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- Algorithms and Computing Theory;
- Software Engineering;

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- Computer Security and Cryptography;
- Security and Privacy in Computing and Communications;

C. Electronics:

- Applied Electronics and Embedded Systems;
- Micro & Nano-electronics.

D. Communications:

- Technology, Networks & Software for Telecommunications;
- Operations, Administration & Maintenance on Electronics and Telecommunications.

E. Research and Education for knowledge - based Society:

- Education methods based on ICT;
- e-Government and Society;
- Open data.

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- A. Computing:**
- Automatic Control and Robotics;**
 - Algorithms and Computing Theory;**
 - Software Engineering;**

APPROXIMATE PERFORMANCE ANALYSIS OF COMPUTING PROCESS BY AGGREGATED HSPN WITH FUZZY PARAMETERS

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One of the most widespread modern formalisms, used for the model-based performance and dependability evaluation of complex computing systems and networks, with discrete-continuous processes, are the fluid stochastic Petri nets (FSPN) [1] and the hybrid stochastic Petri nets (HSPN) [2] in which one or more finite places (buffers) can hold fluid rather than discrete tokens. However, an FSPN or HSPN model with $N \geq 3$ buffers cannot be exactly analyzed analytically [1, 2], thus justifying the development of approximation methods.

In this paper, is developed an approximate-aggregate method for performance analysis of *HSPN* with fuzzy parameters model, called *FHSPN*, of a multiprocessing production pipeline (MPPL) system with SV_i , $i = 1, 2, \dots, N$ servers and with finite storage capacity buffers b_i between them. The method consist in a decomposition of initial model into *FHSPN_i*, $i = 1, 2, \dots, N-1$ sub-models, called dipoles, each consisting of an aggregate $u_{i,1}$ of arrival SV_i (resp. $u_{i,2}$ of departure SV_{i+1}) continuous timed transition and b_i buffer between them. Each $u_{i,1}$ and $u_{i,2}$ are controlled by the discrete part which contains only 2 places and 2 discrete timed transitions that render the active or passive state of $u_{i,1}$ and $u_{i,2}$. The quantitative attributes of *FHSPN_i* are approximately aggregated from those of the initial *FHSPN* model.

For performance analysis of dipoles and MPPL, a method is proposed whereby the average credible rates of the respective states change and the average credible processing speeds of the respective dipole servers are determined based on an iterative fixed-point algorithm to numerical evaluation of the specified performance indicators. The accuracy of the proposed method has been validated by numerical simulations experiments.

The approach described in the paper can be further generalized to study hybrid systems from domains with dynamically reconfigurable behavioral characteristics that are conditioned by specified events at the design stage.

This work was carried out within the national project of applied scientific research 14.820.18.02.03 / U.

Keywords: Aggregation, analysis, approximation, computing, decomposition, fuzzy numbers, model, performance, stochastic process, hybrid Petri net.

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TRI-AXIAL SQUARE HELMHOLTZ COIL FOR TESTING SATELLITE STABILIZATION WITH MAGNETORQUERS

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The paper describes the design, construction and initial testing of a magnetic field simulator consisting of Helmholtz coils, for testing under laboratory conditions the system for determining and controlling the attitude of microsatellites. In addition to numerical modeling, it is necessary to validate the results in real experiments which leads to a higher level of confidence in orbit performance and lower risks.

One of the methods of satellite stabilization is by magnetorquers: coils that create magnetic field. The momentum created by the magnetorquer interacts with the geomagnetic field in orbit and rotates the satellite. For the proper work of the attitude determination system as well as the attitude control system, it is necessary the ability to detect the magnetometer, the ability to act in pairs as well as the interface between these two. For this purpose at the Center for Space Technologies of Technical University of Moldova was created three-axis Helmholtz cage, consisting of 3 pairs of square coils. This simulator allows the magnetic field to be generated from the orbit of the satellite. Initial tests confirmed the purpose of creating the desired magnetic field, by programmed change of the current intensity in the Helmholtz coils.

The described system will be used in the Center for Space Technologies for further research of the attitude determination and control systems of satellites designed within this center, including for other research that requires the creation of a uniform and programmable magnetic field.

Keywords: *Helmholtz coil, magnetic field, satellite, magnetometer, magnetorquer.*

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KIBOCUBE PROGRAM FOR THE LAUNCH OF THE TUMNANOSAT NANOSATELLITE

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The TUM National Space Technologies Center team was selected by the Japan Aerospace Agency (JAXA) and the United Nations Office for Outer Space Affairs (UNOOSA) for the fourth round of the KiboCUBE Program for the launch of the TUMnanoSAT nanosatellite from the International Space Station (ISS) in 2020, with the help of the Japanese experimental KiboCUBE module. KiboCUBE is a collaboration between UNOOSA and JAXA, dedicated to the use of ISS KiboLancer for the launch of CubeSat nanosatellites. KiboCUBE aims to provide the members of the United Nations Organization members – educational or research institutions, with the opportunity to launch CubeSat satellites from ISS KiboCUBE, developed for educational and research purposes.

The International Space Station was designed to be used as both a microgravity laboratory, as well as a launch pad for low-Earth-orbit services. The Japanese Space Agency's Kibo ISS module includes a small satellite-deployment system called the J-SSOD. Deploying CubeSats from ISS has a number of benefits. Launching the vehicles aboard the logistics carrier of ISS visiting vehicle reduces the vibration and loads they have to encounter during launch. In addition, they can be packed in protective materials so that the probability of CubeSat damage during launch is reduced significantly. In addition, for earth observation satellites, such as those of Planet Labs, the lower orbit of the ISS orbit, at roughly 400 km, is an advantage. In addition, the lower orbit allows a natural decay of the satellites, thus reducing the build-up of orbital debris.



Figure 1: Nanosatellites deployment from JAXA Kibo Module.

The National Space Technologies Center of TUM projected the family of TUMnanoSAT's nanosatellites, according to the international CubeSat standard. The mission of these nanosatellites is to verify the functionality of the various satellite modules and subsystems.

In the 2019 year, NCST participated in the fourth round of the KiboCUBE Program with the nanosatellite project from the "TUMnanoSAT" family, including the following basic missions:

- studying the functionality and behavior of sensors based on nano- and micro-wires in space conditions;
- testing subsystem sensors to determine satellite attitude (magnetometers, micro-gyroscopes, solar sensors) to optimize attitude control algorithms.
- the development of an efficient "satellite-terrestrial station" communication subsystem;
- testing of the solar energy system to obtain the optimal modes of distribution of the accumulated energy;
- testing the reliability of electronic components under the conditions of space radiation.

This project includes the launch of the first satellite of the Republic of Moldova under the KiboCUBE program under the auspices of UNOOSA and JAXA. It has a major impact on the improvement of the quality of engineering studies based on modern space technologies, attracting young students to develop and strengthen scientific research in space exploration. Also, it supports the integration of the Republic of Moldova into the community of countries which develop space technologies.

Keywords: *nanosatellite, International Space Station (ISS). Japan Aerospace Agency (JAXA), KiboCube module, United Nations Office for Outer Space Affairs (UNOOSA)*

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FUNCTIONAL SAFETY AND RELIABILITY OF TUMnanoSAT SATELLITE ON-BOARD COMPUTER SOFTWARE

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The TUM National Space Technologies Center team was selected by the Japan Aerospace Agency (JAXA) and the United Nations Office for Outer Space Affairs (UNOOSA) for the fourth round of the KiboCUBE Program for the launch of the TUMnanoSAT nanosatellite from the International Space Station (ISS) in 2020, with the help of the Japanese experimental KiboCUBE module. The National Space Technologies Center of TUM projected the family of TUMnanoSAT's nanosatellites, according to the international CubeSat standard. In the 2019 year, NCST participated in the fourth round of the KiboCUBE Program with the nanosatellite project from the "TUMnanoSAT" family. The harsh space environment with high levels of radiation and large temperature variations (even on low earth orbits) imposes the implementation of measures and techniques to achieve high level of satellite systems reliability over its full lifetime. The on-board computer and its software play a key role in this regard.

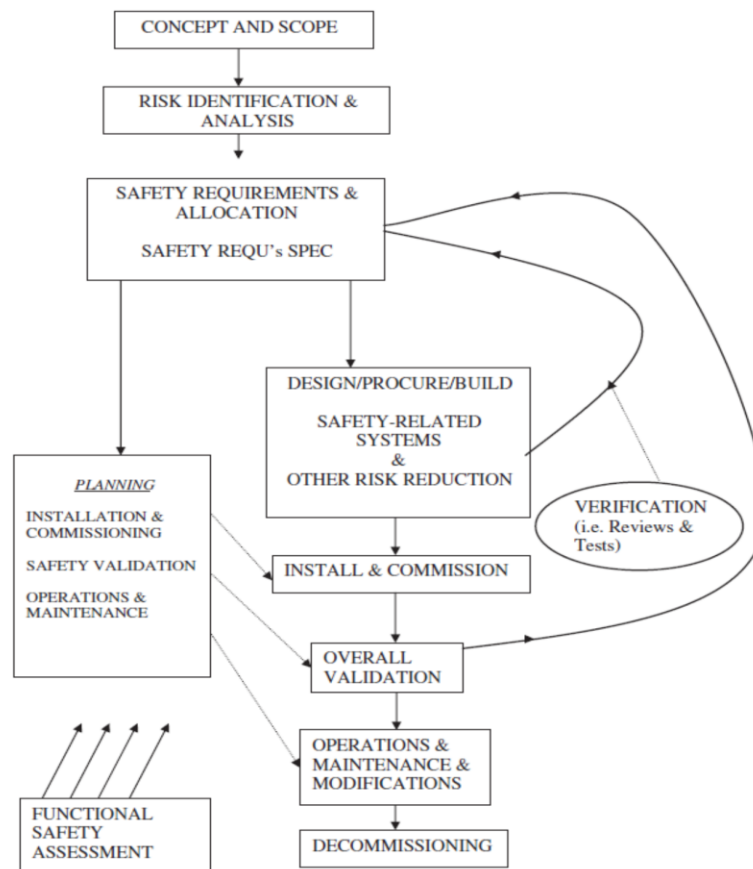


Figure 1: Schema of safety and reliability of nanosatellite software computer.

