make users think that all pages are different web-pages while moving from one page into another; because it causes the negative result for users as they are forced to stop connecting to the web-page. The design should not be very complex with non-necessary details and elements. In general, the web-page should present the unity of factors, such as modernity, individuality, style, simplicity, lightness.

The static maquette of the web-page is built with the suggested methods, which is realized with the **(X)HTML, CSS technology relevant to the W3C standards. HTML (HyperText Markup Language)** is the marking language, which contributes to the web-page preparation. This is the simple language, however it is composed with a lot of element, which are called as tags. Through the **HTML** tags, the links, pictures and different blocks are added on the web-page, the main structure of the web-page is built. For making visuals of **HTML** tags, **CSS (Cascading Style Sheets)** are used. According to the **W3C**, the main function of the styles is web-page code and demarcation of visual part from each other, which means that building the logical structure of

the web-page is processed with the **HTML** marking language, and the documents, which need the visuals, are arranged with the **CSS** style.

One of the stages of creating an educational web-page is database, which is a set of tables that are related to each other, and keep the data. The tables are made up of rows and columns. Each column has a name and one type of data stored in it. In the table, the columns are strictly sequenced while strings are unresolved. Through the database we systematize information on the web-page. The database management system is software **MYSQL**, which allows us to create a base, contact it, send the **SQL** demands and receive the result. Its most important advantage is the speed of work, fast processing and reliability of data.

The dynamic part of the educational web-page **PHP** (Hypertext Preprocessor) is a server-side programming language, which is used for dynamic generation of **HTML** pages. It belongs to a number of rare programming languages that were created specifically for web applications. **PHP** orders are written in **HTML** pages using the special tags, which allow PHP machines to perform the necessary actions on the server.

THE FIBONACCI–CIRCULANT SEQUENCES IN THE BINARY POLYHEDRAL GROUPS ^e

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Deveci et. al. defined [2] the Fibonacci–Circulant sequences of the first and second kinds as shown, respectively:

$$\begin{aligned} x_n^1 &= -x_{n-1}^1 + x_{n-2}^1 - x_{n-3}^1 \quad \text{for } n \geq 4 \quad \text{where } x_1^1 = x_2^1 = 0 \quad \text{and } x_3^1 = 1 \text{ and} \\ x_n^2 &= -x_{n-3}^2 - x_{n-4}^2 + x_{n-5}^2 \quad \text{for } n \geq 6 \quad \text{where } x_1^2 = x_2^2 = x_3^2 = x_4^2 = 0 \quad \text{and} \\ x_5^2 &= 1. \end{aligned}$$

Also, they extended the Fibonacci–Circulant sequences of the first and second kinds to groups. In this work, we obtain the periods of the

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Fibonacci–Circulant sequences of the first and second kinds in the binary polyhedral groups.

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MULTI-OBJECTIVE OPTIMIZATION OF THE PORTFOLIO INVESTMENT ACCORDING TO ITS EXPECTED RISK AND EXPECTED RETURN WITH THE LINEAR CONVOLUTION METHOD

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When compiling a portfolio, the investor solves two problems: minimizing the risk of the portfolio at a given level of profitability and maximizing the yield (efficiency) of the portfolio at a given level of risk. The purpose of these optimization tasks is to determine the structure of the investment portfolio of securities, under which the specified conditions are solved. The mathematical form of the optimization problem is shown below for calculating the weights of the investment portfolio by the model of J. Tobin [1].

$$\left\{ \begin{array}{l} \sqrt{\sum_{i=1}^n w_i^2 \cdot \sigma_i^2 + 2 \sum_{i=1}^{n-1} \sum_{j=i+1}^n w_i \cdot w_j \cdot \rho_{ij} \cdot \sigma_i \cdot \sigma_j} \rightarrow \min, \\ w_0 r_0 + \sum_{i=1}^n w_i \cdot r_i > r_p, \\ w_0 + \sum_{i=1}^n w_i = 1, \\ w_i \geq 0, \end{array} \right. \quad (1)$$

$$\begin{cases} w_0 r_0 + \sum_{i=1}^n w_i \cdot r_i \rightarrow \max, \\ \sqrt{\sum_{i=1}^n w_i^2 \cdot \sigma_i^2 + 2 \sum_{i=1}^{n-1} \sum_{j=i+1}^n w_i \cdot w_j \cdot \rho_{ij} \cdot \sigma_i \cdot \sigma_j} < \sigma_p, \\ w_0 + \sum_{i=1}^n w_i = 1, \\ w_i \geq 0, \end{cases} \quad (2)$$

However, the traditional method of solving this problem is mono objective optimization, i.e. reflects only one aspect of the investor's benefit: to maximize the portfolio return with minimum risk or to minimize the risk to obtain an acceptable return. A multi objective model of the investment portfolio that allows to take into account the heterogeneous objectives of the investor, as well as the influence of environmental factors by aggregating particular criteria of portfolio quality into a single objective function and a scenario approach to its modeling.

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INVESTIGATION OF A SEMI-MARKOVIAN MODEL OF TYPE (s, S) WITH DEPENDENT COMPONENTS

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In this study, we construct a stochastic process with dependent components $(X(t))$, that expresses a semi-Markovian inventory model of type (s, S) . Assume that the initial level in some warehouse is S and a control level $s=0$ is selected. The stock level is reduced by the random amounts (η_n) , at random times $\left(\sum_{i=1}^n \xi_i\right)$. If the stock level is reduced below the control level, the stock level is instantaneously replenished up to the level S . We assume that the magnitude of the demands (η_n) dependent on the inter-arrival time of demands (ξ_n) . This

model is expressed by the process $X(t)$. It is shown that this process $X(t)$ is ergodic. Moreover, the exact expression for the ergodic distribution of the process is obtained.

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STOCHASTIC APPROXIMATION PROCEDURE WITH SWITCHING

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Stochastic approximation procedure (SAP) with allowance for external influences on the regression function $C(u, x)$ is described by the equation

$$du = a(t)[C(u, x)dt + \sigma(u, x)dw,$$

where $x(t), t \geq 0$, Markov or semi-Markov uniformly ergodic process in the phase space (X, X) [1].

In the report we develop the conditions of the convergence of the SAP with the small parameter $\varepsilon > 0$ which leads to the establishment of the asymptotic properties of the random evolution of $u^\varepsilon(t)$ the form like this

$$du^\varepsilon(t) = a(t)[C(u^\varepsilon(t), x(t/\varepsilon))dt + \sigma(u^\varepsilon(t), x(t/\varepsilon))dw.$$

Using the scheme of diffusion approximation and asymptotically small diffusion we obtained convergence SAP. The same method is used for continuous stochastic optimization procedure. And using small parameter we have got asymptotic dissipative[2] for such procedures in the Poisson approximation scheme [3].

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CONSTRUCTION OF BASIC STRUCTURES OF SIMPLE SENTENCES SEMANTIC COMPONENTS FOR TRANSLATION INTO SIGN LANGUAGE

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In accordance to various estimations from 300 to 500 thousand people have hearing problem in Ukraine. Therefore task of developing modern information technologies helpful to create new computer training and communication systems for hearing impaired people is very actual and important. To solve the task information technology concept for non-verbal communication of such people is proposed [1]. Creating an automated system for translating from Ukrainian into a sign language is the concept direction. Since sign language is an independent language, the most suitable description for the morphology facts description is: from value to form that is semantic component of information is decisive. To construct an automated translation from the Ukrainian into the sign language basic system of simple sentence structures constructing that have analogies in sign language and convey information semantic component is suggested. Simple sentences means sentence with one predicative link and any complex sentence can be decomposed with simple sentences.

Relations representation mechanism between the words of Ukrainian language and the gestures of sign language was developed to determine basic system of simple grammar structures that allowed to align the words with corresponding gestures, as well as generalized grammatical constructions translation from the Ukrainian language into the sign language representation mechanism that made possible to determine input sentence grammatical structure to find gesture sentence appropriate structure for the translation. Using inflection parameters of input sentence to determine its grammatical structure makes the difference from existing approaches.

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CONTROL OF SEGREGATION PHENOMENA IN THE BULK MATERIALS FLOW

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Additional studies of the fractional composition of the charge along the intersections of the entire flow path to determine the possibilities of optimizing the charge flow and the heat redistributing over the layer height are required. The control of the distribution of fines at the height of the sinter layer should provide more of their content at the bottom of the downward flow.

The process of moving of small particles inside the layer can be considered as a stationary continuous. At the same time, the position of each particle depends on the value of the source of the transfer potential, which in the considered volume of the layer is characterized by a specific volume density of the inflow γ , i.e., the rate of the flow of voids in a unit of volume $[\gamma] = \text{m}^3/(\text{m}^3 \cdot \text{s})$. The movement of small particles down the layer is carried out under the influence of gravity and counteracting friction forces, which reduce the speed of movement of small up to zero due to jamming of particles in narrow places between large ones. The second law of Fick's diffusion is used to describe the penetration of fine particles down the layer [1], which binds the spatial and temporal changes in the concentration of voids. The diffusion coefficient depends on the ratio of the size of the fractions and the properties of their surface, the basis of which is the Arrhenius equation. The diffusion coefficient is significantly higher for a moving flow.

The movement of the fractions of the charge from unloading of a pelletizing drum to download on a sinter machine PJSC "MMC Ilyich's name" investigated by using the model. The obtained results confirmed the findings about the significant influence of the fractional distribution inside the flow on the segregation of particles along the height of the layer. Therefore, the existing design of the loading device sintering

machines was not optimal for the distribution of the fractions in the flow on a sloping reflective sheet.

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DIVERSIFICATION OF STOCK PORTFOLIOS

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Mathematical models of the dynamics of the formation of the market value per share and stock portfolio are constructed in a class of ordinary differential equations. Such models are needed to build the trajectories of the market price of shares and the optimal portfolio diversification. Initially, procedure is based on the method of variation of arbitrary constants and enables one to find an analytical solution of the corresponding equation. Model of the dynamics of the portfolio is constructed based on the mathematical model of the market value per share. This model is used because of its diversification and for building the initial values of the optimal vector of shares of different types in the portfolio. Mathematical set theory and methods of optimal control theory are applied to achieve that. The problem of partitioning of investment interval on subintervals is studied. On each of them the problem of constructing an optimal investment portfolio is solved taking into account constraints on the control.

The formulation of the problem and built algorithm greatly expand the possibilities of investing, as in every moment of diversification it is possible to construct a set of alternatives that are equivalent in terms of quality of selected criteria. The investor, as in the classical approach, Mr. Markowitz has the ability to take into account when deciding additional factors that arise in the course of practical investment and are associated with the peculiarities of the system dynamics modeling. Mathematical portfolio diversification procedure makes it possible for the above-mentioned models of the dynamics of the market value of a share and the stock portfolio to solve the problem of constructing an

initial portfolio with a known value of its expected market value at the selected future date.

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STATIONARY REGIME FOR RETRIAL QUEUES WITH UNRELIABLE DEVICES

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In the study of a wide class of stochastic systems with retrial calls, it is necessary to calculate the characteristics of systems with infinite phase space. The Markov process describing the functioning of such a system has a countable set of states, and the matrix of intensity rates usually does not have any special properties that would facilitate its transformation in order to obtain an explicit solution.

We consider a queueing system with one server that is subject to active breakdowns. The time between retrials is exponentially distributed with known intensity $\lambda > 0$. Intensities of server breaking down ($\alpha > 0$), repair work ($\beta > 0$), service ($\mu > 0$) and retrial calls ($\theta > 0$) are known as well. When server breaks down the current customer leaves the server and becomes a new source of retrial calls. Primary arrivals, retrial calls, breakdown and service processes are mutually independent. The stochastic process $X(t) = (Q(t), A(t))$ describes the state of the system at time t ; where $Q(t) \in \{0, 1, 2, \dots\}$ is a number of retrial calls while $A(t) \in \{0, 1, 2\}$ describes the state of the server (0 – waiting, 1 – service, 2 – repair).

The stationary distribution was obtained under mentioned conditions. The stationary distribution existence conditions were derived similarly to standard algorithm (see [1]) while one more approach was considered too. Later the obtained results will be applied to hysteresis strategies.

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METHODS OF MATHEMATICAL STATISTICS AND THEIR APPLICATIONS TO ANALYSIS OF OPTICAL-ELECTRONIC SYSTEMS

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The purpose of the work is to present a tutorial that contains classical methods of mathematical statistics and to demonstrate the effectiveness of their use in the analysis of optoelectronic systems. The tutorial provides basic information on mathematical statistics. In this tutorial, we analyze the concept of point and interval estimations, their classification, methods of searching for evaluations and constructing reliable intervals, the main criteria for checking statistical hypotheses, including the case of a parametric model. The problems of constructing linear regression models and the least squares method for estimation of unknown parameters are considered.

There are also sections, which, as a rule, go beyond the classical theory of mathematical statistics: statistical methods for investigating random flows and their transformations, statistics of stable distributions, and methods for detecting useful signals.