This article describes approaches and methods used for failure risk evaluation for TUMnanoSAT nanosatellite on-board computer software. These methodologies are mainly based on IEC 31508-3 and DO-178C standards and MISRA coding rules, and aim to ensure a high level of software reliability. To achieve this goal, the measures and techniques developed are applied on all stages of software design, development and testing, starting from identification and evaluation of possible risks and vulnerabilities in whole system and ending with performance and reliability evaluation during testing. Noteworthy is the fact that the functional safety measures taken in software development process are not intended to prevent human injuries or material losses. Their goal is to ensure functional reliability of the satellite systems, including on-board computer, as in case of unrecoverable fault only the satellite will be affected.

Due to the fact that IEC 61508 is a generic functional safety standard, it is agnostic to implementation field, but imposes some requirements on particular system components such as software, described in part 3 of this standard. The DO-178C standard and MISRA coding rules are more specific and focuses on safety related software development: the first focuses on aerospace applications software development safety requirements and the second focuses on mandatory coding styles in safety-critical development of software that requires high reliability. Another important feature discussed in this article is implementation of enhanced reliability and safety techniques and approaches in software development in context of multitasking system with embedded RTOS (Real-Time Operating System)

Keywords: *nanosatellite, software, RTOS task, functional safety, nanosatellite, reliability, cosmic radiation, digital electronic memory.*

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QoS INTUITIONISTIC FUZZY DECISION-MAKING IN MOBILE CLOUD OFFLOADING SYSTEMS BASED ON EXTENSION THEORY

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The offloading process is one of the techniques used in mobile cloud computing (MCC) to enhance the capabilities of mobile devices by moving mobile data and computation applications to cloud platforms [1]. Cloud-path selection will be a crucial issue due to the intensive development of MCC. Recently, several similar alternative cloud services are considered and evaluated in terms of many different Quality of Service (QoS) criteria such as *performance, bandwidth, security, financial, availability*, etc. that need to be considered when making final decisions in cloud-path selection problem [2].

In this paper, due to the uncertain intervals and the incomplete attribute information in a fuzzy environment of the complex MCC process with contradictory QoS criteria, a model and computing method for the multi-attribute extension intuitionistic fuzzy decision-making (MAEFDM) of cloud-path selection is proposed. This model is developed based on the intuitionistic fuzzy set (IFS) [3] and the extension theory (ET) [4]. The ET was originally created by W. Cai [4] to solve contradictions and incompatibility problems by the transformation of the matter - elements. The extension set (ES) extends the IFS from $[0, 1]$ to $[-\infty, \infty]$. This means that an element belongs to an ES with a different degree, defined by the membership function $K(x)$ that represents the degree to which an element belongs to that ES. A degree between zero and one corresponds to the normal fuzzy set. When $K(x) < 0$, it describes the degree to which the element does not belong to an ES, which is not defined in a fuzzy set. When $-1 < K(x) < 0$, this means that the element x still has a better chance of being included in the ES if this ES is adjusted.

By adopting the intuitionistic fuzzy matter - element, the obtained MAEFDM matrix and extension distance is standardized. Then, the synthetic weights of QoS indexes criteria that include both subjective preference and objective information are given. Finally, a numerical analysis example is performed to evaluate the model.

In our future work, we will try to create and develop a software Toolkit with a friendly graphical interface to implement the MAEFDM proposed approach.

This work was carried out within the national project of applied scientific research 14.820.18.02.03 / U.

Keywords: *Cloud computing, decision-making, extension theory, intuitionistic fuzzy number, Quality of Service, matter-element.*

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ELABORATION OF A HIGH-SPEED MICROPROCESSOR RELAY PROTECTION DEVICE

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Microprocessor relay protection devices (MP RPD) are an integral part of the automated control system (SCADA) of the electrical part of energy networks and systems, because they provide a high degree of informatization of electric power processes. MP RPD are intelligent systems with the ability to be improved by changing software and using more advanced principles and algorithms for the protection. Such algorithms are signal filtering algorithms that are difficult to implement due to the large volume of operations for processing the input signal. An effective algorithm for extracting symmetrical components for MP RPD was developed. The filtration of symmetrical components is based on well-known relationships, which are generally presented as follows:

$$3\bar{A}0 = \bar{A} + \bar{B} + \bar{C}, \quad 3\bar{A}1 = \bar{A} + \underline{a}\bar{B} + \underline{a}^2\bar{C}, \quad 3\bar{A}2 = \bar{A} + \underline{a}^2\bar{B} + \underline{a}\bar{C}, \quad (1)$$

where \underline{a} is a phase operator; A, B, C is a 3-phase system of values of currents and voltages; A0, A1 and A2 are zero, forward and reverse sequences.

The existing relay protection and automation equipment mainly analyze only currents and voltages of the zero sequence A0, while more than 50% of the accidents occur during 2 and 3 phase failures, which require analysis of the values of currents and voltages of the negative sequence A2 [2].

Therefore, the urgent task is to develop effective algorithms for calculating A2, providing high speed and accuracy when using industrial microcontrollers. For A2 calculations, it is proposed the following expression:

$$3X2i = 3 * (Xci - Xbi) + Xa(i-30^\circ) + Xb(i-30^\circ) - 2 * Xc(i-30^\circ), \quad (2)$$

where Xci , Xbi is the instantaneous value of the current (voltage) of phase c and phase b ;

$Xa(i-30^\circ)$, $Xb(i-30^\circ)$, $Xc(i-30^\circ)$ - instantaneous value of current (voltage) of phase a, b, c of 1/12 of the period back;

The proposed algorithm for A2 calculating was implemented in MP RZA LIRA (Local measuring and recording device). The following results were obtained: the error in measuring of currents and voltages amplitudes of zero A0 and inverse sequences of A2 was no more than 2%, speed - not less than 0.8 ms, that shows the effectiveness of the proposed algorithm. The pilot operation at MOLDELECTRICA confirmed the efficiency of the use of the developed devices.

Keywords: *high speed algorithm, microprocessor, relay protection, symmetric digital filters.*

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EVOLUTIONARY LOGIC DESIGN OF REVERSIBLE/QUANTUM DEVICES

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In recent years, artificial intelligent methods have been widely used to solve optimization problems. In particular, the evolutionary logic design has proved to be fruitful enough in developing the reversible/quantum devices [1,2]. In the paper, we have used the genetic algorithms to synthesize such devices of ternary logic.

The idea of reversible computing is that the information in its processing, transmission, and storage does not lost at a logical level when mapping of the input to the output sets is bijective. Reversible calculations, as shown theoretically and recently confirmed experimentally, do not lead to a loss of the thermal energy [3]. Therefore, reversible devices can be successfully used in the low-power digital devices, bioinformatics, and quantum computing.

In this work, the adaptive genetic algorithm was used to find the optimal circuits of combinational and sequential reversible/quantum devices. In particular, we designed the schemes of full adders, subtractors, multiplexers, comparators, various latches and flip-flop devices. The method for encoding circuits (chromosomes) and automating the selection of fitness-function parameters are proposed. The basic gates are the permutative one- and two-inputs Muthukrishnan-Stroud ternary gates [4]. The selected gate basis is shown to be functionally complete and may be physically realized. The obtained devices have a minimum quantum cost, a minimum number of constant inputs and garbage outputs, a minimum delay time, and also do not contain fan-out, which follows from the no-cloning theorem in quantum circuits. The proposed method, simultaneously with the solution of the synthesis problem, allows testing of the obtained schemes. The latter circumstance is connected with the fact that the condition for the end of the genetic search is the absence of errors in the final truth table. A detailed comparison with the results of the other studies is made and the advantages of the chosen synthesis method are shown.

The use of the genetic algorithms in the search and testing of the optimal circuits for the reversible/quantum synthesis of ternary digital devices has shown several advantages over analytical and graphical methods.

Keywords: *Reversible computations, genetic algorithm, combinational and sequential circuits.*

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ANALYSIS OF TELECOMMUNICATION NETWORKS BY ENLARGING SIMULATED PARAMETERS

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Proposed in this paper is the new technique of distributed telecommunication networks research. It is based on penetration of parameters, determined analytically, into simulated parameters and vice versa. Introduction of this principle has made analytical and simulation methods widely used. The results obtained allow to: consider the influence of equipment unreliability on transmission capacity; simulate the control of packets routing, ensuring the flat loading of outbound channels; create algorithms of routing methods information support, etc.

Present work is aimed toward the creation of advanced technique on the basis of analytical simulation method.

At the analysis of network operation, specific detail level is fixed, which can be described by elementary time unit. It is usually called simulated time unit.

Analytical simulation concept is based on the use of simulated time matching. That includes summarization of modulated parameters using analytical procedures, as well as parametric design of simulation models, etc. [1-3].

In the present work we have described the system of above-listed procedures.

In order to take the influence of main channels unreliability into account, one should seek the function:

$$\Phi(t) = \Phi\{W(t), F_1(t), F_2(t)\},$$

where: $W(t)$ - function of service time allocation at non-failure channel operation, $F_1(t)$ function of non-failure timing, $F_2(t)$ function of re-establishment timing. Function $\Phi(t)$ can be written as follows:

$$\Phi(t) = \int_0^t \sum_{k=0}^{\infty} F_2^{*k}(t-x) P_k(x) dW(t), \quad \text{where - symbol of Stilties convolution,}$$

or: $\varphi(s) = \int_0^{\infty} e^{-st} P(f_1(s), t) dW(t), \quad \text{where: } P(z, t) = \sum_{k=0}^{\infty} z^k P_k(t); \quad f_1(s) = \int_0^{\infty} e^{-st} dF_1(t).$

Using the well known procedures for the special case, when $F_1(t) = 1 - e^{-\lambda_1 t}$, the mean value of total time for the channel being occupied with message transmission is determined as: $\bar{\varphi} = \bar{W}(1 + \lambda_1 \bar{f}_1)$.

Thus, in the present work we have systematized generalities of telecommunication networks operation. We have determined the scopes for application of analytical and simulation methods of distributed telecommunications research. The methodology of analytical simulation is based on the system of dynamical processes, which take place in telecommunication networks.

Keywords: *simulation modeling, telecommunication networks, method of enlarging simulated parameters.*

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ON MAINTAINING OPTIMAL CONDITIONS FOR MANAGING INFORMATION FLOWS IN TELECOMMUNICATION NETWORKS

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In the present paper we have found Laplace-Stieltjes transformation for the time of message delivery to the receiver, as well as its response in the form of appropriate controlling frames. We have obtained the expression for estimation of optimal mean value of scanning period. Boundary conditions of scanning period have been laid down for several routing methods.

In telecommunication networks data streams control is realized using appropriate protocol procedures, whose main purposes are: maintenance of efficient network operation; ensuring of the required resources allocation; network overload protection.

The most of routing algorithms require fixed information interchange between the nodes (in order to choose control strategy), as well as commands interchange (in order to implement this strategy). This work is aimed toward the search of time parameters, which determine resources outlay for maintenance of optimal control conditions packet flows in telecommunication networks.

Protocols of packet streams control provide for categorization of interaction objects into masters and slaves (primary and secondary ones). In order to form routing tables, information is necessary about the instantaneous network state and its traffic.

Routing method, ensuring the better efficiency/cost ratio may be not very dynamical. It depends on information transmission/processing ratio at decisions making. In the process of simulation it has been determined that simple and cheap routing algorithms are better [1-3].

Optimal period of scanning of $(i+1)(i+2)...(i+m)$ -nodes by i -node is determined by minimization of influence of scanning period on the network response time. In order to determine the influence of scanning on response of receiving node, Laplace-Stieltjes transformation has been obtained:

$$r(s) = (1 - e^{-s\tau}) \frac{\beta(s\alpha)}{s\tau}, \quad \text{where: } \beta(s\alpha) = \int_0^\infty e^{-st(1+\frac{\sigma}{\tau})} dB(t); \quad \alpha = 1 + \frac{\sigma}{\tau};$$
 σ – scanning cycle time; τ – time interval between the end of i scanning cycle and the beginning of $(i+1)$ -cycle; $B(t)$ – the time of information transmission and processing. Mean value has been determined:

$$M\{R\} = \bar{r} = - \left. \frac{dr(s)}{ds} \right|_{s=0} = \frac{\tau}{2} + \left(1 + \frac{\sigma}{\tau}\right) \bar{\beta}, \quad \text{where: } \bar{\beta} = \int_0^\infty t dB(t) .$$

Thus, the results obtained represent the accurate estimate of network "monitoring" by i -node at the constant monitoring level.

Keywords: *control, packet flows, telecommunication networks, Laplace-Stieltjes transform, optimal scanning.*

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AUTOMATE PLAGIARISM DETECTION

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The paper presents a study in which an application for plagiarism detection has been created. It has been evaluated using the set of documents provided by PAN 2009 task on external plagiarism detection [1]. The task has been formulated as follows: Given a set of suspicious documents and a set of source documents the task is to find all text passages in the suspicious documents which have been plagiarized and the corresponding text passages in the source documents.

The organizers provided a training corpus which comprises a set of suspicious documents and a set of source documents. A suspicious document may contain plagiarized passages from one or more source documents.

The main metrics used for document comparison was NCD (Normalized Compression Distance) which is actually a family of functions which take as arguments two objects (some texts) and evaluate a fixed formula expressed in terms of the compressed versions of these objects, separately and combined [3]. The method is the outcome of a mathematical theoretical developments based on Kolmogorov complexity [4]. The smaller is the result, the more similar are the objects.

The application for plagiarism detection has been written in PHP. The similarity of two lines is calculated using the algorithm described in [2].

The selected threshold value has been estimated on the base of training data. This value provides the best plagiarism detection accuracy on the given texts.

In order to evaluate our application we used 400 documents from the set provided by the task organizers. We calculated Precision and Recall on 1/10 part of this set, namely, on 40 documents.

The information of the plagiarism in these 40 documents has been provided by the task organizers, so we knew exactly that only 5 of these 40 documents contained plagiarized fragments. The application returned exactly 5 files in which plagiarism was found. This result demonstrated that the application is good for the task.

Keywords: *plagiarism, automate plagiarism detection, text classification, substring search.*

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ESTIMATION OF THE MATHEMATICAL MODEL OF THE DC ENGINE COUPLED WITH A REACTION WHEEL USING GA

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The Center for Space Technology of the Technical University of Moldova is designing a satellite that aims to scan the territory of the Republic of Moldova using a camera. This implies the need to control the attitude of the satellite in orbit using reaction wheels and magetoquers. In this paper, it was proposed to carry out the experimental identification of the mathematical model of the DC motor, coupled with a reaction wheel.

The experimental data acquired from the DC motor are shown in Figure 1, representing the variation of the DC motor speeds at the reference speed of 8270 rpm.

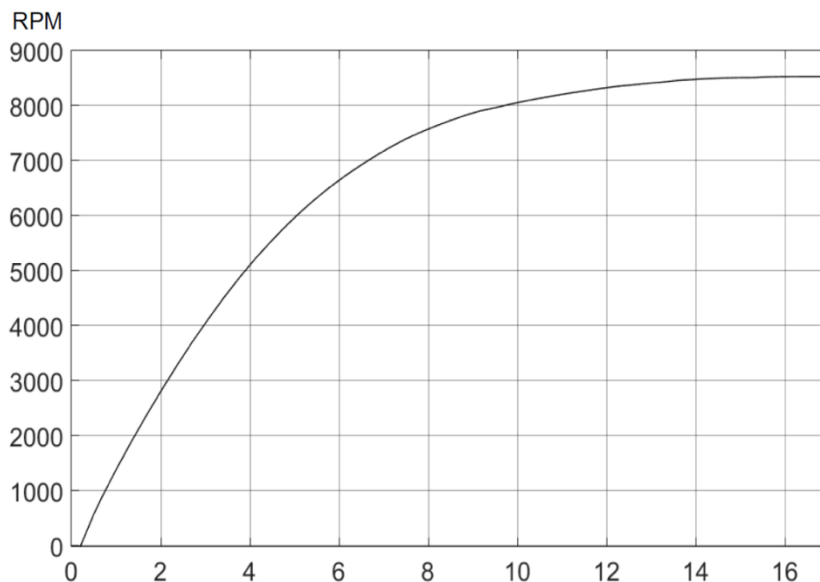


Figure 1: Experimental curve.

It was proposed to approximate the experimental curve with the mathematical model with inertia of order 2, identified by genetic algorithm.

To estimate the mathematical model of the control object it was proposed to use the genetic algorithm, the results obtained were compared with the Kupfmuller and Strejc methods, and the results obtained using the Process Models module from System Identification Toolbox from MATLAB.

Keywords: *model, identification, genetic algorithm, DC motor.*

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DATA SCIENCE APPROACH FOR IT PROJECT MANAGEMENT

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Majority of the IT companies realized that ability to analyse and use data, could be one of the key factors for increasing of number of successful projects, portfolios, programs. Key performance indicators based on data analysis helps organizations be more prosperous in a long term perspective. Also, statistical data are very useful for monitoring and evaluation of project results which are very important for managers, delivery directors, CTO and others high level management of company. The Data Science methods could make more efficient project management in several of business problems.

Analysis of historical data from the project life-cycle based on Data Science models could provide more efficient benefits for different stakeholders. Differential of the project data vector with target as an integral evaluation of the project success which allow for the complex correlations between separate features. Therefore, the influence of features importance and override creatures could be decreased on the target.

This study propose new approach based on Data Science providing more efficient and accurately project management, taking into account best practices and project performance data.

Nowadays, the ability to analyse and use data is one of the key factors affecting the organization's ability of the IT companies to work effectively in the long perspective. The main factor affected the successful implementation of the projects could be described with so-called project management triangle. The triangle consists of following components: time, budget and quality (or scope). There are several ways to calculate indicators related to the deadlines:

- assessment of the task in hours of the developer who will be engaged in it (previously agreed with the developer himself);
- have the data on how many hours were actually spent on this task (this requires a time tracker);
- due date due to which the task should be ready.

From the other hand, it is possible to convert part of the time metrics to the project budget. The evaluation of the project time scale could be described as - *Start date, Due Date, Actual Date*. Specifically, the time metric can be measured as the number of deadlines per task, or the ratio of differences between *Start date / Due Date* and *Due Date / Actual Date*. The budget indicator is based on a preliminary assessment of the time and the actual time spent to the task.

Keywords: *Machine Learning, Data Analysis, Project Management, Business Processes.*

ANALYSIS OF ROUTING TECHNIQUES IN MOBILE AD-HOC NETWORKS

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Mobile ad hoc networks (MANET) are self-configuring networks of nodes connected by wireless connections without any form of centralized management. They are currently one of the most important research subjects due to the large number of different applications (military, rescue, etc.). In MANET networks, each node is both a terminal and a router. Therefore, each node must be able to forward packets to other nodes. Due to the mobility of the topology nodes, these networks tend to be frequent changes. Traditional routing protocols developed for cable networks cannot work effectively in MANET networks, so they are for them special routing protocols developed. Routing protocols are classified according to the way forwarding of packets in point-to-point, point-to-multipoint, and broadcast routing protocols.

The Mobile Ad Hoc Network (MANET) is a dynamic network that enables wireless networking on the go without the need for a pre-built network infrastructure. It consists of moving nodes, wherein the node may be a human carrying a handheld computer equipped with a suitable wireless communication device, a laptop computer, an unmanned robot, or anyone equipped with suitable wireless communication equipment.

An ad hoc routing protocol is a convention, or standard, that controls on how nodes decide how to forward data packets among other nodes in the MANET network. Effective mechanisms for routing protocols within MANET networks have been the subject of much research, some of which have become widely accepted standards.

Routing protocols intended for use in traditional cable networks cannot be used in MANET networks. The specific characteristics of these networks require special routing protocols that address the identified challenges in these networks.

The topology of mobile ad hoc networks can be dynamic and unpredictable. Traditional routing protocols used with cable networks cannot be directly applied to mobile ad hoc wireless networks, since many of the assumptions adopted are not valid in a mobile wireless environment. Thus, for example, one assumption is that a node can receive any broadcast message from other nodes within the same subnet. However, this is not the case for nodes in the wireless MANET network, due to the fact that bandwidth is limited in this type of network. Thus, the MANET network model introduces a number of challenges to routing protocols.