The tutorial is developed as a course for distance learning in the system of distance education Omega <http://omega.univ.kiev.ua>. This will make it possible for students to access the materials of the tutorial, and also it will be possible to create tests and control works that students will solve in the same system of distance education in order to consolidate the knowledge gained from the theoretical material of the tutorial. This type of independent work of students can be considered as a separate independent form of training, and it can supplement the classical lectures at the university as well.

The tutorial was developed primarily for students of the Faculty of Computer Science and Cybernetics of Taras Shevchenko University of Kyiv and the Faculty of Electronic and Medical Engineering of the Kharkiv National University of Radio Electronics. It can also be useful for students of physical and mathematical faculties of technical and pedagogical higher educational institutions.

ON DESCRIPTION OF EQUILIBRIUM STATES OF AN ECONOMIC SYSTEM WITH AN ADDITIONAL REDISTRIBUTION OF A CAPITAL[‡]

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The knowledge of a state of an economic system requires an information concerned a set of variable characteristics. Using the equilibrium description of the economy can secure values of necessary characteristics to perform an analysis of the economy state.

The aim of an investigation is to a description of possible equilibrium states of the economic system under conditions of profitable productions of all economy subjects and a selection of equilibrium states with defined properties.

There are factors affected on the economy most strongly then others for a certain time period of an economy evolution. These influence factors change the variable characteristics of equilibrium states and properties of equilibrium states.

Every equilibrium state is a solution of equations

$$\sum_{j=1}^l c_{kj}(z)y_j = \Psi_k, \quad k = \overline{1, n}, \quad (1)$$

$$\tilde{D}_j^1(p) + D_j = y_j \sum_{s=1}^n c_{sj}(z)p_s, \quad j = \overline{1, l}. \quad (2)$$

Where variable z describes an influence of a selected factor. Variables $\{D_i\}_{i=1}^l$ define an additional redistribution of a capital. Similar redistribution can describe an investment activity of economy subjects.

There is an algorithm of a solution of the equilibrium problem (1) – (2). The algorithm leads to a determination unknowns variables in a defined area of values. That fact means a detection of characteristics of equilibrium states of the economy with required properties. There is a possibility of an estimation of the quality of equilibrium states to indicate the most acceptable equilibrium state.

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UNIQUENESS OF THE SOLUTION OF THE INVERSE PROBLEM FOR A CLASS OF DIRAC EQUATIONS SYSTEM

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In this paper it is devoted to study the inverse scattering problem for a singular boundary value problem of generalized form of a two dimensional system Dirac type with discontinuous coefficient

$$BY' + \Omega(x)Y = \lambda \rho(x)Y,$$

$$-(\alpha_1 Y_1(0) - \alpha_2 Y_2(0)) = \lambda(\beta_1 Y_1(0) - \beta_2 Y_2(0)),$$

where

$$B = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}, \quad \Omega(x) = \begin{pmatrix} p(x) & q(x) \\ q(x) & -p(x) \end{pmatrix}, \quad Y = \begin{pmatrix} Y_1(x) \\ Y_2(x) \end{pmatrix},$$

on the half line.

The new representation for the solutions of the differential equations system is considered, the scattering function is defined and its properties are given. The expansion formula by eigenfunctions associated with the given problem is obtained. The main equation is derived for the solution of the inverse problem and the solvability of the main equation is showed. It is shown the uniqueness of the solution of the inverse problem of scattering theory on the half line. The potasitil is uniquely constructed with respect to the scattering function.

NECESSARY CONDITIONS OF OPTIMALITY IN DISCRETE CONTROL SYSTEMS

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Suppose we want to minimize the functional

$$S(u(\cdot)) = \Phi(x(t_1)) \rightarrow \min_{u(\cdot)}, \quad (1)$$

$$x(t+1) = f(x(t), u(t), t), x(t_0) = x_0, t \in I := \{t_0, t_0 + 1, \dots, t_1 - 1\}, \quad (2)$$

$$u(t) \in U(t) \subseteq R^r, \quad t \in I. \quad (3)$$

Here $R^r - r$ - dimensional Euclidean space, $x(\cdot) \in R^n$ is a state vector, $u(\cdot) \in R^r$ control vector, t time (discrete), t_0, t_1, x_0 are given points, $\Phi(\cdot), f(\cdot, \cdot, \cdot)$ are given functions, and $U(t), t \in I$ is a given set.

A control satisfying the constraints we call valid. The valid control $u(t), t \in I$, which delivers the minimum to the functional (1) under the restriction (2) we call optimal control and its corresponding decision $x(t), t \in I := I \cup \{t_1\}$ of the system (2) is an optimal trajectory. We call a couple $(u(\cdot), x(\cdot))$ an optimal process.

We introduce the following concepts in our work:

Definition 1. Let $Z \subset R^m$, $z_0 \in Z$ and $\hat{z} \in Z \setminus \{z_0\} \neq \emptyset$. We call a point z_0 relative internal point of the set Z along a line $l(z_0, \hat{z}) := \{\tilde{z} : \tilde{z} = z_0 + \tau(\hat{z} - z_0), \tau \in R\}$, if there is a positive number $\gamma = \gamma(\hat{z}) \in [0, 1]$ such, that for all $\varepsilon \in (-\gamma, \gamma)$ the inclusion $z_0 + \varepsilon(\hat{z} - z_0) \in Z$ is justified. We call the point z_0 a relative internal point of the set Z in a broad meaning, if the point z_0 is the relative internal point of the set Z along any lines of the set $\{\ell(z_0, z) : z \in Z \setminus \{z_0\}\}$. We call the set of such points the relative internal subset of the set Z in a broad meaning, and denote it by symbol $Z^{[0]}$. We call the set Z relatively open in the broad meaning, if $Z^{[0]} = Z$.

Definition 2. We call the set $Z \subset E^m$ γ -convex ($\pm \gamma$ -convex) with respect to the point $z_0 \in Z$, if for any point $z \in Z$ there is a number $\gamma = \gamma(z) \in (0, 1]$, such that for all $\varepsilon \in (0, \gamma]$ ($\varepsilon \in (0, \gamma]$ or for all $\varepsilon \in [-\gamma, 0]$) the inclusion $z_0 + \varepsilon(z - z_0) \in Z$ is justified. If the set Z is γ -convex ($\pm \gamma$ -convex) with respect to every its points, we call it γ -convex ($\pm \gamma$ -convex).

Based on these concepts, we obtained new optimality conditions of the first and second order for problems (1) - (3), which is a generalized result of the article [1].

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STABILITY INVESTIGATION OF IMMUNOSENSOR MODEL BASED ON LATTICE DIFFERENTIAL EQUATIONS WITH DELAY

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In the work we offered model of immunosensor which is based on the system of lattice differential equations with delay.

We used a very simple model of advancing anti-antigen delay for a two-dimensional array of biopsies, which is based on the well-known Marchuk model [1]. The main result of the work is conditions of local asymptotic stability for endemic state. For this purpose we have used method of Lyapunov functionals. It combines general approach for construction of Lyapunov functionals of predator-prey models with lattice differential equations.

We used a very simple model of advancing anti-antigen delay for a two-dimensional array of biopsies, which is based on the well-known Marchuk model [1]. Numerical examples showed us influence on stability of different parameters. Increasing time delay we transmit from stable node to limit cycle and finally to chaotic behavior.

We have gotten interesting experimental results when taking into account the number of pixels. We see that ammount of pixels in immunosensor narrows the range of enabling local asymptotic stability.

We left open problems for the next studies: conditions for global asymptotic stability and the taking into consideration of some biological phenomena of population growth.

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A MAXIMIZATION ON TYPE-2 FUZZY SETS

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In this report the Bellman-Zadeh approach [1] is applied to decision-making problems which are defined on type-2 fuzzy sets (T2FSs). A T2FS of solutions is defined. An extension of the natural order relation to the class of fuzzy sets [2] is used for comparison of fuzzy sets of alternatives membership degrees. It is shown that this is a fuzzy preference relation provided that fuzzy sets of membership degrees of T2FSs of feasible alternatives are normal. With the help of this preference relation a fuzzy set of non-dominated alternatives is constructed. The notion of an α -level non-dominated alternative is introduced.

It is shown that this is a solution to an optimization problem. In this problem the objective function is maximized with a bounded secondary membership degree of the T2FS of feasible alternatives. The existence of 1-level non-dominated alternatives is investigated. It is explained that when selecting a maximizing alternative one should obtain as large values as possible for both the objective function and the secondary membership degree to the T2FS of feasible alternatives. The problem of alternatives selection with respect to two criteria (the objective function and secondary degrees of membership to the T2FS of feasible alternatives) is formulated. Its Pareto optimal solutions are called effective maximizing alternatives. Their properties are investigated.

There are known areas of applications of mathematical programming problems in the case when different types of uncertainty are present in the membership function of the fuzzy set feasible alternatives. It is expected that the method developed in the present article will be useful in these areas.

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NONPARAMETRIC OUTLIERS IDENTIFICATION

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A nonparametric method for the identification of outliers and risk events in current security environment data based on nonparametric statistical techniques will be presented. The core principle of the algorithm is to smoothen the data using nonparametric regression with variable bandwidth and subsequently analyse the residuals by nonparametric statistical methods. The proposed procedure is verified by simulations and will be applied for the data from Global Terrorism Database - University of Maryland for identification of outliers and risk events.

OPTIMAL ESTIMATES OF RIGHT PARTS OF POISSON EQUATIONS WITH OBSERVATIONS UNDER UNKNOWN DEVIATIONS

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Let we have some given values $y_k, k = \overline{1, N}$, which have the form

$$y_k = (h_k, \varphi) + v_k, \quad k = \overline{1, N}, \quad (1)$$

here $(h_k, \varphi) = \int_D h_k(x) \varphi(x) dx$, and D is a limited area in a space R^n

with a piecewise smooth border Γ , here $h_k(x)$ are given integrated functions with the square function, $\varphi(x)$ is a generalized solution of the equation

$$\Delta \varphi(x) = f(x), \quad \varphi|_{\Gamma} = 0, \quad (2)$$

A function $f(x)$ is an unknown function integrated with the square, v_k is an unknown deviation of observation.

Assume that G is a given region and functions $f(x)$ and numbers $\eta_1, \dots, \eta_N$ belong to it.

$$G = \left\{ (f, \eta) : \int_D F_1(x, f(x)) dx + F_2(\eta_1, \dots, \eta_N) \leq \gamma^2 \right\},$$

here F_1, F_2 are given nonnegative functions. We right functional

$$J(f) = \int_D F_1(x, f(x)) dx + F_2(y_1 - (h_1, \varphi), \dots, y_N - (h_N, \varphi)), \quad (3)$$

Definition. A function $\hat{f}(x)$, which can be get from the condition $\hat{f}(x) \in \text{Arg min } J(f)$, we call the optimal estimate for the functional $J(f)$.

With some limitations on the functions F_1, F_2 we investigate the problem of existence and uniqueness of the optimal estimates. We shown that such estimates can be expressed in terms of solutions of some nonlinear equations.

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OPTIMAL ESTIMATION OF NON-STATIONARY PARAMETERS OF DIFFERECCE EQUATIONS

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Problems of building estimations of parameters of are investigated in [1] – [3]. Algorithms of building optimal estimation are analyzed in work [4].

Let the vector $x_k \in R^n, k = \overline{0, N}$ are the solutions of equations

$$x_{k+1} = F_k(x_k) a_k + \eta_k, k = \overline{0, N},$$

where $F_k(x_k)$ is the certain $n \times m$ matrix function, $a_k \in R^m$ and $\eta_k \in R^n$ are unknown vector-functions.

Suppose condition

$$\sum_{k=0}^{N-1} \varphi_k(\Delta_+ a_k) + \sum_{k=0}^N \psi_k(\eta_k) \leq \gamma^2$$

is satisfied, where $\varphi_k, k = \overline{0, N-1}$ and $\psi_j, j = \overline{0, N}$ are nonnegative functions and $\varphi_k(0) = \psi_k(0) = 0$; and $\Delta_+ a_k = a_{k+1} - a_k, k = \overline{0, N-1}$.

Let the function $I(u)$ of form

$$I(u) = \sum_{k=0}^{N-1} \varphi_k(u_k) + \sum_{k=0}^N \psi_k(x_{k+1} - F_k(x_k)a_k),$$

where $\Delta_+ a_k = u_k, k = \overline{0, N-1}$ and $a_0 = 0$.

Let $\hat{u} \in \text{Arg min } I(u)$ and conditions $\Delta_+ \hat{a}_k = \hat{u}_k, k = \overline{0, N-1}, \hat{a}_0 = 0$ are satisfied, then the estimate $\hat{a}_k$ is called the optimal by function $I(u)$.

Theorem. Let the functions $\varphi_k, k = \overline{0, N-1}$ and $\psi_j, j = \overline{0, N}$ are continuous-differential. The optimal by function $I(u)$ estimate $\hat{a}_k$ can be found from solving the boundary value problem for difference equations:

$$\begin{aligned} \Delta_- \text{grad} \varphi_k(\Delta_+ a_k) &= F_k^T(x_k) \text{grad} \psi_k(x_{k+1} - F_k(x_k)a_k), \\ \text{grad}(\Delta_+ a_k)|_{k=N} &= 0, a_0 = 0, \end{aligned} \quad (1)$$

where $\Delta_- b_k = b_k - b_{k-1}$.