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INTERNET OF THINGS SYSTEM FOR ENVIRONMENTAL MAP ACQUISITION

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The paper discusses the importance of contemporary electronic systems, with the focus on the development of distributed electronic equipment. Here the devices, potentially members of an Internet of Things (IoT) network, are part of a complex distributed electronic system, organized in an IoT network, dedicated to solving a specific problem. The paper proposes a concept of a distributed electronic system, consisting of a collection of sub-components of the electronic devices placed on certain cartesian coordinates. Also is presenting a case study of the operation for a distributed electronic system which is scanning environmental parameters such as temperature, humidity, CO₂, noise, brightness, or others. The proposed system consists in a set of electronic devices equipped with sensors for measuring the environmental parameters and communication modules to send the data collected to the IoT type network. The system stands for an analogy of a camera where every pixel collects environmental data at certain coordinates. All the collected pixels construct a 2D image. The uncovered areas interpolated from the nearest sensors. As a result, a 2D image is obtained, which represents a map of the specific area in the selected parameter, such as the temperature distribution map, brightness, CO₂, motion, noise, or another parameter, depending on the type of sensors available on the scanning devices.

Based on this concept, a prototype of a distributed electronic system, interconnected via an IoT network, was developed, following the ZigBee technology. It is capable to collect 2D images of a predefined area, in several parameters such as temperature, brightness, CO₂, motion, noise, simulating a "video" camera on these parameters.

Keywords: *IoT, electronic, device, environment, map.*

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CHARACTERISTICS OF SOME APPORTIONMENT METHODS BY COMPUTER SIMULATION

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In examined homogeneous multi-optional systems, the decision is made on two or more final options, consisting of parts of a homogeneous resource measured in integers; the resource in question is apportioned to beneficiaries-options (states, parties, etc.), aiming at ensuring the extreme value of a given criterion. It is considered that decisions are based on solving a deterministic optimization problem. To solve the optimization problem is used an apportionment method (algorithm). There is not yet a universally accepted apportionment (APP) method to be used in similar situations. Thereby are used several apportionment methods.

Studies [1, 2] show that APP methods, which in some situations allow for better solutions, in other ones yield to other methods. This can lead to unexpected effects. Known theoretical results sometimes do not give an unambiguous answer to what APP method is preferable to use in a concrete situation. In such cases, it is appropriate the comparative analysis of APP methods by computer simulation.

In this aim was elaborated the computer application SIMAP and were done respective calculations for eleven APP methods [1-3]: Hamilton (H), Sainte-Laguë (SL), d'Hondt (d'H), Huntington-Hill (HH), Adapted Sainte-Laguë (ASL), Quota linear divisor (QLD), Lower quota linear divisor (LQLD), Quota dependent linear divisor (QDLD), Variable linear divisor (VLD), Quota variable linear divisor (QVLD) and Lower quota variable linear divisor (LQVLD).

Done comparative analyses show the following preferences of investigated APP methods:

- by the disproportionality of solutions,
 $H > QVLD > LQVLD > QLD > LQLD > \{SL, VLD\} > ASL > HH > d'H > QDLD$;
- by the percentage of compliance with the Quota rule,
 $\{H, QVLD, QLD, QDLD\} > LQLD > SL > LQVLD > VLD > ASL > HH > d'H$;
- by not favoring options, $H > SL > ASL > HH > d'H$;
- by the percentage of Alabama paradox,
 $\{SL, ASL, HH, d'H\} > QLD > LQLD > H > QVLD > LQVLD > VLD > QDLD$;
- by the percentage of New state paradox,
 $\{SL, ASL, HH, d'H\} > QLD > LQLD > H > QVLD > VLD > LQVLD > QDLD$;
- by the percentage of Population paradox,
 $\{SL, ASL, HH, d'H\} > QLD > LQLD > H > QVLD > LQVLD > VLD > QDLD$.

Comparative multi-aspectual analyses show that from eleven investigated methods there is reasonable to use, in specific areas, only three or four: the Hamilton, Sainte-Laguë and Adapted Sainte-Laguë methods and may be the Quota linear divisor method.

Keywords: *apportionment methods, computer simulation, comparative analyses.*

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SYNTHESIS OF THE AUTO-TUNED PID CONTROLLER TO THE INERTIAL OBJECT

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In the paper, it was developed the mechanism for adaptation of the transfer coefficient of PID controller to the model of object with inertia first order and time delay; schema for simulation of the control system with adaptive controller and the research results of the functioning of the adaptation internal contour of the PID controller, which it realizes the auto-tuning of the controller's parameters.

For the given model of the control object with the parameters $k_0 = 0,42$, $T_0 = 60$ s, $\tau = 30$ s the parameters $k_p = 6,94$, $T_i = 48$ s, $T_d = 10$ s of the PID algorithm were determined according to the Ziegler-Nichols method as initial parameters for the procedure of adaptation the transfer coefficient k_p of the controller. The parameters of the control object k_0 , T_0 and τ were varied by $\pm 50\%$ from the initial values.

The obtained results demonstrated that in order to achieve the high performances of the automatic control system it is necessary to perform at least three cycles of adaptation of the k_p tuning parameter. The criterion for stopping the adaptation cycle it can be used to assess the increase of the step variation of the coefficient k_p : $k_p |K_p^{i+1} - K_p^i| \leq \varepsilon$, where i is the adaptation step. The value of ε is chosen based on the precision conditions of the system (the recommended value is 0.05).

It was elaborated and simulated in MATLAB 6.5 the structure of the automatic closed loop system with model of object with inertia and time delay with PID controller with adaptation contour of the tuning parameters.

As a result of the study of the automatic control system with the designed adaptive PID algorithm it can be concluded:

1. The transfer coefficient of the object k_0 it has been varied more than 10 times, and the time constant and time delay within the limits: $0,1 \leq \tau/T_0 \leq 10$, $\tau > 10$ s, $T_0 > 5$ s
2. The proposed algorithm corrects the transfer coefficient k_p of the PID controller with goal to obtain the performance of the system with overshoot $\sigma \leq 20\%$ with the absolute error $\varepsilon = 0.05$ from the value of the output signal of the automatic control system.

Keywords: *model of the object with inertia and time delay, PID algorithm with auto-tuning, adaptive control, adaptation mechanism.*

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AUTOMATIC CONTROL SYSTEM FOR CROP CULTIVATION

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Nowadays, greenhouses are widely used, they permit to exclude the influence of climatic factors and to ensure a stable crop of fresh vegetables. For the large scale in the greenhouses is used the automation, that suppose the continuous controlling of climatic parameters as temperature, humidity etc.

In this paper was done the study about factors that influence the crop process and it was developed an automatic control system for crop cultivation. The designed system is a complex system that contains many logical, mechanical and power control elements. The core of the system is represented by two logical control units: the Raspberry Pi 3 mini-computer (RPI 3) and the Atmega328P microcontroller. The RPi 3 is responsible for implementing the general system control algorithms and for linking the system to the graphical interface. The ATmega328P microcontroller is responsible for driving DC motors. Mechanical construction is a CNC machine that has three movement axes. The motion is provided by „Faulhaber 23421012CR” DC motors. It was done the synthesis of the proportional controller and the control algorithm was developed using the programming language C and implemented on the microcontroller. In the figure 1 it is presented the graphical representation of the system, with the axes displacement.

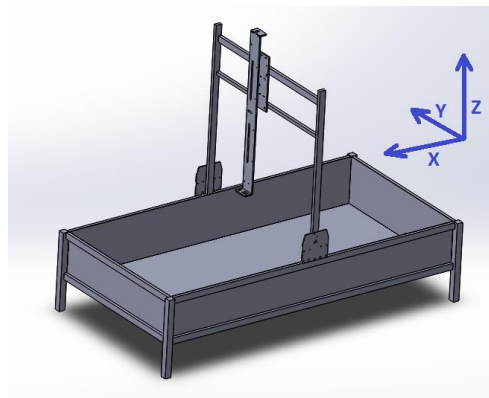


Fig.1 The graphical representation of the system.

Keywords: *crop cultivation, climatic parameters, automatic control system.*

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STOCHASTIC OPTIMAL CONTROL OF A TWO-DIMENSIONAL DYNAMICAL SYSTEM

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We consider the following controlled two-dimensional dynamical system:

$$\begin{aligned}\dot{x}(t) &= -k x(t)y(t), \\ \dot{y}(t) &= k x(t)y(t) + f[x(t), y(t)] + b[x(t), y(t)]u(t) + \{v[x(t), y(t)]\}^{1/2} \dot{B}(t),\end{aligned}$$

where k is a positive constant, $u(t)$ is the control variable, $v[x(t), y(t)]$ is a positive function and $B(t)$ is a standard Brownian motion.

Let $x(0) = x$ and $y(0) = y$ be such that $0 < x + y < d$, and define the *first-passage time*

$$T(x, y) = \inf \{t \geq 0 : x(t) + y(t) = 0 \text{ or } d\}.$$

Our aim is to find the value u^* of the control variable that minimizes the expected value of the cost criterion

$$J(x, y) = \int_0^T \left\{ \frac{1}{2} q[x(t), y(t)] u^2(t) + \lambda \right\} dt,$$

where $q[x(t), y(t)]$ is a positive function and λ is a *negative* constant. Hence, the aim is to maximize the expected survival time in the interval $(0, d)$, taking the quadratic control costs into account.

This type of optimal control problem, for which the final time is a random variable, has been termed LQG homing by Whittle (1982). These problems are generally very difficult to solve explicitly, especially in two or more dimensions. LQG homing problems have been considered, in particular, by Lefebvre and Zitouni (2014) and Makasu (2013), who solved explicitly a two-dimensional problem.

In this paper, exact and explicit solutions will be found in particular cases by making use of the *method of similarity solutions* to solve the partial differential equation satisfied by the value function.

Keywords: *Dynamic programming, Brownian motion, first-passage time, partial differential equations, error function.*

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MONITORING SOFTWARE FOR CROP CULTIVATION

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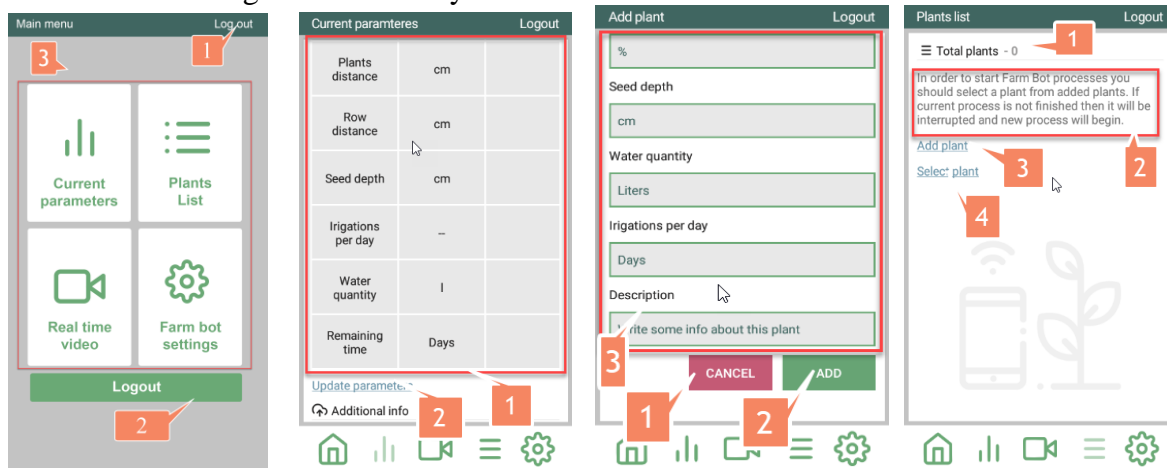
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On the large scale, there is used the greenhouses, which are providing the most comfortable conditions for the growing of plants in limited space. The microclimate of a greenhouse must be balanced and it should be taking into account all parameters as humidity, air composition, temperature etc.

The online monitoring, via the Internet, of the temperature and humidity in the greenhouse and in the soil, as well as the automation of the control these parameters leads to the reduction of the production costs and unjustified consumption of electricity.

In this paper was done the study about climatic factors that influence directly the growing process of plants and was developed the monitoring software system for this automatic control system. This monitoring software offers to the user the possibility to monitor the parameters of the agricultural crops, especially offers possibility:

1. Adding agricultural crop parameters.
2. Monitoring the parameters of agricultural crops.
3. Real-time video streaming.
4. Remote control.
5. Monitoring events in the system.



Keywords: crop cultivation, automatic control system, online monitoring.

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IDENTIFICATION OF THE MATHEMATICAL MODEL OF THE CONTROL OBJECT BASED ON THE GENETIC ALGORITHM

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In industrial automation is widely used the PID control algorithm and there are many tuning methods of typical controllers as: the empirical methods based on the classical methods of finding the tuning parameters developed by Ziegler-Nichols, analytical methods, graph-analytical methods and methods based on the optimization techniques. A large class of these methods require to be known the mathematical model of the technological process, that involves to be used the identification procedure. Identification procedure suppose mathematical modelling of the technological process, based on the experimental data acquisition. There are two kind of identification methods: parametric and non-parametric methods. There are a lot of parametric methods that permit to obtain the mathematical model of the technological process as: model adjustment method, iterative optimization, neural network etc.

In this study was proposed to use the genetic algorithm with the goal to obtain the mathematical model of the process. In the figure 1 is presented the obtained results, where: curve 1 - represents the experimental data, curve 2 - represents transient process obtained by using the genetic algorithm for the parameter estimation and curve 3 - presents results obtained in case of using the MATLAB for model identification.

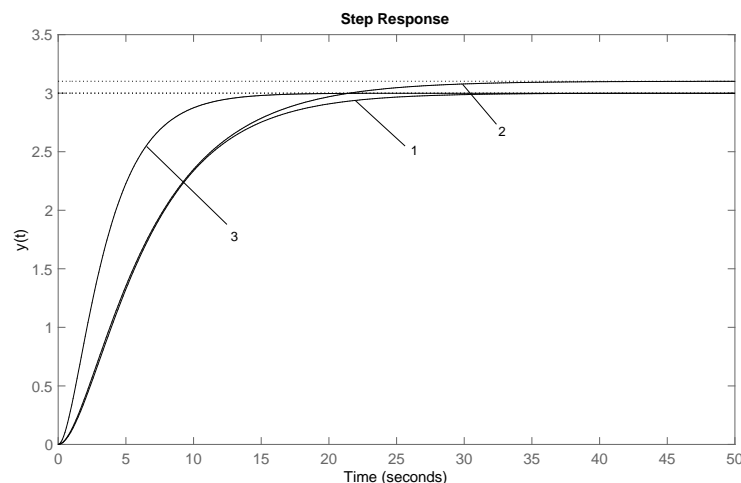


Fig.1. The results of identification.

Keywords: *identification, mathematical model, transfer function, genetic algorithm.*

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SYNTHESIS OF THE PID CONTROLLER TO THE SYSTEM WITH MAXIMUM STABILITY DEGREE BASED ON THE GENETIC ALGORITHM

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The control problem in the various industrial applications is one of the most important problem, on which depends the high performance of the automatic control system. At the automation of the industrial processes in a lot of cases are widely used the PID controller and its variation. There are a lot of tuning methods of the PID controller and one of the tuning method is the maximum stability degree (GMS) method with iterations [1]. This method is graph-analytical methods which permits to obtain good performance of the automatic control, but this method require to be known the mathematical model of the control object. The tuning parameters of PID controller - k_p , k_i and k_d are the functions of known parametrs of control object and of the unknown value J stability degree of control system: $k_p=f(J)$, $k_i=f(J)$, $k_d=f(J)$. In case, when the control object is described by the transfer function with inertia second order the maximum stability degree method in the classic version [2] it is not applied. From these considerations, it was proposed to use the genetic algorithm for finding the maximum stability degree of the system. In the figure 1, *a* it is presented the transient process obtained for the case of tuning PID controller by the GMS method with iterations and in the figure 1, *b* it is presented the transient process obtained for the case of tuning PID controller by the genetic algorithm. It can be observed that for the case of using genetic algorithm it was obtained the transient process with lower settling time.

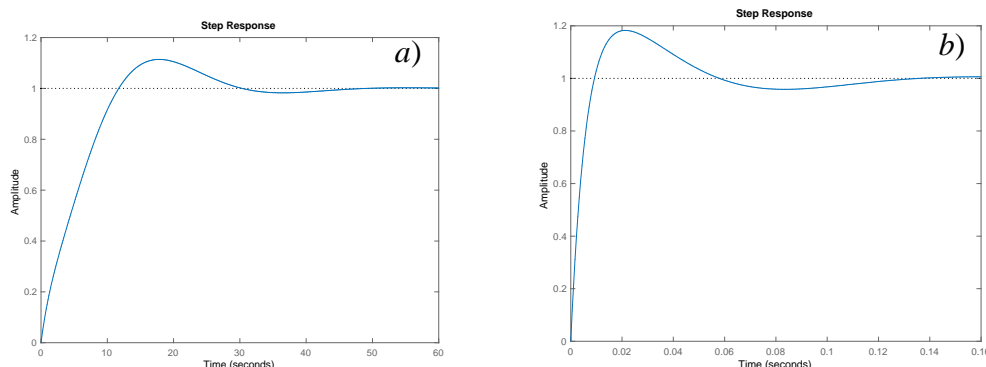


Fig.1. Transient processes of the control system.

Keywords: *maximum stability degree method, genetic algorithm, PID controller.*

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THE ALGORITHM OF TUNING THE PID CONTROLLER TO THE UNSTABLE MODEL OF OBJECT WITH INERTIA SECOND ORDER

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The unstable model of the control object with inertia second order with known parameters is given. In order to tune the PID algorithm to these types of control models, several methods can be used as the root-locus allocation method etc., which lead to difficult calculations. The classical method of tuning the PID controller by the maximum stability degree to unstable control models with second order inertia is not applicable. For tuning the PID algorithm to the unstable object model, the algorithm was developed based on the maximum stability degree method with iterations. The advantages of the method of maximum stability degree with iterations are highlighted by reduced calculations in minimum time, which lead to the simplification of the procedure of according the PID algorithm for these classes of unstable control models of objects. In order to verify the obtained results when PID algorithm is tuned to the unstable models of control objects, an example of an automatic system was studied and simulated in MATLAB.

Analyzing the obtained results when the PID algorithm was tuned to the model of object by the maximum stability degree method with iterations, it was observed that:

- With the increase the degree of stability J increases the values of the parameters of the PID controller and the performances of the system the rise time t_c and the settling time t_r are reduced, and the overshoot is kept at the level $\sigma = 20 - 22 \%$.
- With the increase of T_1, T_2 it is reduced the performance and, conversely, the reduction of the T_1, T_2 rises performance.
- With the increase of k the performances also increase, and with the decrease of k the performances are reduced.

Keywords: unstable control model of object with second order inertia, tuning of the PID algorithm, maximum stability degree method with iterations, system performance.

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MODELLING RELIABILITY OF SERIAL-PARALLEL AND PARALLEL-SERIAL NETWORKS WITH CONSTANT NUMBERS OF SUBNETWORKS AND UNITS.

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Abstract. On the basis of dynamic mathematical models, a comparative analysis of the reliability of two types of networks (serial-parallel and parallel-serial) is performed in our paper. Cases are analyzed when the numbers of sub-networks and units each sub-network are constants, but also when the lifetimes of all units are independent, identically distributed random variables (i.i.d.r.v.). The formulas for calculating the reliability of the related networks are deduced. The invoked examples show us that Reliability of Serial-Parallel Networks versus Parallel-Serial Networks depends only of number of the sub-networks and number of units in the sub-networks.

Keywords: *lifetime distributions, survival functions, serial-parallel and parallel-serial networks.*

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OVERVIEW OF COMPUTER VISION SUPERVISED LEARNING TECHNIQUES FOR LOW-DATA TRAINING

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This work is an overview of techniques of varying complexity and novelty for supervised, or rather weakly supervised learning for computer vision algorithms. With the advent of deep learning the number of organizations and practitioners who think that they can solve problems using it also grows. Deep learning algorithms normally require vast amounts of labeled data, but depending on the domain it is not always possible to have a well annotated huge dataset, just think about healthcare.