The conditions of existence of unique solution of (1) are considered.

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INVERSE PROBLEMS FOR LINEAR SCHRÖDINGER EQUATION UNDER UNCERTAINTIES

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Let complex-valued function $\psi(x, t)$ on the set $\Omega = D \times (0, T)$ is the solution of the equation

$$i \frac{\partial \psi}{\partial t} + L\psi = f(x, t) \quad (1)$$

under the conditions

$$\psi(x, 0) = \varphi(x), \quad \psi|_S = 0, \quad (2)$$

Here D is a restricted area in R^n with a piecewise continuous (smooth) border Γ , $S = \Gamma \times (0, T)$, $i = \sqrt{-1}$, L is elliptical operator of the form

$$L\psi = \sum_{i,j=1}^n \frac{\partial}{\partial x_i} a_{ij}(x) \frac{\partial \psi}{\partial x_j} + v(x)\psi.$$

The coefficients $a_{ij}(x), v(x)$ and functions $f(x, t), \varphi(x)$ are restricted by such conditions, that there can be the only generalized solution of the equation (1) with conditions (2).

It is assumed that for unknown complex-valued functions $f(x, t)$ and $\varphi(x)$ are given the functions

$$y_k(t) = \int_D \overline{h_k(x)} \psi(x, t) dt + \eta_k(t), \quad 0 < t < T, \quad k = \overline{1, N}, \quad (3)$$

here $h_k(x)$ known functions, $\eta_k(t)$ unknown deviation.

Let unknown functions $f(x, t), \varphi(x), \eta_k(t)$ belong to a restricted set G , here

$$G = \left\{ (\psi, f, \eta) : \int_D F_1(\varphi(x)) dx + \int_\Omega F_2(f(x, t), t) dt + \int_0^T F_3(\eta_1(t), \dots, \eta_N(t), t) dt \leq \gamma^2 \right\}, \quad (4)$$

F_1, F_2, F_3 - some non-negative given functions.

Therefore, we study the problems of the optimal in a certain sense estimation of functions $f(x, t)$ and $\varphi(x)$ according to measurements (3). It is shown that such estimates can be found as the solution of the optimal control problem of the Schrödinger equation.

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MATRIX MULTIPLE REGRESSION AND CLASSICAL BIOMETRIC METHODS FOR PREDICTION OF BIOLOGICAL INDICATORS: EXAMPLES OF APPLICATIONS

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Modern biology widely uses the mathematical apparatus for the simulation and prediction of processes in living systems. In the report examples of prediction of biological (vital) indicators are considered. In this case, the classical methods of biometrics and methods based on matrix multiple regression are used. In order to solve the problem of estimation by the method of least squares for multiple matrix regression, a mathematical apparatus for singular (SVD) decomposition and pseudo-inversion technique for Moore-Penrose was used within the development of the concept of cortege operators [1].

The empirical data for calculations were data of an experiment [2] conducted at the Educational and Scientific Center "Institute of Biology and Medicine" (Taras Shevchenko National University of Kyiv). The calculations were made in Microsoft Office Excel and Wolfram Mathematica. The accuracy of the prediction of the APE (absolute percentage error) criterion is according to algorithm based on matrix multiple regression (the error is from 0% to 10%) is higher than for classical methods of biometrics (some errors are greater than 50%).

As shown in the examples, matrix multiple regression can be effective prediction instrument in biology with acceptable planning processes accuracy.

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ON A BOUNDARY PROBLEM FOR THE COMPOSITE TYPE EQUATION IN THE BOUNDED PLANE DOMAIN

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Here we consider boundary problem for the composite type equation

$$\frac{\partial u_s(x)}{\partial x_2} + i\sqrt{(-1)^s} \frac{\partial u_s(x)}{\partial x_1} = 0, \quad x = (x_1, x_2) \in D_s, \quad s = 1, 2; \quad (1)$$

that is hyperbolic in the domain D of the lower semiplane, and elliptic in the domain D_2 of the upper semiplane with the following boundary conditions

$$\alpha_{k,-1}^{(1)}(t)u_1(t+1,-1) + \alpha_{k,0}^{(1)}(t)u_1(t,0) + \alpha_{k,0}^{(2)}(t)u_2(t,0) + \alpha_{k,1}^{(2)}(t)u_2(t,1) = \alpha_k(t), \quad k = 1, 2; \quad t \in [-1, 1], \quad (2)$$

$$\beta_{11}(t)u_1(-t, t-1) + \beta_{12}(t)u_1(2-t, t-1) = \beta_1(t), \quad t \in [0, 1], \quad (3)$$

$$\beta_{11}(t)u_2(-1, t-1) + \beta_{12}(t)u_2(1, t-1) = \beta_1(t), \quad t \in [1, 2], \quad (4)$$

Here $i = \sqrt{(-1)}$, D_1 is a parallelogram the lateral surface of which is characteristics of the considered problem, D_2 is a rectangular domain. The coefficients of the boundary conditions are continuous functions

and conditions (2) are linearly independent. Investigation of the boundary problems for the different type equations was considered in [1].

Using the fundamental solutions

$$U_2(x - \xi) = \frac{1}{2\pi} \cdot \frac{1}{x_2 - \xi_2 + i(x_1 - \xi_1)},$$

$$U_1(x - \xi) = \theta(x_2 - \xi_2) \delta(x_1 - \xi_1 + x_2 - \xi_2),$$

of the elliptic Cauchy-Riemann equation [2] and first order hyperbolic equation correspondingly we obtain the main relations. Here $\theta(t)$ is Heaviside's unit function, and $\delta(t)$ Dirac's function. We get necessary conditions from these main relations. Some of the obtained necessary conditions contain singular terms. The expressions obtained after regularization of these conditions together with the boundary conditions allows one to get sufficient conditions for the Fredholm property of the considered boundary problem.

Note that the regularization of the obtained integrals is carried out by some special method since the existing singularities do not belong to the general case.

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DOUBLE MERGING OF THE PHASE SPACE FOR STOCHASTIC DIFFERENTIAL EQUATIONS WITH IMPULSE PERTURBATIONS IN POISSON APPROXIMATING CONDITIONS

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We investigate of some properties of stochastic differential equations with small additions. In particular, we are interested in the double merging of the phase space of states for a stochastic evolutionary system

with impulse perturbation under conditions of approximation of Poisson.

Stochastic evolutionary equations in ergodic Markovian environment can be given by stochastic differential equation

$$du^\varepsilon(t) = C(u^\varepsilon(t), x^\varepsilon(t/\varepsilon^2))dt + \varepsilon d\eta^\varepsilon(t), \quad u^\varepsilon(t) \in \mathbb{R} \quad (1)$$

where $x(t)$ is defined on standard phase space $(E, \mathcal{E})$ with splitting

$$E_k \cap E_{k'} = \emptyset, \quad k \neq k'$$

in a series scheme with a small parameter of a series $\varepsilon \rightarrow 0$, $\varepsilon > 0$.

Markovian kernel has a form

$$Q^\varepsilon(x, B, t) = P^\varepsilon(x, B)[1 - \exp\{-q(x)t\}], \quad x \in E, \quad B \in \mathcal{E}, \quad t \geq 0.$$

Theorem 1. Under assumptions of Poisson approximation and some additional assumptions for impulse perturbation process, weak convergence $\eta^\varepsilon(t) \rightarrow \eta^0(t)$, $\varepsilon \rightarrow 0$ holds true.

Limiting process $\eta^0(t)$ can be given by generator

$$\hat{\Gamma}\varphi(w) = \hat{\Pi}\hat{\Gamma}_1(x)\varphi(w) = \hat{a}\varphi'(w) + \int_R [\varphi(w+v) - \varphi(w) - v\varphi'(w)]\hat{\Gamma}_0(dv),$$

where

$$\hat{a} = \sum_{k \in \hat{E}} \hat{\pi}_k \int_{E_k} \pi_k(dx) a(x), \quad \hat{\Gamma}_0(v) = \sum_{k \in \hat{E}} \hat{\pi}_k \int_{\hat{E}_k} \pi(dx) \Gamma_0(v, x).$$

and it is a process with independent increments that has deterministic shift and Poisson jumping part.

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DECISION SUPPORT FOR EMERGENCY ENVIRONMENTAL POLLUTION

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The task of decision making relating to emergency response is to minimize the environmental and health damage and the monetary cost of possible measures and actions [1]. For these tasks, analytical systems based on numerical modeling [2] of air pollution dispersion with rapid identification of meteorological fields and emergency situation play a key role. The Decision Support System (DSS) concept is proposed that includes air pollution modeling, observation data management, mapping of pollution fields, and a set of simulation and optimization models. The main task of the system is exposure prediction for the main modes of emergencies (accidental releases), and proposed measures to counteract disasters through mitigation plans (population informing and evacuation options: areas, routes, etc). Central to the proposed method is the creation of a knowledge base of emergency scenarios and relevant key measures for emergency response. Decision model approach is based on time-constrained diagnosis of emergency situation using observational data. This approach is needed in order to provide output on a response time that is appropriate for emergency response and decision support.

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ARCHITECTURE OF A SYSTEM FOR CONTENT BASED VIDEO INFORMATION RETRIEVAL

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Video information retrieval is area of high interest for a number of researchers because of diversity and amount of video information available. The structure of video and its characteristics: richer content than individual images, huge amount of raw data and very little prior structure makes it very difficult for analysis and querying. The aim of this abstraction is to introduce researchers an architecture of the system for fast and robust content based video information retrieval. System for video indexing and retrieval has a wide spectrum of promising applications like: video information retrieval, video annotation, video indexing, news event analysis [1], intelligent management of web videos (useful video search and harmful video tracing). This system focuses on key features that help to index, classify and retrieve desired and relevant videos and filter out undesired ones like human detection and recognition, scene detection and recognition, image and video hashing, key-frame extraction, text detection and recognition etc. and the way this information is retrieved and managed. Such systems have two phases:

- 1) raw information retrieval (timing);
- 2) information post processing (recognition and annotation).

So, during first phase we extract low-level information from each frame, and during second phase we use this low-level information to form scene representation.

Purpose of this systems architecture is to develop search engine for video processing and querying information. Also, in sake of search robustness system may generate textual description for each scene with multiple synonyms, a mind map or semantic web.

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MODELLING OF INNOVATION DEVELOPMENT OF SOCIO-ECONOMIC SYSTEMS

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The rapidly increasing complexity of the interconnection and interaction of innovation development of socio-economic systems is a characteristic feature of modern science and technology progress. With the formalization of these problems, unstructured problems and problems of principle non formalized are appearing. It is shown [1] that the solution of complex unstructured problems must be created on the basis of synthesis of foresight methodologies and cognitive modelling. Involvement of the process of modeling of foresight methodology at the first stage, which is sufficiently formalized, allows with the help of expert evaluation to identify the critical technologies and build the alternatives of scenarios with quantitative characteristic values. The obtained characteristics are the initial data for the initial iteration of cognitive modeling.

Technology of modelling for innovation development of socio-economic systems is that on the basis of cognitive models to identify possible and rational way to manage the situation with the purpose of transition from the initial state to the desired one. To obtain a reliable solution of the problem, the connections between vertices are defined using the membership functions. In the modeling process at each stage of building a model the one of the important issues is substantiation of the reliability of its construction, which is achieved by mathematical justification stability of the model in the process of its creation. In this work, when creation a cognitive model the following types of sustainability as structural stability, sustainability of the perturbation and stability by value (numerical stability) are considered.

Research on structural stability, i.e. to find all of the cycles of the graph, is carried out by a recursive search, all the vertices and all possible ways are searched, after which found cycles are investigated on parity. The stability of the graph by the perturbation and value is based on the concept of the process of propagation of perturbations of a graph. The real of innovation socio-economic systems are created.

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STATISTICAL SIMULATION OF STOCHASTIC FINANCIAL PROCESSES

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The article deals with the methods of statistical simulation of the Wiener and generalized Wiener (fractional Brownian motion) of random processes based on their spectral images in the form of random series [1]. With the help of the developed methods, the implementation of the Wiener processes used in models of financial processes is modeled. A generalized Wiener process has the properties of self-similarity. This property of the generalized Wiener process is characterized by the Hurst index.

The Wiener and generalized Wiener process is used in the tasks of actuarial and financial mathematics [2].

An American-type option at discrete moments of time is described by the model:

$$S_n = S_{n-1} \exp\left\{\sigma\sqrt{\Delta t}\xi_n + \lambda\Delta t\right\}, \text{ where } t_n = n * \Delta t, \Delta t = \frac{T}{N}, \{\xi_n\} - \text{are}$$

independent standard Gaussian random variables.

The Merton model of the firm's cost has the form:

$$V(t) = V_0 \exp\left\{\left(\mu - \frac{\sigma^2}{2}\right)t + \sigma W(t)\right\},$$

where μ is a yield, σ is a volatility, $W(t)$ is the standard Wiener process.