This paper starts with giving some background on supervised, weakly-supervised and then self-supervised learning in general, and in computer vision specifically. Then it goes on describing various methods to ease the need for a big labeled dataset. The paper describes the importance of these methods in fields such as medical imaging, autonomous driving, and even drone autonomous navigation. Starting with simple methods like knowledge transfer it also describes a number of knowledge distillation techniques and ends with the latest methods from self- and semi-supervised methods like Unsupervised Data Augmentation (UDA), MixMatch, Snorkel and adding synthetic tasks to the learning model, thus touching the multi-task learning problem. Finally topics/papers not reviewed yet are mentioned with some commentaries and the paper is closed with a discussions section. This paper does not go into few-shot/one-shot learning, because this another huge sub-domain, with a scope a bit different from the one of weakly-supervised and self-supervised learning.

Keywords: *knowledge distillation, knowledge transfer, self-supervised learning, semi-supervised learning, weakly-supervised learning*

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RELIABILITY OF SERIAL-PARALLEL NETWORKS VS RELIABILITY OF PARALLEL-SERIAL NETWORKS

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In our paper we introduce some dynamic mathematical models to perform a comparative analysis of the reliability of two types of networks: serial-parallel and parallel-serial. Cases are analyzed when the number of sub-networks and the number of units in each sub-network are Power Series Distributed (PSD) random variables (r.v.), but also when lifetimes are independent, identically distributed r.v. The formulas for calculating the reliability of the related networks it was deduced. Some examples are analyzed grafically.

Key words: *lifetime distributions, survival functions, PSD distributions, serial-parallel and parallel-serial networks.*

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DECISION-MAKING PROCESSES FOR INTELLIGENT AGENTS

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The purpose of this article is to harmonize decision-making processes. The theory of decision-making is a totality of methods (mathematical, intuitive or otherwise) designed to find the best possible variants that allow to avoid exhaustive search of all alternatives. Normally the decision involves the allocation of the necessary resources and is the result of processing the information and knowledge that is achieved by a person (or a group of people), who is empowered to choose and is responsible for the quality of the solution adopted to solve a particular problem or situation. This definition highlights three elements of the selection process: the problem, which needs to be solved, the person or collective body that makes the decision, the multitude of alternatives from which the choice is made [1]. If one of these elements is missing, it is not a process of choice. The factors that influence the decision-making process have a wide range: from very subjective, conditioned by the competence, intuition, life experience and the degree of information of the decider, to the objective ones, such as the process model and the methods of use. The field of science, which deals with decision making, is still in training - it is an interdisciplinary field, in which methods of management science, optimization, information technologies, psychology, etc. are accumulated. Each author examines the problem, making decisions through the perspective of his own experience, knowledge and conception of the world, his vision on the examined system, the arisen problem and the objectives that he sets. The following components of the decision-making process can be highlighted: the object (system, examined process), the subject (the decision maker) - the one who has the right and the obligation to make the decision who establishes that the system (the process) does not work in the way it was conceived or that it must be transformed in order to obtain new qualities and characteristics, the one which organizes the decision-making process. Decision-making process includes [2]:

1. The problem, the elements of which are: objectives, the criteria, the decision-making environment, which includes information about the object (system) and the environment in which the object (system) works, the restrictions, in which the problem is solved.

2. Alternatives (variants, strategies).

3. The method of choosing the alternative, which to a large extent, satisfies the objectives set and the calculation of the consequences. Any decision is made in order to improve the organization's activity, in order to achieve some objectives. Therefore, in order to achieve the intended purpose, the decision-making process must be followed by two further components:

4. Further analysis of the chosen decision, its consequences and elaboration of a plan for its implementation.

5. Carrying out measures to make the decision and mitigating the unfavorable consequences.

Keywords: *decision, process, system, intelligence*

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MICROSERVICE BASED SYSTEM FOR PAPER DOCUMENTS COUNTERFEIT DETECTION

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The anti-counterfeiting is widely in demand and significant financial resources are constantly allocated for anti-counterfeiting. Eventually these additional expenses are reflected in the final price of a product, that means the customers pay for anti-counterfeiting. It is required to design and develop a cheap and simple from user perspective method for document validation, which should bring the confidence in product quality, reducing the product price.

The article represents a new method of paper document validation using modern smartphones. The proposed paper document validation method is based on paper surface structure comparison between the registered reference document and the candidate document under validation. The method allows for a regular owner of a smartphone to quickly validate the paper document without having any knowledge about the validation process itself.

The important requirements for the system, which is based on proposed method of paper document counterfeit detection, are high availability and scalability, which are dictated by a great need for quick document authentication from clients and manufacturers side, wide popularity of smartphones and high counterfeiting level of different kind of goods (ex.: clothes, appliances or medicines). To achieve stable and effective work of such system the special technical design approach is required. The usage of modern microservice approach for the counterfeit detection system design allows to solve mentioned problem and to effectively allocate the hardware resources to serve the system users and to make the system work under high load stable.

Keywords: *anti-counterfeiting, document protection, microservices architecture, paper surface structure, system design.*

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ANALYSIS AND TREATMENT OF RISKS IN INFORMATION SYSTEMS

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The risk is the mathematical estimation of the probability of human loss, material damage, environmental damage, social and psychological damage, over a reference period, respectively future and in a given area, for a certain type of risk event. Risk is defined as a product between the probability of the disaster occurring and its impact [1].

Risks exist in all information systems, but they do not necessarily occur. Most experts are of the opinion: the sooner the potential danger will be determined, the more time it will remain for the team of designers to neutralize it or minimize the losses. Thus, the identification of risks must be carried out at the beginning of the works on the information systems. The risks that affect a system and that must be considered at the estimation stage can be differentiated as inherent risks, control risks and undetected risks.

These factors have a direct impact on the degree of risk of the audit, which can be defined as the risk that the information / financial report could contain material errors that could go undetected during the audit.

Risk management must be subordinated to the objectives that form an integrated, coherent and convergent system towards the general objectives, so that the activity levels are mutually supportive [2]. In order to manage the risks in an organization, it is necessary, first of all, to know these risks and to identify them. Risk identification is the first step in building the risk profile of an organization. The risks must be identified at any level where it is noticed that there are consequences on reaching the objectives and specific measures can be taken to solve the problems, raised by the respective risks.

Keywords: *risk, information systems, impact, probability, vulnerability*

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B. Cyber Security:

- Computer Security and Cryptography;**
- Security and Privacy in Computing and Communications.**

DESIGN AND DEVELOP BB84 PROTOCOL

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Since ancient times, methods of coding information have been used to ensure confidentiality. Roman Emperor Caesar proposed among the first a substitution-based encryption algorithm. Today it is called Caesar Cipher. The idea was simple, replacing the letters according to a key initially established and known to both the source and the recipient. Today, however, the amount of information is growing exponentially, computers have made available to mankind the computing power as it never was before. Therefore, the confidentiality of the data has been attacked.

Quantum cryptography comes with a completely different approach to traditional systems. The distribution of keys is completely random and driven by the principles of quantum mechanics. Thus, it is almost impossible to intercept the transmission of information. Given that quantum cryptography is environmentally sensitive and requires extremely sophisticated technology, research has led to the development of several protocols. In this article, one of the most known quantum protocols called BB84 will be analyzed. This protocol is developed both in the real environment and with the help of the computer simulator. The distribution of the keys takes place between Alice (the source) and Bob (the destination). Within the physical machine, the distribution is performed using light particles called a photon. Their polarization process leads to an observable phenomenon. Thus, the source uses slots for polarization under angles defined by the device construction. And the destination uses diagonal or vertical bases for reception. In this transmission the most important is confirmation. Within the standard protocol the confirmation is made by communicating the bases that were randomly selected by Bob (the recipient). Next, a new method of confirming information, the Quantum Teleportation method, will be investigated and implemented. This method involves the direct transmission of the information, to the bits used through the same communication channel as the BB84 protocol. This medium being fiber optic. The advantages of this method of confirmation include speed, increased security, working in parallel with the protocol. But in the real environment there are deficiencies. Even if this method is functional in the simulator, there are technological deficiencies and environmental interference in the real environment. Synchronization can be easily distorted by vibration, radiation, noise.

However, if these deficiencies are eventually overcome, a new era of security of information transmission will be introduced with the system. In the following, the fundamental principles of quantum mechanics on which both the protocol and teleportation are based will be explained and implemented. Both modes of operation, both the physical machine and the simulator, will be designed and described. On the practical side, the synchronization test of the teleportation protocol will be performed using the specialized programming language and the processing core from Microsoft. Also the aim will be to improve the security of the protocol by increasing the number of bits transmitted at random as well as the conversion from bit to qubit. The supreme test being the presentation of the synchronized work on the resonance between the protocol and the teleportation method. Executing as a causal dependency between these two methods. In the real environment, afterwards if it will be possible to test the protocol together with the teleportation, more precisely it can be established and adjusted their functioning. Within the real system there is also a parameter that is used in quantum mechanics or in the simulator, time. This may be a limitation because, if the timing is not properly calibrated, the laser beams will collapse over time. Any carrier information of a particle will be blocked in this area. This deficiency will also be analyzed with some potential

solutions. The problem having no direct solution, there are only solutions that come from applied mathematical equations. Structurally, quantum logic gates for circuits will be used within the simulator. The mathematical definition will be presented with the explanation of their use and the principles of quantum mechanics that represent them. The similarities as well as some common features of both the protocol and the teleportation, from the mathematical perspective will represent research and testing. The development together with the testing will be parallel since theoretically it is far too complex to predict how the physical system will behave by applying different factors.

As a result implementation, was able to achieve higher security check in key distribution system in simulator. Because we have limited access on physical resources as memory, CPU power and in general computer power, it was necessary in experiment to set relatively low key rate generation. But because added additional quantum gate for processing bits, was able to increase security, respectively lower latency. This consequence is valuable only on relatively short keys generation. If quantum bits are in higher number simulated and processed, performance will drop significantly.