The Black-Scholes model has the form

$$dS(t) = S(t)(\mu dt + \sigma dW(t)), dB(t) = rB(t)dt, \quad r > 0, B(0) > 0, S(0) > 0,$$

where μ is an expected yield, σ is a volatility, $W(t)$ is the standard Wiener process. Or in a different form

$$S(t) = S(0) \exp \left\{ \sigma W(t) + \left(\mu - 0.5 \sigma^2 \right) t \right\}, \quad B(t) = B(0) \exp \{rt\}.$$

In [1] the portfolio of securities is determined by the equation

$$X(t) = \exp \{rt\} \left(\exp \{W_\alpha(t)\} - 1 \right)^2 \text{ at } \alpha \in \left(\frac{1}{2}, 1 \right),$$

where $W_\alpha(t)$ is a fractional Brownian motion with the index of Hurst α .

The resulting implementation can be used in the computational experiment in the investigated financial processes, the models of which use the Wiener and generalized Wiener random processes.

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ASSESSMENT OF THE TRAINING SAMPLE QUALITY IN DATA MINING TASKS AND THE STRATEGY SELECTION FOR FINDING DECISIVE RULES

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An attempt was made in [1] to assess the training sample (TS) quality for constructing a predictive neural network. However, the requirements to TS for such an assessment reduce the effect of its application and do not provide an opportunity to assess the TS quality for more general cases that are much more frequent in practice.

Undoubtedly, the TS quality is directly related to the choice of characteristics system for the objects description.

Nowadays, almost the only way to assess the TS quality in the general case is the assessment that is determined by the probability of TS sets correct recognition built by the decisive rule (DR). However, such an assessment obtaining requires a training procedure and a significant time consumption [2]. At the same time, it is desirable to know the TS quality, without training itself and indicate the TS limiting capabilities

for objects identifiability. It is desirable to obtain a similar assessment for the examination sample (ES). In this case, different strategies for the DR searching are possible depending on the relationship between the values of such assessments for TS and ES.

The proposed assessment is calculated directly from the TS (ES) data and characterizes the TS (ES) distinctive ability.

The assessment is based on the formula application for calculating the characteristics informativeness that is given in [3] and studies in the field of nonparametric statistical problems [4].

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ON $M/M/c$ QUEUE WITH THE LIMITED NUMBER OF RETRIALS AND CONSTANT RETRIAL RATE

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Retrial queues have been widely used to model the many practical situations arising in telephone systems, telecommunication networks, wireless networks and call centers. Retrial queues are characterized by that a primary customer who finds busy the service facility upon arrival moment immediately leaves the servers area, but some time later he repeats his demand. Between retrials he is said to be in 'orbit' [1].

In this paper, we consider a multi-channel queueing system with a single retrial attempt to begin service process and constant retrial rate. Such system is determined by next parameters: λ is the arrival rate, μ

is the service rate and ν is the rate of repeated attempt that does not depend on the number of sources of retrial calls.

The system with a single retrial attempt at time t are modelled by a two-dimensional Markov chain $Q(t) = (Q_0(t), Q_1(t))^T$, $t \geq 0$ with continuous time in phase space $S = \{0, 1, \dots, c\} \times \mathbf{Z}_+$. The component $Q_0(t)$ is the number of busy servers at time t , $Q_1(t)$ is the number of sources of repeated attempt at time t .

For such system we have explored the conditions of the existence of stationary regime using theorem 1 in [2]. Using the approximation of the initial system by the one with limited number of sources of repeated calls we have obtained the explicit vector-matrix formulas for stationary probabilities in terms of system's parameters.

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COMPARING METHODS OF ROBUST CONTROL OF IMPULSE PROCESSES IN COMPLEX SYSTEMS' COGNITIVE MAPS

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Problem of suppressing constrained disturbances in cognitive map's (CM) impulse process control when some coordinates are unmeasurable is stated and solved in the report. We suppose that increments of unmeasurable CM coordinates are constrained and their probabilistic characteristics are unknown.

To solve the problem a model of CM impulse process dynamics is split into two interrelated sets of difference equations with measurable and unmeasurable CM nodes coordinates respectively. Increments of unmeasurable coordinates are considered as constrained disturbances in the first equations set of CM model for impulse processes with measurable nodes coordinates.

The first method of robust control with suppressing constrained disturbances is based on adaptation of H_∞ theory to the operating conditions of complex system's dynamics in CM impulse process mode [1]. Control optimality criterion is to minimize maximal ratio of l_2 -norm of increments of measurable CM nodes coordinates to l_2 -norm of increments of disturbances (unmeasurable nodes coordinates and measurement noise).

The second method is based on applying invariant ellipsoids w.r.t. state variables to description of the effect of constrained disturbances on trajectory of measurable nodes coordinates in the impulse process. Linear matrix inequalities are used for this purpose [2].

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EXPLORING OF STATISTICAL DEPENDANCE OF MENTAL CHARACTERISTICS AND MORBIDITY TO PSORIASIS

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Today there are many ways of treatment of psoriasis. However, there are no effective methods, and existing ones allow only to discard symptoms that come back over and over again. Moreover, both psychological and medical approaches are used for the treatment. In the study the disease was analyzed in terms of physiology and psychology. Different mental characteristics were considered and the connection between the power of their manifestation and the possibility of having a disease in progress were explored using statistical and regression

analysis methods. This enables psoriasis to be examined from the inside and influence the most important factors to avoid further development of the disease.

Thus, for the purpose of the study it is taken: to construct a model for determining the relationships between certain psychological characteristics and the incidence of psoriasis, determining the factors that most affect the mental state of patients in general.

SAS programming language is used for the analysis. Initially, data obtained after passing psychological tests, are systematized and an interpretation in numerical form was performed. Then, the data undergoes regressive processing for the significance of the factors. The next step is to build a model for patients with psoriasis using the logistic regression method. The constructed model identified the most significant factors for such patients: they have a significantly increased perception of hearing. In addition, nervousness and anxiety are greatly increased. At the same time, increasing endurance and ability to risk, and alexectmia - the inability to express and understand their emotions.

The resulting model suggests that psoriasis is a manifestation of the biological mechanism of stress - that is, an organism perceives stress as an existing threat and activates adaptation characteristics to combat it. The study can help many people who are prone to the disease to avoid its further development with the use of the recommendations, and for sick people - to weaken the symptoms or to reject the disease.

HYPOTHESIS TESTING ON THE IMPULSE RESPONSE FUNCTION

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A time-invariant casual continuous linear system with impulse response function $H(\tau)$, $\tau \in R$, is considered. It means that the response of the system to an input $X(t)$, $t \in R$ is

$$Y(t) = \int_0^{\infty} H(\tau) X(t-\tau) d\tau. \quad (1)$$

One of the problems arising in the theory of such systems is to estimate or identify the function H by observations of the responses of

the system. Here we use a method of cross-correlograms for the estimation of the response function H .

Assume that $X_{N,i}(t), t \in R, i = \overline{1, n}$, is a family of measurable real-valued stationary zero-mean Gaussian processes that have such representation

$$X_{N,i}(u) = \sum_{j=1}^N \xi_{j,i} g_j(t-u), \text{ for } t, u \in R,$$

where $\xi_{j,i}$ are supposed to be jointly independent random variables with

$$E\xi_{j,i} = 0, E\xi_{j,i}^2 = 1 \text{ and } g_j(z), j \geq 1 \text{ is an orthonormal basis in } L_2(R).$$

Definition. As an estimator for H we will use the function

$$\hat{H}_{N,n}(\tau) = \frac{1}{n} \sum_{i=1}^n Y_{N,i}(\tau) X_{N,i}(t-\tau), \quad \tau > 0.$$

Applying the theory of Square-Gaussian Processes the estimation of large deviation probability $P \left\{ \int_0^T |\hat{H}_{N,n}(\tau) - H(\tau)|^2 d\tau > \varepsilon \right\}$ can be founded that allows to construct the criterion on the shape of the impulse response function.

Let the null hypothesis H_0 state that an impulse response function is $H(\tau), \tau \in [0, A]$, and the alternative H_a implies the opposite.

Denote

$$g_{N,n}(\varepsilon) = 2 \times \sqrt{1 + \frac{\sqrt{2}(\sqrt{\varepsilon} - Tc_1(N,n))}{\sqrt{Tc_2(N,n)}}} \exp \left\{ -\frac{\sqrt{\varepsilon} - Tc_1(N,n)}{\sqrt{2Tc_2(N,n)}} \right\},$$

where $c_i(N,n), i = \overline{1, 2}$, are known functions that depend on N, n .

Let ε_δ be a solution of the equation

$$g_{N,n}(\varepsilon_\delta) = \delta, \quad 0 < \delta < 1.$$

To test the hypothesis H_0 , we can use the following criterion.

Criterion. For a given level of confidence $1 - \delta, \delta \in (0, 1)$, the hypothesis H_0 is rejected if

$$\int_0^T |\hat{H}_{N,n}(\tau) - H(\tau)|^2 d\tau > \varepsilon_\delta$$

otherwise the hypothesis H_0 is accepted.

Remark. The equation $g_{N,n}(\varepsilon_\delta) = \delta$ has a solution for any $\delta > 0$ since the function $g_{N,n}(\varepsilon)$ decreases with respect to ε . We can find solution of the equation using numerical methods.

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AN EXTERNAL SIGNALS AMPLIFICATION ON PROBABILITY

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In statistical radio engineering and the nuclear physics, in the quantum theory of crystal firm bodies, and also in number of scientific areas connected to them, while studying the properties of macroobjects consisting of occasionally reacting with occasional features of microelements, probabilistic theory is usually used for determining quantitative reaction measurements on external effects of macroobject as a whole. At the same time issues on direct connections between external effects on macroobject and variations of probabilistic characteristics of its microelements stay out of view.

Let $F_X(x)$ be the probability distribution function of stochastic variable X with zero expectation M and dispersion σ^2 . Obviously probability distribution function of stochastic $Y = \sigma X + M$ that has M expectation and σ^2 dispersion will be defined by the next ratio

$$F_Y(x) = P\{\sigma X + M \leq x\} = F_X\left(\frac{x - M}{\sigma}\right), \quad (1)$$

where $p\{\sigma X + M \leq x\}$ is probability of that the stochastic variable $\sigma X + M$ takes value less or equal x .

Suppose that the stochastic variable X is under external influence. This leads to the fact, that its expectation and dispersion become the time functions: $M(t)$, $\sigma^2(t)$. Due to this the probability distribution function of stochastic variable Y will change to:

$$F_Y(x, t) = p\{\sigma(t)X + M(t) \leq x\} = F_X\{x(t)\}, \quad (2)$$

where

$$x(t) = [x - M(t)] / \sigma(t).$$

From (2) follows that analysis of changes of probability distribution function of stochastic variable caused by external effects can be led to analysis of distribution function below

$$F\{x(t)\} = p\{X \leq x(t)\}, \quad (3)$$

Comparison of characteristic (3) with well known characteristics of amplifying elements allows us make a conclusion: high enough slope of probability distribution function makes amplification of external effect possible, and it acts like change of probability distribution function of stochastic variable.

PROPERTIES OF QUADRATIC PROBLEMS OF PARETO-PARETO'S OPTIMIZATION

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Let $F(x) = (f_1(x), \dots, f_l(x))$ – a composite convolution of the criteria $f_k(x) = (f_{k1}(x), \dots, f_{kl_k}(x))$, $k = 1, 2, \dots, l$, according to the subordination of paired equal value, each of which is a vector convolution of the convex quadratic functions of equal value criteria $f_{ki}(x)$, $i = 1, 2, \dots, l_k$. The problem of Pareto-Pareto's maximization is being investigated

$$\max^{PP} \{F(x) | x \in X\}, \quad (1)$$

where $X \subset R^n$ – is a bounded feasible set being described as a certain finite system of linear equations and inequalities.

Let $Z(F(x)) = (f_{11}, f_{12}, \dots, f_{1l_1}, \dots, f_{l1}, f_{l2}, \dots, f_{ll_l})$. We will solve the problem

$$\max^L \{Z(F(x)) \mid x \in X\} \quad (2)$$

Indicate $PP(F, X)$ and $L(Z, X)$ the sets of the optimal solutions of the problems (1) and (2) correspondingly, $PP^v(F, X)$, $L^v(Z, X)$ the sets of the optimal solutions of the problems (1) and (2), which are the extremal points of set X .

Theorem 1. The optimal solution of the problem (2) is an optimal solution of the Pareto-Pareto's problem (1).

Theorem 2. $PP^v(F, X) \neq \emptyset$.

To solve the problem (2) we may apply the methods of multicriteria optimization [1, 2], for single-staged solving we may use the results of the research [3].

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GAUSS-NEWTON-KURCHATOV METHOD FOR NONLINEAR LEAST SQUARES PROBLEMS

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Consider the nonlinear least squares problem [1, 2]

$$\min_{x \in R^p} \frac{1}{2} (F(x) + G(x))^T (F(x) + G(x)), \quad (1)$$

where residual function $F + G: R^p \rightarrow R^m$ ($m \geq p$) is nonlinear by x , F is continuously differentiable function, G is continuous function, differentiability which, in general, is not required.

For finding the solution of the problem (1) we propose the modification of Gauss-Newton method, which uses the sum of derivative of differentiable parts of operator and divided difference of nondifferentiable parts instead full Jacobian,

$$x_{n+1} = x_n - (A_n^T A_n)^{-1} A_n^T (F(x_n) + G(x_n)), \quad n = 0, 1, \dots \quad (2)$$

where $A_n = F'(x_n) + G(2x_n - x_{n-1}, x_{n-1})$, $F'(x_n)$ is Fréchet derivative of function $F(x)$; $G(2x_n - x_{n-1}, x_{n-1})$ is divided difference of the first order of $G(x)$ [2] by points $2x_n - x_{n-1}$, x_{n-1} ; x_0 , x_{-1} are given. This combined method for solving (1) on the Gauss-Newton method and Kurchatov-type method [2] is based. We have proved theorems under weak conditions where convergence of the proposed method are justified and rate of convergence are established. On test problems we show its high performance compared with Secant-type method [2] and Gauss-Newton type's method which uses only the derivative of differentiable part of operator.

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EVALUATING OF VALUE-AT-RISK FOR FAT MODEL

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During the last couple of years market risk has become a focus of bank regulators. For these purposes, the Value-at-risk (VaR) has become the benchmark methodology. It measures the potential portfolio loss caused by adverse price moves during a holding period of one day with a given probability. The Value-at-Risk (VaR) is defined as the maximum loss that will not be exceeded with a certain probability [1].

The purpose of this paper is to evaluate of Value-at-Risk for FAT model. This FAT model [2] gives asset prices as GBM but is driven by some nondecreasing stochastic "activity time" process. We consider the model for the stock price P_t , where parameters $\mu \in \mathbb{R}$ and $\sigma > 0$ reflect drift and diffusion, and P_t is the strong solution

$$dP_t = \mu P_t dt + \left(\theta + \frac{\sigma^2}{2} \right) P_t dT_t + \sigma P_t dW_t$$

We construct the activity time $T_t^m = \sum_{i=1}^t \tau_i^m$, where τ_i has reciprocal (inverse) Gamma distribution $R\Gamma(\alpha, \beta)$.

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TECHNOLOGY ENRICHED LESSON PLANNING

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Computerization and connection to the internet space greatly assist the school in achievement of the main educational objectives.

During planning of technology enriched lesson, one shall act with special prudence so that the process of completing the task on the computer by the pupil does not turn into random game instead of focusing on authentic learning. Technology enriched activity must be based on the ideas and concepts which ought to be taught by our curriculum. Technologies are a wonderful tool for acquisition, organization, assessment of knowledge.

In order to plan the technology enriched lesson, it is important to consider the following:

During lesson planning – select a computer software (office, multimedia, etc.) which will support (and not impede) the teaching

process in the classroom. We must take into account whether the computer software is accessible for the pupils, so that they can gather the facts, assess and organize the information/source, use their knowledge.

Relate technology to the lesson – we must determine the role of the technology during a lesson. For instance, shall we use digital literature or concept map for introduction of the new topic? Shall we instruct the pupils to search for the information about specific topic in teams, using electronic library or do we prefer simulations by subject classes? Thus, through the use of technologies the teachers give opportunity to the pupils to obtain high-quality information. They will be able to make difficult and complex concepts easily understandable for the pupils, increase their motivation and interest to learn, present the same information in different ways and deliver it to the pupils considering their interests.

NON-STATIONARY PARAMETER RECURRENT ESTIMATION BY LEAST SQUARES METHOD WITH LEAST DEVIATIONS FROM ‘ATTRACTION’ POINTS FOR BILINEAR DYNAMIC SYSTEMS UNDER UNCERTAINTIES

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Consider the estimation problem of unknown slowly time-varying matrices $A, B_1, B_2, \dots, B_m, B$ in dynamic system:

$$x(k+1) = Ax(k) + \sum_{i=1}^m u_i(k)B_i x(k) + Bu(k) + \xi(k), \quad k \in \mathbb{N}, \quad (1)$$

where $x(k), u(k) = (u_1(k), u_2(k), \dots, u_m(k))^T, \xi(k)$ are state, control and disturbance vectors respectively.

The least squares estimate with variable forgetting factor $\lambda(k)$ ($\lambda(k) \in (0, 1], k \in \mathbb{N}$) is considered for object (1) in non-classical case when this one may be not unique and additionally ‘attraction’ points $A_*(N), B_{1*}(N), B_{2*}(N), \dots, B_{m*}(N), B_*(N)$ for parameter matrices $A, B_1, B_2, \dots, B_m, B$ are given at any moment N ($N = 0, 1, 2, \dots$).

The set of all above-mentioned estimates of unknown non-stationary parameter matrices under these assumptions is defined as

$$\text{Arg} \min_{A, B_1, B_2, \dots, B_m, B} Q(A, B_1, B_2, \dots, B_m, B, N), \quad (2)$$

where $Q(A, B_1, B_2, \dots, B_m, B, N) = \sum_{k=1}^N w(k, N) \|\xi(k)\|^2$,

$$w(k, N) = \begin{cases} \prod_{i=k}^{N-1} \lambda(i), & \text{if } k = \overline{1, N-1}, \\ 1, & \text{if } k = N. \end{cases}$$

The required least squares estimate with variable forgetting factor $\lambda(k)$ and least deviations from given ‘attraction’ points $A_*(N), B_{1*}(N), B_{2*}(N), \dots, B_{m*}(N), B_*(N)$ at any moment N is obtained as unique estimate on estimate set (2).

The recurrent representations for this estimate and corresponding weighted residual sum of squares are proposed too.

THE NEW METHOD OF A THIRD-DEGREE BEZIER TYPE SPLINE CURVE CONSTRUCTION

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Interpolation and approximation of numerical data sets is an actual problem of applied mathematics through wide use in various fields of science and technology. Two different areas of study are distinguished: interpolation using polynomial splines, which solves the problem of constructing curves passing through given points, and methods for constructing Bezier curves, for which the given points are controlling. This is understood in the sense that the curve does not pass through these points, but approaches them, changing their shape depending on their location. Now researchers have gone by combining these two approaches. This allows you to get pretty smooth curves and effective algorithms for constructing them with the ability to interact with the curve shape with the help of control points.

A new method for constructing a third-order spline curve with properties like cubic spline and Bezier curve is proposed and realized

[1]. To develop a method for constructing a spline curve with given properties, we use the approach that was developed for constructing a parabolic spline [2] and developed for nonuniform grids [3].

As with the construction of the Bezier curves, control points are set, the location of which affects the shape of the curve. In the proposed approach, the line segments that connect the control points are tangent to the curve being constructed. The location of the points of contact may be different, which allows you to build different curves for one set of control points.

A peculiarity of the proposed method is the assignment some unknown values of the spline in the abscissas of control points, which are found on the conditions of continuity of the first derivatives of the curve at these points. Finding the coefficients of the polynomials forming the curve is reduced to solving a system of linear equations with a tridiagonal matrix. The constructed curve is a piecewise-cubic continuous with its first derivative function over the entire interval.

For an arbitrary set of control points conditions are found in the form of inequalities, which the parameters of the curve must satisfy, in which it exists and is unique. These conditions derive from the requirement of the diagonal superiority of the system matrix to determine the coefficients of the curve. A series of computational experiments has been carried out, which showed that the curve imitates the shape that is given by the control points, and allows it to locally change its shape. Like Bezier curves, the proposed curve can be used in computer graphics systems and computer engineering systems, in particular for the creation of fonts, drawings of parts, vehicle body parts, etc.

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FOR SOLVING OF THE PROBLEMS OF MATHEMATICAL MODELLING OF SPATIALLY DISTRIBUTED DYNAMIC SYSTEMS UNDER THE PRESENCE OF RESTRICTIONS ON THEIR FUNCTIONING CONDITIONS

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The methods of mathematical modeling of the dynamics of linear spatially distributed systems allowed to successfully solve the mathematical problems of constructing the system state functions, the dynamics of which is described by a linear differential operator in the presence of arbitrary quantity and quality of discretely and continuously determined initial-boundary observations for it. The problems of controlling such systems with the participation of an arbitrary combination of three external dynamic controlling factors: initial, boundary and spatially distributed external dynamic disturbances were also successfully solved. However, outside the author's attention remained processes and phenomena, the dynamics of which is conducted in the presence of external dynamic restrictions on the controlling possibilities of control factors and the system state function.

The subject of this report is the discussion of the methodology of solving the initial-boundary problems of which for processes and phenomena, differential model of functioning in addition to discretely and continuously determined boundary-initial observations are considered in the presence of limiting relations, determined by the system of algebraic, integral and functional inequalities. The solutions of the latter, if they are to be constructed, narrow the set of solutions, incorrect in the quantity and quality of the boundary-initial observations of the formulated initial-boundary problems of the researched systems' dynamics.

The obtained mathematical results on the solution of systems of linear integral and functional inequalities' solutions, having independent significance, allow successfully solve the problem of research of the arbitrary nature of linear spatially distributed systems in the presence of discretely-continuous restrictions, either on both the initial-boundary and spatially distributed external dynamic disturbances or on the result of their actions– on the function system state. The ways of spreading of the proposed methodology of the considered systems and on the problems' controlling of the latter, will be discussed in this report.

COMBINING FUZZY PETRI NETS WITH INTERVAL ANALYSIS^g

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Fuzzy Petri nets (FPNs) are a modification of the classic Petri nets (PNs) to deal with uncertain information in knowledge-based systems (KBSs). They have been widely used to represent knowledge and model approximate reasoning in KBSs. In particular, FPNs support structural organization of information, provide visualization of knowledge reasoning, and facilitate design of efficient fuzzy inference algorithms. They received much attention from scientists and practitioners in the field of artificial intelligence. However, previous FPN models, as indicated in the literature on the subject, are plagued by a number of shortcomings and are not suitable for increasingly complex KBSs. That is why many alternative models have been proposed in the literature to increase the power of FPN knowledge representation and to implement rule-based reasoning more intelligently and effectively. A framework of interval analysis (IA) was developed to deal with uncertain information. In this work, we establish a connection between FPNs and IA. This takes place in a somewhat broader perspective of the relationship between these two mathematical models. The relationship that we create between these two research areas is methodological: it demonstrates the use of IA methodology to strengthen the FPN into a more realistic model. The work is independent in the sense that it introduces the basic concepts of FPNs and the basic concepts of IA. Hence, this work creates another bridge: it enables FPN scientists and related fields to become familiar with the basic concepts of IA and vice versa, for researchers from IA to become familiar with the basic ideas of the FPNs.

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CARL ROGERS ABOUT INNOVATIVE TECHNOLOGIES OF TEACHING

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Various educational resources and teaching methods, involving electronic instruments in creating a new educational resource, enable the teachers to make a variety of chemical, physical and biological phenomena for students; to travel in the countries whose language, culture, history or geography they teach; actively engage students in the learning process, give them an opportunity to discover themselves based on their own experience.

Carl Rogers, one of the authors of human psychology, believes that the aim of modern education should be focus on the process and not the accumulation of knowledge. The senseless memorizing will bring no results to the student because it does not include feelings, student engagement in the learning process. Rogers gave preference to learning with experience. This kind of teaching, in his opinion, affects the whole person, his views and actions.

Effective teaching is the one that changes the humans behavior, their attitudes and personality. The teacher's task is to create an atmosphere in the class, facilitating the formation of important teaching for the learner. The teacher introduces the students' his/her experience and helps them to use this experience. He/she introduces them different ways of getting knowledge. The teacher encourages students by giving directions and instructions in the learning process. When students' wishes and abilities are taken into consideration in the learning process, when students are in the teaching center, with their interests and aspirations, the teaching process becomes effective and promotes learners' personal changes and growth.

Studies have shown that a successful teacher is a leader, promoting and creating the environment to achieve unbelievable consequences. For this reason the teacher creates the atmosphere of creativity and confidence, by using different methods and technologies, the individual inclinations and interests in the classroom are developed, promoting creative and cooperative skills.

INTELLIGENT TECHNOLOGY FOR THE DIGITAL ECONOMY OF THE SMART ENTERPRISE

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The aim is to develop a new approach for enterprises operation in the highly dynamic environment of changing production, technological, and business processes in the digital economy. The concepts and technologies of a smart enterprise creation are suggested. The smart enterprise is considered as a production innovation based on the high level of knowledge about the system, highly productive methods of intellectualization of management processes and models of creative thinking.

The main concepts. The smart enterprise is characterized by the new management potentialities that led to increase productiveness. Also it is characterized by creating the concept, model and way of functioning in different industries. The smart enterprise is a flexible system with the Distributed Artificial Intelligence for industrial automation that provides an enterprise with the efficient functioning and support. In such system a flexible distributed model is a basic component alongside with universal use of the miniature mobile devices, wireless networks, satellite navigation systems for “cloud” calculations, information depositories, electronic environment, that creates the image of surrounding objects and processes. This model runs all processes in real time and reflects mentation processes supported by powerful software tools.