Keywords: *Quantum Cryptography, Key Distribution, Photon, Polarization*

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LEVERAGING BLOCKCHAIN TECHNOLOGY TO ASSURE SECURITY OF SDN

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Software-defined networking is a new way of managing how computer networks behave, it gives more ability to manage the network nodes, facilitates policies enforcement, provides more speed in applying configurations on network nodes, it has one point of controlling which is laying in the control plane represented by the controller which is the only brain for the network which provides flexibility and single point of administration but, in the same time this situation from a security point of view this could be a single point of failure so, as restriction of the control in the network by the control plane is a good security feature, it could also open new security challenges and here comes our research secure software-defined networks in order to assure the security of computer networks in general. We propose a whole suite of algorithms and methodologies incorporated with each other in one framework called the Hydra, to help securing the control plane of the SDN represented by the controller or multiple controllers; one of the ideas for proposed for our research is to use blockchain for securing the connection between multiple controllers which is called east-west API, since that blockchain can provide decentralization for SDN which its best features is the centralization and it is also one of the main security challenges in case if the centralization point was jeopardized. In this article we try to show how it is nearly possible to implement and use blockchain-based technologies and methods to secure the east-west API connection from some famous attacks like man in the middle attack MITM.

Keywords: *software-defined networks, blockchain, application programming interface, hash function, cryptocurrency.*

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- C. Electronics:**
- Applied Electronics and Embedded Systems;**
 - Micro & Nano-electronics.**

AEROGALNITE AS A BIOMIMETIC ELECTRONIC NANOMATERIAL FOR MULTIFUNCTIONAL APPLICATIONS

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We report on fabrication of three-dimensional architectures based on GaN micro-tubular structures (the so-called Aerogalnite or Aero-GaN) with nanoscopic thin walls which exhibit dual hydrophobic-hydrophilic behaviour. The micro-tubular structures are shown to self-organize when interacting with water to mimic the formation and functions of a cell membrane. Self-organization processes result in the formation of stretchable and self-healing waterproof rafts with impressive cargo capabilities (cargo up to 500 times heavier than the floating raft [1]). Along with this, we demonstrate self-propelled liquid marbles with exceptional mechanical robustness which may find applications as bioreactors for scalable *in vitro* cell growth. The physical properties of the new material based on three-dimensional GaN architectures will be presented in the context of its prospects for biomimetic applications in nano/microfluidics, biomedicine, microrobotics, electronics etc.

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LOW DOSE RATE EFFECTS IN BIPOLAR DEVICES DURING LONG-TERM OPERATION SPACE ELECTRONIC SYSTEMS

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The maintenance of uninterrupted successful operation space system for navigation and investigation of different astronomic objective (planets, universes, nebulas) demands the development of on-board electronic systems which have possibility for long-term working in radiation ionizing space environments. During impact of the long-term radiation the two kinds low dose rate effects were observed: enhanced [1] and reduced [2] degradation of electrical characteristics of bipolar devices at the same total absorbed dose. It denotes as ELDRS (Enhanced Low Dose Rate Sensitivity) and RLDRS (Reduced Low Dose Rate Sensitivity). In given work the physical mechanisms of these low dose rate effects are considered. This kind of investigation can serve as the base for development of the testing methods for input control of bipolar microelectronic devices for on-board electronic system application.

Our approach is based on the conversion hydrogen-electron model of the SiO₂/Si interface traps buildup [3]. There are two types of traps located in the oxide near the silicon/dioxide interface—shallow traps (near conduction band border) and deep traps (near the middle of the forbidden gap). The probability of thermal excitation of the oxide positive center up to the conduction band depends on its energy depth in the oxide relative to the Si forbidden gap. The shallow oxide traps with energy near the conduction band are converted to interface traps in a short period of time and are responsible for the degradation at high dose rates, whereas the deep traps, whose energy levels are near the middle of the Si forbidden gap, require more time for conversion and determine the increase in excess base current under long-time irradiation, i.e., at low dose rates.

The case of ELDRS devices the acceptor-like traps are neutral while the donor-like traps are positively charged. The recombination rate of injected from emitter electrons connects with their capture on the positively charged traps with relatively large capture cross section (10^{-14} - 10^{-13} cm²). Therefore the excess base current is relatively large. The increasing of dose rate (the reducing of the irradiation time) leads to decreasing of the interface trap concentration and the excess base current reduces. For RLDRS devices the acceptor-like and donor-like traps are neutral. The recombination rate of injected from emitter electrons relatively small (capture cross section 10^{-15} cm²). For this reason at low dose rate irradiation the excess base current is relatively small in spite of all trapped oxide charges are converted to interface traps during long time irradiation. The increasing of dose rate (the reducing of the irradiation time) leads to increasing of the non converted trapped positive charge and the increasing of the excess base current.

Keywords: *interface traps, low dose rate, conversion model, bipolar device, ionizing radiation.*

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MICROHEATERS FOR COPPER OXIDE BASED GAS SENSORS

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In recent years, gas sensors based on oxide semiconductors such as copper oxide [1], have a very high development progress, as their market demands are high for the detection of toxic and flammable gases, as well as their low cost, functionality and higher sensor performance are necessarily at elevated operating temperatures between 200-300 °C. For these reasons, the need micro-heaters design and elaboration arises together with uniformity of thermal distribution, low energy consumption and prices, as well as compatibility with the sensor technological processes for integration in microsystems [2]. Laconte et al. presented a configuration of the micro-heater that includes all the properties listed above, the polysilicon based microheater demonstrated a temperature rise of 400 °C with a consumption of 20 mW [2]. Suehle et al. have developed polysilicon based micro-heaters, obtaining a temperature of 400 °C at 47 mW [3]. Baroncini et al. they obtained the temperature of ~ 400 °C with the consumption of 65 mW, based on the micro-heater with double coil of Pt [4]. Briand et al. have developed Pt-based micro-heater on silicon oxide substrate, obtaining 300 °C at 75 mW [5]. Mo et al. have developed Pt/Ti micro-heater on silicon oxide substrate, obtaining 400 °C by applying 9 mW [6]. Udrea et al. they obtained a temperature of 350 °C at 100 mW consumption [7].

From the above, in this paper we report about nichrome micro-heaters on glass substrate for copper oxide based gas sensors, with the possibility of raising temperatures up to 350 °C without damaging the substrate or the elements of the micro-heater, cost efficient micro-heaters and very simple technology of elaboration.

Keywords: *micro-heater, copper oxide, gas sensors, glass substrate, semiconductors.*

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EFFECT OF PEIERLS TRANSITION ON THE PHONON SPECTRUM IN ORGANIC CRYSTALS OF TTT_2I_3 FOR DIFFERENT VALUES OF CARRIER CONCENTRATION

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The metal-insulator transition of Peierls type and its effect on the phonon spectrum in quasi-one-dimensional organic crystals of TTT_2I_3 for different values of carrier concentration is studied in 2D approximation. In the frame of the physical model, two electron-phonon interaction mechanisms are taken into account. The first mechanism is of deformation potential type and the second one is of polaron type. The ratio of amplitudes of polaron-type interaction to the deformation potential one in x and y directions is characterized by parameters γ_1 and γ_2 . The interaction of carriers with structural defects is also considered. It was demonstrated that this interaction is very important to explain the behavior of Peierls transition. The renormalized phonon spectrum is calculated in the random phase approximation. The method of retarded temperature dependent Green function is applied.

Computer modellings for 2D physical model of the crystal were performed for different values of carrier concentration. The numerical calculations for renormalized phonon spectrum, $\Omega(q_x)$ as function of q_x , for different temperatures are presented in two cases: 1) when the interaction between transversal chains is neglected ($q_y = 0$) and 2) when the interaction between the adjacent chains is considered ($q_y \neq 0$). It is shown that in the second case when the interaction between adjacent chains is considered, the Peierls transition occurs at a lower temperature compared to the case when the interaction between transversal chains is neglected, for the same value of carrier concentration. Furthermore, it is shown that the Peierls structural transition strongly depends on iodine concentration. It was observed that with an increase in carrier concentration the Peierls critical temperature decreases.

Keywords: *Peierls transition, quasi-one-dimensional organic crystals, renormalized phonons, Peierls critical temperature, interchain interaction.*

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FIRST-PRINCIPLES CALCULATIONS AND INSIGHT OF MICROSTRUCTURAL EFFECTS ON MECHANICAL PROPERTIES IN THE HETEROSTRUCTURED (CrN/ZrN)/(Cr/Zr) NANOCOMPOSITE COATINGS

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Coatings with desirable properties of adhesion, strength and high wear performance can be achieved by depositing multilayered structures of Me/MeN architecture. Recent investigations have shown that the combination of hard but brittle metal nitride layers with tough but relatively soft metallic layers in multilayered “sandwich” improves the performance of the composite material for many reasons [1]. Herein, a sandwich (CrN/ZrN)/(Cr/Zr) nanocomposite coatings were synthesized by the vacuum-arc evaporation of the cathodes (Arc-PVD) in nitrogen atmosphere ($P_{N(CrN/ZrN)} = 0.53$ Pa, $P_{N(Cr/Zr)} = 0.003$ Pa). The highest value of hardness up to 29 GPa had been registered for the coatings of the series with the bilayers thickness relation of CrN/ZrN(1069 nm)/Cr/Zr(110 nm). The increase in hardness for (CrN/ZrN)/(Cr/Zr) coatings is mainly attributed to the high volume of boundary interfaces, the high number of interlayer interfaces and lattice parameter mismatch. The last is affect the total number of interfacial dislocations, hence, increases the required force to cause the deformation. Additionally, the thinness of the metallic layers also results in fewer dislocation formations and, hence, less accumulation of dislocations near the interfaces.

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EFFICIENCY EVALUATION OF CERAMIC MEMS DEVICE MANUFACTURED BY LASER MICROMILLING

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This work discusses the design of flexible laser micromilling technology for fast prototyping metal oxide based (MOX) gas sensors in SMD packages as a alternative to traditional silicon clean-room technologies. By laser micromilling technology possible to fabricate custom Micro Electro Mechanical System (MEMS) microhotplate platform and also SMD packages for MOX sensor, that gives complete solution for integration one in devices using IoT conception.

Keywords: *gas sensor, MEMS, SMD-package, 3D-printing*

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LOW POWER THERMOCATALYTIC SENSORS WITH NANOSTRUCTURED GAS SENSITIVE MATERIALS

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Micro-catalytic gas sensors are essential devices for detection of combustible gases up to lower explosion limit (LEL). As the power dissipation of Pt coil based sensors are 120 - 150 mW [1] intensive research is devoted to reduce it to the order range while preserving sensitivity and stability. The reported micro-hotplate structures can operate up to 600 °C at a cost of 20-50 mW power consumption [2]. Nowadays the research activity is focused on development and processing of stable, nano-structured catalyst layer in MEMS compatible thick film form.