Methods and algorithms. The management system uses the concept of creative thinking. It represents the set of scenarios that allow processing the image of the controlled process in order to get an appropriate image of controlling operations. The control image reflects the general purpose of the management system. It is divided for numerous scenarios corresponding to the separate functions of the management system. Theses scenarios are interconnected so as they operate as separate links of a general algorithm in certain production situations. Thus, the set of separate scenarios function not in a fixed sequence (one by one) and not chaotically but they are set in different chains depending on the changing image of the production situation.

All functions realized in the control system are divided into information and controlling ones. For their turn, information functions

are divided into the functions that represent the simplest transformation of signals with realization on individual instrument control, registration, and signaling devices, and information and calculating functions that include centralized information preprocessing by relatively simple algorithms and its following processing by complex branched algorithms.

Summary. The smart enterprise as a basic element of the digital economy constitutes its future in many respects. The smart enterprises of the digital economy especially need artificial intelligence systems. There is still a certain gap between development works, artificial intelligence software and possibilities of their widespread adoption into practice. Hopefully, the results obtained by the authors will help to overcome these hardships.

THE PROBLEMS OF COMBINATORIAL OPTIMIZATION IN SEMANTIC MODELING

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Existing database systems usually have very limited information about the semantic characteristics of the data stored in them. Most often, they only allow you to manipulate data of certain simple types. A more complex interpretation relies on the user. For intellectualization of the system it is necessary to expand the knowledge of its base and maintain high-level user interfaces. To this end, use semantic modeling, which allows you to define the essence of a particular object more deeply. It consists in the maximum definition of the semantic signs that it describes.

Consequently, with semantic modeling, there is a problem of covering the object of the certain signs that characterize it. It refers to the problems of the partition, the argument of the objective function in which is the partition n -element set on a subset [1]. The signs are divided into those that characterize only a given object, which is easy to identify in the database. In this case, the problem is solvable. If the same signs describe different objects, but with the help of differential analysis you can find the desired object, then such a problem is partially solvable. If the same signs characterize different objects and can not

identify the searched for, then there is a situation of uncertainty. In this case, additional conditions or other search rules are required to solve the problem. Also, in order to combine the common signs of certain objects into classes, it is necessary to solve the problem of clustering or classification, which are related to the problem of the partition, and are problems of combinatorial optimization.

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**METHODS OF GEODYNAMIC PROCESSES SIMULATION AS
A MEANS OF FORECASTING IN DECISION SUPPORT
SYSTEMS**

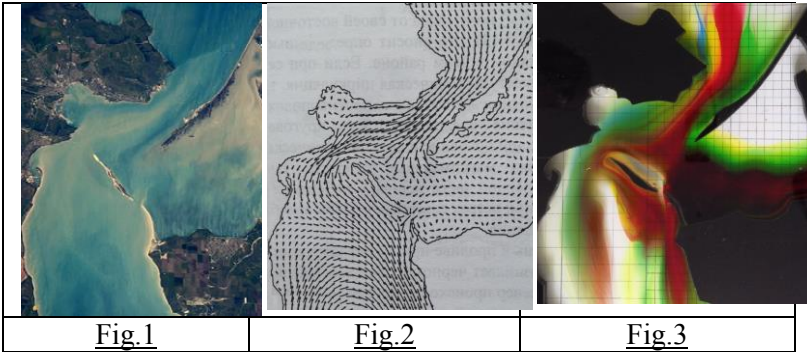
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The report presents new mathematical models, computing methods, algorithms and computer modeling technologies that create the core of software for forecasting systems [1]. Detailed comparison of different simulation methods is illustrated, examples of application of methods (remote aerospace monitoring Fig.1, GIS-technologies, mathematical Fig.2, experimental and laboratory Fig.3) for prediction to real geodynamic processes are given [2].



Examples of prediction of mass transfer (distribution of surface contamination, sediment deposits) in the water environment (in marine and river water areas), as well as dynamics of air pollution from local pollutants are presented.

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STRENGTH OF CONCRETE FROM THE POSITIONS OF ADSORPTION AND ITS COMPUTER SOFTWARE

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The strength of concrete is determined by the fact that it depends on many factors and can significantly differ from the generally accepted approximate volume of 0.8.

The study of the strength of concrete is related to the universal graph of performance indicators of concrete in time, based on the adsorption theory on the nature of linear creep of concrete [1,2].

The analysis of this graph shows that the greater the strength of concrete is, the stronger its endurance limit R_r is. At the same time the ratio of the short-term strength R to the endurance limit R / R_r remains constant until the end of the growth of concrete strength and when R_r is reached, the endurance limit R_r tends to the long-term strength of the concrete R_e . Based on this consideration, we can write:

$$\frac{R}{R_r} = \frac{R_t}{R_e} \quad (1)$$

Consequently,
$$R_e = \frac{R_t}{R} R_r \quad (2)$$

A computer program has been compiled for their calculation.

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MULTI-LEVEL MODELS OF AN HIL TEST SYSTEM

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Multi-level models describe a system at least at two different levels. Interactions are taking place within and between those levels. Multi-level models allow for the explicit representation of “upward” and “downward” relations. Upward relations model the fact that the system is somehow constrained by the behaviour of its parts, but at the same time downward relations model the fact that the behaviour of each part is influenced by the behaviour of the system as a whole. When considering multi-level models it is important to make an explicit distinction between the concept of scale and the concept of level. More specifically, the concept of scale refers to a measurable dimension of the analysis of the considered phenomenon. This dimension can be spatial, temporal, and quantitative. The spatial dimension refers to the size of the entities involved in the phenomenon whereas the temporal dimension is related to the timing associated with the behaviours of these entities and their interactions. The quantitative dimension instead refers to the amount of entities involved in the phenomenon. Differently, the concept of level provides a way to locate the studied phenomenon and/or the entities involved in a phenomenon along the considered dimension of the analysis. A level usually corresponds to all the entities whose size and/or characteristic evolution time have the same or comparable orders of magnitude. The concept of multi-level models can be coupled with the concept of hybrid models. A hybrid model corresponds to any interaction or coupling between two or more models that are not based on the same formalism. We define models which are both multi-level and hybrid as representations supporting different formalisms and organized in levels encompassing multiple systems scales. When building up a multi-level and hybrid model, besides choosing the organizational levels, it is necessary to choose the formalisms to describe the different components in the overall model structure.

OPTIMAL THRESHOLD STRATEGIES FOR RETRIAL SYSTEMS WITH QUEUE

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One of the queueing theory important topics is the theory of retrial queues. Retrial queues widely used in designing of computer networks, in studying of stochastic information processing networks, modern mobile communication systems, etc. Review of retrial queue literature could be found in [1],[2]. Retrial queues are characterized by the following feature. When an arriving customer finds that all servers are busy and no waiting position is available, the customer joins a virtual 'orbit' and repeat its request after a random time until the customer gets into the service area. Such attempts become a source of repeated calls.

We introduce a bivariate Markov process $Q(t) = (Q_1(t), Q_2(t))$ in space $S = \{0, 1, \dots, m+n\} \times Z_+$. The process $Q(t)$, $t \geq 0$ can be seen as the joint process of the number of servers and waiting positions occupied and the number of customers in the orbit of a $[M|M|m+m+n]$ -type retrial queueing system with variable rate of input flow without limitation on the capacity of the orbit controlled by threshold strategies. At first for such models the existence conditions of stationary regime are pointed out. Further analysis is based on the approximation of the initial systems by the ones with limited orbit for which explicit vector-matrix formulas of stationary probabilities are found. As a result, we obtained effective calculating algorithms for the characteristics of the systems in stationary regime in terms of parameters of the systems according to the control strategy. The variable rate of the input flow in the $[M|M|m+m+n]$ - 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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ANTHROPOECOLOGICAL MONITORING OF HUMAN LIFE ACTIVITY AIMED AT ACHIEVEMENT THE HIGHEST LEVEL OF EDUCATIONAL AND CREATIVE ACTIVITIES

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The achieved development of society has made it possible to prioritize the quality of human life, made it necessary to develop practical and research programs relating to the maintenance and improvement of quality of life, based on their harmony, interests and human health.

Conducting monitoring (as systems of observing changes in the processes of human life due to the influence of environmental factors on them) which aims to studying processes of preservation and restoration of health, social and labor potential, is an instrument for solving the problem of achieving a higher level of human creative activity and preserving its health in conditions of active learning.

Scientific and practical developments related to solving this problem allow to build effective adaptation, rehabilitation and improvement programs. Given that, indicators of human health are not only the absence of chronic disease, but also the functional state of its organs, mental and physical development, then in order to achieve a high level of pupils' health also need preservation and growth of their social and employment potential. To address this issue is very important such monitoring, which allows to analyze the processes of preservation and restoration of health.

In the study, the starting point for finding ways to improve the state of health, creativity and physical activity of a person was the conduct of a survey related to the quality of life for pupils of grades 8-11, according to the WHO-recommended general questionnaire.

The use of close correlation of self-improvement and human performance parameters, life-monitoring methods allowed to perform a comparative analysis of the appropriate parameters among schoolchildren on the basis of interviews conducted, to propose a method for analyzing the parameters of their physical and psychological health, detect changes in the dynamics of indicators of the health and employment potential of schoolchildren.

Using the methods of assessing the quality of life and methods for calculating the corresponding general indicators, the methods of

calculating the adaptive potential of the organism, the level of physical condition, the basic indicators of activity of pupils of grades 8-11 of the lyceum "Goloseevsky" related to the level of their physical and mental health were obtained. Following a slightly modified WHO-recommended general questionnaire, "average portraits" were received for pupils of grades 8-11, the estimation of the general quality of life and the general estimation of perception of life was calculated.

According to the proposed method of analysis of the parameters of physical and psychological health of pupils, a comprehensive personal application is constructed. It can be used as a tool of the system of support and decision making for adaptation, self-improvement, enhancement of functional parameters, preservation and development of health and functional capacity of pupils in conditions of active learning, achievement of a higher level of creative, educational and physical activity.

According to the summarized results of the survey, a description of the average state of affairs and the dynamics of changes in the corresponding parameters during the school year was obtained for each class that participated in the survey.

The aggregated survey results allowed a multidimensional analysis of the influence of input and output factors. As a result, the tiredness of the 10th form and the increase of fatigue of the 11th class was revealed.

It is shown that the use of such an approach in dynamics (once per school month) makes it possible to trace pupils' state, analyze the causes of deterioration of physical and mental condition, to recommend corrective measures to improve the life of adolescents, which will allow to achieve the best level of quality of life and learning outcomes.

The program realization of the methodology was proposed for a mobile device to assist in adjusting the parameters of quality of life in order to achieve a person of a higher level of creative and physical activity. It includes the realization of questionnaire levels, computing the values of sub-spheres and sub-spheres, adaptive capacity, level of physical condition, analysis of the obtained values and general recommendations.

MATHEMATICAL MODELLING OF SALT TRANSFER IN HORIZONTAL NON-SATURATED SOIL MASS UNDER NONISOTHERMAL CONDITIONS

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The process is considered of salt transfer in horizontal non-saturated soil mass under nonisothermal conditions.

The mathematical model of this problem in generally adopted specifications may be described by the following boundary problem [1]:

$$\frac{\partial \left(D(c) \frac{\partial c}{\partial x} \right)}{\partial x} - v \frac{\partial c}{\partial x} - \gamma(c - C^*) + D_T \frac{\partial^2 T}{\partial x^2} = \sigma \frac{\partial c}{\partial t}, \quad (1)$$

$$\mu(h) \frac{\partial h}{\partial t} = \frac{\partial}{\partial x} \left(k(c, h, T) \frac{\partial h}{\partial x} \right) - v \frac{\partial^2 c}{\partial x^2} - D_T \frac{\partial^2 T}{\partial x^2}, \quad (2)$$

$$\lambda \frac{\partial^2 T}{\partial x^2} - v c_p \frac{\partial T}{\partial x} = c_n \frac{\partial T}{\partial t}, \quad (3)$$

$$v = -k(c, h, T) \frac{\partial h}{\partial x} + v(c) \frac{\partial c}{\partial x} + D_T \frac{\partial T}{\partial x}, \quad (4)$$

$$c(0, t) = \tilde{C}_1(t), \quad c(l, t) = \tilde{C}_2(t), \quad c(x, 0) = \tilde{C}_0(x), \quad (5)$$

$$h|_{x=0} = \tilde{H}_1(t), \quad h|_{x=l} = \tilde{H}_2(t), \quad h|_{t=0} = \tilde{H}_0(x), \quad (6)$$

$$T(x, 0) = T_0(x), \quad T(0, t) = T_1(t), \quad T(l, t) = T_2(t), \quad (7)$$

The numerical solution of the problem (1)-(7) is found by a method of finite differences using the monotonic scheme.

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MATHEMATICAL MODELLING OF SALT TRANSFER TO SYSTEM OF HORIZONTAL DRAINS WITH FILTERING ELEMENT IN ZONES OF COMPLETE AND INCOMPLETE SATURATION

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The process is considered of salt transfer to a system of horizontal drains of deep and shallow occurrence with a strong filtering element (geotextile) in zones of complete G_1 and incomplete G_2 saturation (fig.1).

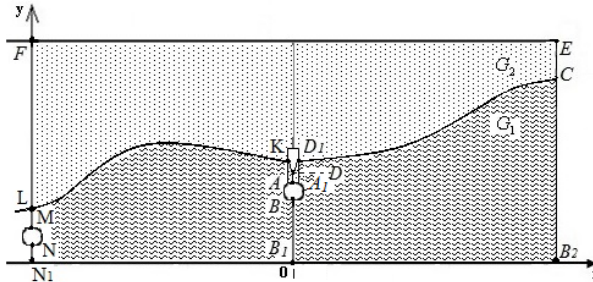


Fig. 1. Salt transfer to system of horizontal drains with filtering element
in saturated-non-saturated soil mass

The mathematical model of this problem in generally adopted specifications may be described by the following boundary problem [1]:

$$\frac{\partial \left(D_1(c_1) \frac{\partial c_1}{\partial x} \right)}{\partial x} + \frac{\partial \left(D_1(c_1) \frac{\partial c_1}{\partial y} \right)}{\partial y} - v'_x(c_1) \frac{\partial c_1}{\partial x} - v'_y(c_1) \frac{\partial c_1}{\partial y} - \gamma_1(c_1 - C_1^*) = \sigma_1 \frac{\partial c_1}{\partial t}, \quad (1)$$

$$\frac{\partial}{\partial x} \left(k_1(c_1, h_1) \frac{\partial h_1}{\partial x} \right) + \frac{\partial}{\partial y} \left(k_1(c_1, h_1) \frac{\partial h_1}{\partial y} \right) - \frac{\partial}{\partial x} \left(v(c_1, h_1) \frac{\partial c_1}{\partial x} \right) - \frac{\partial}{\partial y} \left(v(c_1, h_1) \frac{\partial c_1}{\partial y} \right) = 0, \quad (2)$$

$$v'_x(c_1) = -k(c_1, h_1) \frac{\partial h_1}{\partial x} + v(c_1) \frac{\partial c_1}{\partial x}, \quad v'_y(c_1) = -k(c_1, h_1) \frac{\partial h_1}{\partial y} + v(c_1) \frac{\partial c_1}{\partial y}, \quad (3)$$

$$h_1|_{CD \cup KL} = y, \quad \frac{\partial h_1}{\partial n} \Big|_{NN_1 \cup B_2C \cup LM} = 0, \quad \frac{\partial h_1}{\partial n} \Big|_{KA \cup A_1D_1} = 0, \quad h_1|_{AB} = \tilde{H}_1^1, \quad (4)$$

$$c_1|_{t=0} = \tilde{C}_0^1(x, y), \quad \frac{\partial c_1}{\partial n} \Big|_{\substack{ML \cup MN \cup NN_1 \cup N_1 B_2 \cup \\ \cup B_2 C \cup KA \cup BAD}} = 0, \quad (5)$$

$$\frac{\partial \left(D_2(c_2) \frac{\partial c_2}{\partial x} \right)}{\partial x} + \frac{\partial \left(D_2(c_2) \frac{\partial c_2}{\partial y} \right)}{\partial y} - \nu_x(c_2) \frac{\partial c_2}{\partial x} - \nu_y(c_2) \frac{\partial c_1}{\partial y} - \gamma_2(c_2 - C_2^*) = \sigma_2 \frac{\partial c_2}{\partial t}, \quad (6)$$

$$\mu(h_2) \frac{\partial h_2}{\partial t} = \frac{\partial}{\partial x} \left(k(c_2, h_2) \frac{\partial h_2}{\partial x} \right) + \frac{\partial}{\partial y} \left(k(c_2, h_2) \frac{\partial h_2}{\partial y} \right) - \frac{\partial}{\partial x} \left(\nu(c_2) \frac{\partial c_2}{\partial x} \right) - \frac{\partial}{\partial y} \left(\nu(c_2) \frac{\partial c_2}{\partial y} \right), \quad (7)$$

$$\nu_x(c_2) = -k(c_2, h_2) \frac{\partial h_2}{\partial x}, \quad \nu_y(c_2) = -k(c_2, h_2) \frac{\partial h_2}{\partial y}, \quad (8)$$

$$h_2|_{t=0} = \tilde{H}_0(x, y), \quad h_2|_{EF} = \tilde{H}_1^2, \quad h_2|_{CD \cup KL} = y, \quad \frac{\partial h_2}{\partial x} \Big|_{LF \cup EF} = 0, \quad (9)$$

$$c_2|_{t=0} = \tilde{C}_0^2(x, y), \quad c_2|_{EF} = \tilde{C}_1^2, \quad \frac{\partial c_2}{\partial x} \Big|_{LF \cup CE} = 0. \quad (10)$$

Conjugation conditions are set correspondingly for pressure, concentration and salt flows on the saturated and non-saturated domain boundary (depression curves $CD \cup KL$)

$$h_1|_{CD \cup KL} = h_2|_{CD \cup KL}, \quad \left(\frac{\partial h_1}{\partial y} - \frac{\partial h_1}{\partial x} \frac{\partial H}{\partial x} \right) \Big|_{CD \cup KL} = 0, \quad c_1|_{CD \cup KL} = c_2|_{CD \cup KL}, \quad (11)$$

$$\left(D_1(c_1) \frac{\partial c_1}{\partial n} - \nu_1 c_1 \right) \Big|_{CD \cup KL} = \left(D_2(c_2) \frac{\partial c_2}{\partial n} - \nu_2 c_2 \right) \Big|_{CD \cup KL}.$$

The numerical solution of the problem (1)-(11) is found by a method of finite differences using the numerical method of conformic mappings in an inverse statement. As a result of the programmatic implementation of the problem the distribution was found of the field of the concentration of salt solutions to the system of horizontal drains of deep and shallow occurrence under the impact of strong penetrating flat element positioned on a shallow drain and the change is researched of the positions of free surfaces taking into account this filtering element.

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NUMERICAL MODELING OF INFLUENCE OF HEAT AND MASS TRANSFER ON DEFORMATION PROCESSES OF SOIL ARRAY WITH FREE SURFACE IN THREE-DIMENSIONAL CASE

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The numerical modeling of the effect of heat and mass transfer and coupling forces on the deformation processes of a soil array with a free surface having a rectangular parallelepiped in the region $\Omega = \Omega_1 \cup \Omega_2$ is carried out (see Fig. 1), where Ω_1 ($ABCDKLMN$) – area of water-saturated soil array, Ω_2 ($KLMNA_1B_1C_1D_1$) – the area of the soil array in the natural state. Free surface $KLMN$ is considered fixed.

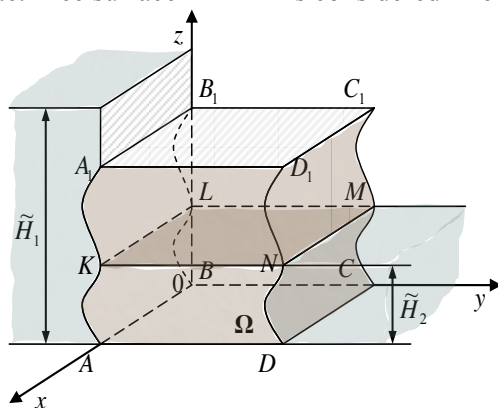


Figure 1. Scheme of a soil array with a free surface

The mathematical model of the problem in general accepted notation can be described as the next boundary value problem [1]:

$$\begin{aligned} & \mu(c, T) \Delta U + (\lambda(c, T) + \mu(c, T)) \frac{\partial \varepsilon_\theta}{\partial x} + \frac{\partial \lambda(c, T)}{\partial x} \varepsilon_\theta + \\ & + 2 \frac{\partial \mu(c, T)}{\partial x} \frac{\partial U}{\partial x} + \frac{\partial \mu(c, T)}{\partial y} \left(\frac{\partial U}{\partial y} + \frac{\partial V}{\partial x} \right) + \frac{\partial \mu(c, T)}{\partial z} \left(\frac{\partial U}{\partial z} + \frac{\partial W}{\partial x} \right) - \\ & - \left(\left(3 \frac{\partial \lambda(c, T)}{\partial x} + 2 \frac{\partial \mu(c, T)}{\partial x} \right) T + (3\lambda(c, T) + 2\mu(c, T)) \frac{\partial T}{\partial x} \right) \alpha_T + X = 0, \end{aligned}$$

$$\begin{aligned}
& \mu(c, T) \Delta V + (\lambda(c, T) + \mu(c, T)) \frac{\partial \varepsilon_\theta}{\partial y} + \frac{\partial \lambda(c, T)}{\partial y} \varepsilon_\theta + \\
& + 2 \frac{\partial \mu(c, T)}{\partial y} \frac{\partial V}{\partial y} + \frac{\partial \mu(c, T)}{\partial x} \left(\frac{\partial U}{\partial y} + \frac{\partial V}{\partial x} \right) + \frac{\partial \mu(c, T)}{\partial z} \left(\frac{\partial V}{\partial z} + \frac{\partial W}{\partial y} \right) - \\
& - \left(\left(3 \frac{\partial \lambda(c, T)}{\partial y} + 2 \frac{\partial \mu(c, T)}{\partial y} \right) T + (3 \lambda(c, T) + 2 \mu(c, T)) \frac{\partial T}{\partial y} \right) \alpha_T + Y = 0, \\
& \mu(c, T) \Delta W + (\lambda(c, T) + \mu(c, T)) \frac{\partial \varepsilon_\theta}{\partial z} + \frac{\partial \lambda(c, T)}{\partial z} \varepsilon_\theta + \\
& + 2 \frac{\partial \mu(c, T)}{\partial z} \frac{\partial W}{\partial z} + \frac{\partial \mu(c, T)}{\partial x} \left(\frac{\partial U}{\partial z} + \frac{\partial W}{\partial x} \right) + \frac{\partial \mu(c, T)}{\partial y} \left(\frac{\partial V}{\partial z} + \frac{\partial W}{\partial y} \right) - \\
& - \left(\left(3 \frac{\partial \lambda(c, T)}{\partial z} + 2 \frac{\partial \mu(c, T)}{\partial z} \right) T + (3 \lambda(c, T) + 2 \mu(c, T)) \frac{\partial T}{\partial z} \right) \alpha_T + Z = 0, \quad \mathbf{X} \in \Omega,
\end{aligned} \tag{1}$$

$$\begin{aligned}
X &= \begin{cases} \frac{dp_1}{dx} + f_1(c), & \mathbf{X} \in \Omega_1, \\ 0, & \mathbf{X} \in \Omega_2, \end{cases} \quad Y = \begin{cases} \frac{dp_2}{dy} + f_2(c), & \mathbf{X} \in \Omega_1, \\ 0, & \mathbf{X} \in \Omega_2, \end{cases} \\
Z &= \begin{cases} \gamma_{36} + \frac{dp_3}{dy} + f_3(c), & \mathbf{X} \in \Omega_1, \\ \gamma_{np}, & \mathbf{X} \in \Omega_2, \end{cases}
\end{aligned} \tag{2}$$

and equations of normal and shear strains and stresses, convective diffusion equation at the presence of mass and heat transfer, the equation of convective mass and heat transfer with appropriate boundary conditions for displacements, stresses, concentration of salt solution, temperature and pressure. Here: $f_1(c)$, $f_2(c)$, $f_3(c)$ are functions that express the influence of soil density on its deformation processes due to the forces of connectivity.

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THE OPTIMAL CONTROL PROBLEM CONTAINING THE FUNCTIONAL WITH BOUNDARY INTEGRAL FOR NONLINEAR SCHRÖDINGER EQUATION WITH COMPLEX POTENTIAL

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The optimal control problem is expressed as the problem of finding the minimum of functional

$$J_a(v) = b_0 y(0, \infty) - y_{0L_2(0,T)}^2 + b_l y(l, T) - y_{lL_2(0,l)}^2 + av - w_{L_2^{(2)}(0,l)}^2$$

on the set

$$V = \left\{ v = v(v) : v(x) = (v_0(x), v_l(x)), v_j \in L_2(0, l), \right. \\ \left. v_{0L_2(0,l)} \leq b_0, v_{lL_2(0,l)} \leq b_l, v_l(x) \geq b_2 > 0, \forall x \in (0, l) \right\}$$

under the conditions

$$i \frac{\partial \psi}{\partial t} + a_0 \frac{\partial^2 \psi}{\partial x^2} + ia_1(x) \frac{\partial \psi}{\partial x} - a(x) \psi + v_0(x) \psi +$$

$$+ iv_l(x) \psi + a_2 |\psi|^2 \psi = f(x, t), \quad (x, t) \in \Omega,$$

$$\psi(x, 0) = \varphi(x), x \in (0, l)$$

$$\frac{\partial \psi}{\partial x}(0, t) = \frac{\partial \psi}{\partial x}(l, t) = 0, t \in (0, T),$$

where ψ is a wave function, l and T be given positive numbers, $x \in (0, l)$, $t \in (0, T)$, $\Omega_t = (0, l) \times (0, t)$, $\Omega = \Omega_T$, $i = \sqrt{-1}$ is an imaginary unit, $a_0 > 0, \alpha \geq 0$, $\beta_0 \geq 0$, $\beta_l \geq 0$, $\beta_0 + \beta_l \neq 0$, $b_0 > 0, b_l > 0, b_2 > 0$ are given numbers.

a_2 is a complex number with property

$$a_2 = \text{Re}a_2 + i\text{Im}a_2, \text{Im}a_2 > 0, \text{Re}a_2 < 0, \text{Im}a_2 \geq 2|\text{Re}a_2|.$$

$a(x)$ and $a_1(x)$ are given bounded and measurable functions that satisfy the additional restrictions

$$0 \leq a(x) \leq \mu_0, \forall x \in (0, l), \mu_0 = \text{constant},$$

$$|a_1(x)| \leq \mu_1, \left| \frac{da_1(x)}{dx} \right| \leq \mu_2, \quad \text{for almost all } x \in (0, l),$$

$$\mu_1, \mu_2 = \text{const.} > 0$$

and $a_1(0) = a_1(l) = 0$.

$v = v(x) = (v_0(x), v_1(x))$ is a control function which is the element of V .

$y_0 = y_0(t), y_1 = y_1(t)$ are given functions and they satisfy the condition $y_0, y_1 \in L_2(0, T)$.

Also, $\varphi = \varphi(x), f = f(x, t)$ are given measurable complex-valued functions such that

$$\varphi \in W_2^2(0, l), \frac{d\varphi(0)}{dx} = \frac{d\varphi(l)}{dx} = 0, f \in W_2^{0,1}(\Omega).$$

We investigate the existence and uniqueness theorem for solution of the second type initial boundary value problem by using Galerkin's method [1]. Afterwards, the existence and uniqueness of solution the identified optimal control problem is examined.

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ON THE INITIAL-BOUNDARY VALUE PROBLEMS FOR THE NONLINEAR SCHRÖDINGER EQUATION WITH A SPECIAL GRADIENT TERMS AND WITH A COMPLEX POTENTIALS

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We consider the initial-boundary value problem for the nonlinear Schrödinger equation with a special gradient terms and with a complex potentials of finding the function $\psi = \psi(x, t)$ from the conditions:

$$i \frac{\partial \psi}{\partial t} + a_0 \frac{\partial^2 \psi}{\partial x^2} + i a_1(x, t) \frac{\partial \psi}{\partial x} - a(x) \psi + v_0(x) \psi +$$

$$+ i v_1(x) \psi + a_2 |\psi|^2 \psi = f(x, t), \quad (x, t) \in \Omega$$

$$\psi(x, 0) = \varphi(x), \quad x \in (0, l), \quad (2)$$

$$\psi(0, t) = \psi(l, t) = 0, \quad t \in (0, T), \quad (3)$$

where $i = \sqrt{-1}$ imaginary unit, $T > 0, l > 0, a_0 > 0$, are given numbers, $0 \leq x \leq l, 0 \leq t \leq T, \Omega_t = (0, l) \times (0, t), \Omega = \Omega_T, \psi = \psi(x, t)$ - is wave function, a_2 - is a complex number that satisfy the conditions:

$$a_2 = \operatorname{Re} a_2 + i \operatorname{Im} a_2, \operatorname{Re} a_2 < 0, \operatorname{Im} a_2 > 0; \operatorname{Im} a_2 \geq |\operatorname{Re} a_2|; \quad (4)$$

$a(x), v_0(x), v_1(x)$ and $a_1(x, t)$ are measurable real-valued functions that satisfy the conditions:

$$0 \leq a(x) \leq \mu_0, \quad \overset{o}{\forall} x \in (0, l), \quad \mu_0 = \operatorname{const} > 0, \quad (5)$$

$$\|v_m\|_{L_2(D)} \leq b_m, \quad b_m = \operatorname{const} > 0, \quad m = 0, 1, \quad (6)$$

$$v_1(x) \geq b_2 = \operatorname{const} > 0, \quad \overset{o}{\forall} x \in (0, l)$$

$$|a_1(x, t)| \leq \mu_1, \quad \left| \frac{\partial a_1(x, t)}{\partial x} \right| \leq \mu_2, \quad \left| \frac{\partial a_1(x, t)}{\partial t} \right| \leq \mu_3, \quad (7)$$

$$\overset{o}{\forall} (x, t) \in \Omega, \quad \mu_1, \mu_2, \mu_3 = \operatorname{const} > 0;$$

$\varphi(x), f(x, t)$ are given complex-valued functions satisfying the conditions:

$$\varphi \in W_2^0(0, l), \quad f \in W_2^{0,1}(\Omega); \quad (8)$$

the symbol $\overset{o}{\forall}$ means “for almost everywhere”.

In this paper, the theorems of existence and uniqueness of solutions of first initial-boundary value problem (1)- (3) and second initial-boundary value problem for equation (1) are proved. To prove the theorems applies method of Galerkin [1,2].

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NONLINEAR NORMALIZATION FOR IMPULSE RECURRENT PROCESS IN THE SCHEME OF LEVI APPROXIMATION

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Impulse recurrent processes are considered in the works [1,2]. In particular, in [2] the switching Markov process are considered on a timescale $\frac{t}{\varepsilon}$. The purpose of this work is to find nonlinear normalizing factors, so the processes are considered in normalization of time $\frac{t}{g_2(\varepsilon)}$, where $g_2(\varepsilon) \rightarrow 0, \varepsilon \rightarrow 0$.

Consider impulse recurrent process in the conditions of Levi approximation

$$\tilde{\xi}^\varepsilon(t) = \tilde{\xi}_0^\varepsilon + \sum_{k=1}^{\nu\left(\frac{t}{g_2(\varepsilon)}\right)} \alpha_k^\varepsilon(x_{k-1}^\varepsilon), \quad t \geq 0,$$

where $x^\varepsilon(t) = x\left(\frac{t}{g_2(\varepsilon)}\right)$ - the switching Markov process, which corresponds to the embedded Markov recovery process $(x_k^\varepsilon, \tau_k^\varepsilon)$, $k \geq 0$, and counting process of jumping $\nu^\varepsilon(t) = \nu\left(\frac{t}{g_2(\varepsilon)}\right)$.

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SYSTEM DECISION-MAKING APPROACH TO IMAGE PROCESSING FOR UNMANNED AERIAL VEHICLES (UAV) SYSTEMS

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New methods of cooperative control for multiple UAVs and image processing technology for remote detection of dangerous chemical and biological components using and optical device are proposed. Algorithms of adaptive control using identification methods and of structure-parametric optimization are used. It is considered a new concept for the cooperative control of UAVs and use compared with dual principle of detection biological and chemical component through the use of laser system, acting on the agents for qualitative identification [1-4]. The authors developed and tested new approaches for analysis of experimental data. Data processing is carried out in real time. The developed algorithms put clear conditions: they must be constructive in programming, optimal performance and in real time to resolve tasks. These requirements med new Adaptive algorithms based on gradient approach. Approaches to approximation of continuous processes, on the basis of easily received discrete counterparts. Usually in the applied problems of measured signals into discrete moments. Because the differencing schemes may be more efficient to use them. When using the proposed algorithms have questions analysis of the convergence of these iterative procedures. You can do this based on Lyapunov's methods, practical sustainability and the use of special criteria of sustainability.

The proposed methods can be effectively applied for the detection of chemical and biological components in the analysis of spectral data. Given the numerous model examples for approximation of continuous signals.

Made the layout of an optical instrument: Onboard spectrometer for the detection of the affected zones of vegetation has been developed: Patent № 110814 / Yatsenko V.A., Donetsk V.V., Lapchuk V.P. State Register of patents of Ukraine for invention 25.02.2016.

As a result of the conducted research the efficient algorithms has developed for the stabilization of the UAV taking into account external influences, algorithms of processing images derived from UAV, and their spatial binding, recognition algorithms and processing of optical

information. Created by hardware-software complex for measuring of pigment content in leaves of plants in the ground field.

REGRESSION MODELS IN A RANDOM ENVIRONMENT

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Let a complete group of events $A_1, A_2, \dots, A_k$ represent the environmental states which should be indicated and explained by experts. The probability $P(A_j)$ of occurrence of random event A_j (random environment is situated in j -th state) should also be determined by experts, $\sum_{j=1}^k P(A_j) = 1$. Assume that N given experimental data $(x_1, y_1), \dots, (x_N, y_N)$ can be represented for $\forall j = \overline{1, k}$ as $\{(x_i^{A_j}, y_i^{A_j})\}$, $i = \overline{1, r_j}$, where $\sum_{j=1}^k r_j = N$.

For each state A_j the equation of linear regression $\hat{y}^{A_j} = b_0^{A_j} + b_1^{A_j} x$ can be found. Let state A_m which describes the environment at the current moment be known. Then linear regression $\hat{y}^{A_m} = b_0^{A_m} + b_1^{A_m} x$ should be chosen. As a result the theoretical value of dependent variable $\hat{y}_i^{A_m}$ for each specific value of x_i can be calculated.

Otherwise so-called “averaged” regression should be chosen

$$\hat{y} = \sum_{j=1}^k (b_0^{A_j} + b_1^{A_j} x) \cdot P(A_j),$$

which can also be transformed in the following way

$$\hat{y} = \sum_{j=1}^k b_0^{A_j} \cdot P(A_j) + \left(\sum_{j=1}^k b_1^{A_j} \cdot P(A_j) \right) x.$$

Even if probabilities $P(A_j)$ can't be accurately estimated by experts they can be approximately calculated by using statistical definition of probability: $P(A_j) = \frac{r_j}{N}$, $j = \overline{1, k}$ (for $N \geq 100k$).

CORRESPONDENCE DISTANCES IN LINEAR STRUCTURES FOR MATRIX CORTEGES

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With the supervised learning every class Kl is represented by learning sample: features vectors – numerical vectors $a_j \in R^m, j = \overline{1, n}$ or set of matrices $A_k \in R^{m \times n}, k = \overline{1, K}$. The class to which the elements of a learning sample belong can be associated with a linear structure (a subspace or hyperplane) or a quadratic structure (an ellipsoid or a minimal grouping ellipsoid – central or noncentral) [4].

Respectively, the standard base linear structures of the "immersion" are linear subspaces L_{Kl} or hyperplanes Γ_{Kl} , $Kl \in \mathbb{C}\ell$ [1,2]:

$$L_{Kl} = \begin{cases} L(a_j \in R^m, j = \overline{1, n}) \\ L(A_k \in R^{m \times n}, k = \overline{1, K}), \end{cases}$$

$$\Gamma_{Kl} = \begin{cases} \Gamma(\bar{a}_{Kl}, L(\tilde{a}_j \in R^m, j = \overline{1, n}): & \bar{a}_{Kl} = \frac{1}{n} \sum_{i=1}^n a_i, \tilde{a}_j = a_j - \bar{a}, j = \overline{1, n} \\ \Gamma(\bar{A}_{Kl}, L(\tilde{A}_k \in R^{m \times n}, k = \overline{1, K}): & \bar{A}_{Kl} = \frac{1}{K} \sum_{k=1}^K A_k, \tilde{A}_k = A_k - \bar{A}, k = \overline{1, K}. \end{cases}$$

Representatives $p_{Kl}, Kl \in \mathbb{C}\ell$ of each cluster in a leaner structures case are

- $p_{Kl} \equiv 0, Kl \in \mathbb{C}\ell$ for subspaces,
- $p_{Kl} = \begin{cases} \bar{a}_{Kl} - \text{vector sampling} \\ \bar{A}_{Kl} - \text{matrix sampling} \end{cases}$ of the class $Kl \in \mathbb{C}\ell$ for hyperplanes.

Correspondence distances to the representatives are Euclidean distances to "immersion" subspaces or hyperplanes, respectively.

- $\rho_{Kl}^2(Y, p_{Kl}) \equiv \rho^2(Y, L_{Kl}), Kl \in \mathbb{C}\ell$ for immersion in to linear subspaces;
- $\rho_{Kl}^2(Y, p_{Kl}) \equiv \rho^2(Y, \Gamma_{Kl}), Kl \in \mathbb{C}\ell$ for immersion in to hyperplanes;

Theorem. Square correspondence distance ρ^2 for "immersion" to the linear structure is represented by the relations, respectively [3]:

$$\rho_{kl}^2(Y, p_{kl}) = \rho^2 \left(Y, \begin{matrix} Kl \\ L_{kl}, \Gamma_{kl} \end{matrix} \right) = \left[\begin{matrix} (Y, Z_{\alpha kl} Y) - \text{subspace} \\ \left(Y - \begin{matrix} p_{kl} \\ \bar{a}_{kl}, \bar{A}_{kl} \end{matrix}, Z_{\bar{\alpha} kl} (Y - \begin{matrix} p_{kl} \\ \bar{a}_{kl}, \bar{A}_{kl} \end{matrix}) \right) - \text{hyperplane} \end{matrix} \right]$$

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