Difference in approach of fabrication gas sensitive material for coil based and silicon MEMS sensors is great. In first type sensors catalytic material must be bulk form bead or cylinder with diameter 400-500µ. In second type sensor catalytic material deposited on planar microhotplate with diameter 100-250µ de facto forming 2D surface. The desire to increase the amount of applied catalytic material leads to form non homogenous thermal profile in bulk of catalytic material (the farther the catalyst particles from the heater, the lower their operating temperature) which in turn entails lead effect of catalytic reforming of organic molecules and blurring of peak signals characteristic of various gases. Similar effects are less common for bulk wire catalytic sensors. But in bulk catalytic material, another problem arises – porosity. The rapid and effective transfer of chemical reactants to solid surfaces through porous structures is essential for enhancing the performance of nanomaterials for gas sensing applications.

The regulation of the porous structure in bulk material has already been solved for wire catalytic sensors using particles of different sizes, usually varying 8-10 times. The use of catalytic carrier particles with a size of the order of ten microns is possible for bulk structures and does not seem realistic for planar structures. In the bulk structure, large particles form a matrix for smaller particle, in the planar they lie on the heater in only a few quantities interfering with adhesion of small particles to MEMS microhotplate. In our work, we tried to reduce this inconsistency by using two classical materials of carriers for Pt-Pd catalytic material. First one is Al₂O₃ and second one is CeO₂/ZrO₂ which were deposited to silicon MEMS microhotplate by inkjet printing, carefully selecting the thickness and viscosity of the layers and dimension of catalytic carrier particles for forming regular porosity of the gas sensitive material for a high sensory response signal.

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Keywords: *combustible gases, MEMS, catalytic sensor*

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INVESTIGATION OF PICOSECOND-PULSE GENERATION BY TWO-SECTION BLUE-VIOLET SEMICONDUCTOR LASERS

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During recent years, the need for picosecond laser pulses has been increasing due to applications in laser tomography, distance measurements for automotive applications, three-dimensional imaging and spectroscopy [1-3].

In this paper, we focus on the generation of ps pulses in a blue-violet InGaN laser containing an additional section (called switching section) with a saturable absorber in axial direction. The main aim of this study is to describe the pulse generation, triggered by injecting a current “Is” into the switching section, theoretically and to explore the dependence of the pulse properties on geometrical and material parameters. The laser structure considered is shown schematically in Fig. 1. The active layer is composed of three InGaN quantum wells the compositions and layer thicknesses of which are fixed. We consider lasers emitting at different wavelengths (395, 400, 405, and 410 nm) which could be achieved by implementing a Bragg grating into the cavity. The length of the active section is $L=800\text{ }\mu\text{m}$ and the width of active area is $W=10\text{ }\mu\text{m}$. The length of the switching section is varied from 0 to $400\text{ }\mu\text{m}$.

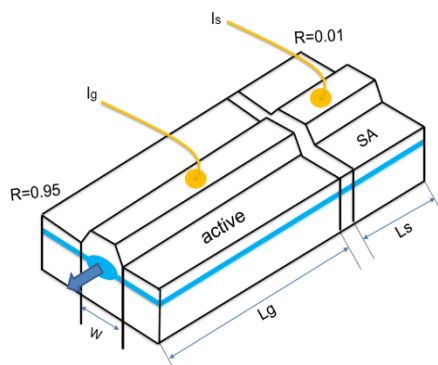


Fig.1. Setup of InGaN laser with two sections.

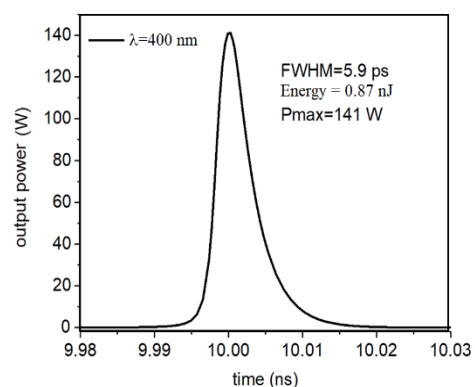


Fig. 2 Output power of a generated ps-pulse vs time.

The evolution in time of the output power is analyzed in the framework of a rate equation model. On the other hand, to get insight into the laser characteristics, we used the software package AUTO for plotting the steady-state dependence of output power on current injected into the active section. As a result of the numerical simulations, we obtained ps pulses with a width of 5.9 ps (FWHM) and energy of 0.87 nJ (see Fig. 2).

Keywords: Picosecond optical pulses, InGaN blue-violet laser, switching

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CTS OPTIMIZATION ON 3D INTEGRATION

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One of the purposes of realizing 3D integration is to reduce the interconnect complexity and delay associated with 2D, which are widely considered as barriers to continued performance gains in future generations. 3D integration has a big impact on all the levels of the flow, starting with the floorplan continuing with the placement, the clock tree synthesis and the routing part. The reduction in wire length enabled a size decrease of the logic gate drivers for these wires, which reduced the distance between logic gates and wire length, causing a "positive effect" that significantly reduce total silicon area.

In this article we have implemented and optimized Clock Tree in a design placed 3D and we have analyzed the results and the impact of reducing wire length on the area, power and timing of the built clock tree. Due to decreasing length of the wires, the number of the buffers and the invertors used to create clock tree is decreasing significantly and optimizing CTS using different strategies leads to a performant clock tree in terms of speed and area. We have chosen to focus on this part of the flow since the Clock Tree Synthesis level holds vital importance in the performance of the entire design. The experimental results show that all the important parameters on CTS like clock-skew, delays and power dissipation are improved compared with existing 2D integration.

Keywords: *3D integration, area reduction, congestion, CTS optimization, skew*

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QUANTUM ELECTRICAL TRANSPORT PROPERTIES OF TOPOLOGICAL INSULATOR $\text{Bi}_{0.83}\text{Sb}_{0.17}$ NANOWIRES

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Recently a new class of insulator, namely, topological insulator (TI) [1], was proposed. A TI is a material with a bulk electronic excitation gap generated by the spin-orbit interaction, which is topologically distinct from an ordinary insulator. The strong topological insulator is predicted to have surface states whose Fermi surface encloses an odd number of Dirac points. This defines a topological metal surface phase, which is predicted to have novel electronic properties. The semiconducting alloy $\text{Bi}_{1-x}\text{Sb}_x$ is a strong topological insulator due to the inversion symmetry of bulk crystalline Bi and Sb. The transport properties of TI $\text{Bi}_{0.83}\text{Sb}_{0.17}$ nanowires were investigated earlier [2].

Here we report the observation of quantum oscillations of magnetoresistance arising from the surface states in topological insulator $\text{Bi}_{0.83}\text{Sb}_{0.17}$ nanowires. Single-crystal nanowire samples with diameters ranging from 75 nm to 1.1 μm are prepared by high-frequency liquid phase casting in a glass capillary. $\text{Bi}_{0.83}\text{Sb}_{0.17}$ is a narrow-gap semiconductor with an energy gap at the L point of the Brillouin zone, $\Delta E = 21 \text{ meV}$.

We study the magnetoresistance (MR) of $\text{Bi}_{0.83}\text{Sb}_{0.17}$ nanowires at various magnetic field orientations. Shubnikov-de Haas (SdH) oscillations are observed in nanowires with diameter $d = 200 \text{ nm}$ at $T = 1.5 \text{ K}$ and 3 K ; this fact indicates the existence of high-mobility ($\mu_s \approx 30000 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$) two-dimensional (2D) carriers in the surface areas of the nanowires, which are nearly perpendicular to the C_3 axis. In thin nanowires ($d \leq 100 \text{ nm}$) at low temperatures ($1.5 \text{ K} \leq T < 5 \text{ K}$), we discovered the Aharonov–Bohm (AB) [3,4] oscillations of longitudinal MR with two periods, namely one flux quantum, Φ_0 and half of flux quantum, $\Phi_0/2$, ($\Delta B_1 = \Phi_0/S$, $\Delta B_2 = \Phi_0/2S$, where S is the cross-sectional area of the nanowire).

The periods ΔB of AB oscillations depend on slope α of the magnetic field direction according to the law $\Delta B = \Delta B_{\text{parallel}}/\cos\alpha$. This law is preserved up to angles of about 60° . The nonmonotonic changes of magnetoresistance, which are equidistant in a direct magnetic field, were observed in transverse magnetic fields under conditions where the magnetic flux through the cylinder $\Phi = 0$. Possible causes of this behaviour by analogy with thin bismuth nanowires are discussed.

Keywords: *topological insulator, Bi-Sb, quantum size effect, Shubnikov-de Haas oscillation, Aharonov-Bohm effect.*

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ANGLE DEPENDENCE OF THE MAGNETORESISTANCE IN Bi NANOWIRES

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Bulk bismuth has been classified as a trivial topological insulator (TI) where the surface states do not have topological protection. Still, the electronic mobility of surface states is exceptionally large. This is not surprising if we consider that bulk Bi can be assembled by stacking bilayers, and that the bilayer of Bi is thought to represent a two dimensional TI that supports edge modes propagating along the perimeter of the sample, modes that exhibit coherent propagation and suppression of backscattering [1].

Recently, it has even been proposed that the hinges of the surface of the crystal also have special topological properties, hosting topologically protected conducting modes. Experimental studies that probe the surface of bulk bismuth as a composite of edges on the surface of bulk Bi are lacking and we present angle-dependent transverse magnetoresistance (TMR) oscillation measurements of small diameter (50 nm) bismuth nanowires where electronic transport is dominated by the surface, rather than the bulk in the core of the nanowire, because of quantum confinement. We find that the TMR of the surface states in our nanowires exhibits a number of nanowire rotation angles that strongly suggest an interpretation in terms of Yamaji magic angles [2]. Magic angles are observed in layered and other low-dimensional conductors with weak interplanar coupling that are amenable to be described by an open, corrugated, Fermi surface [3]. In contrast to nanowires, bulk bismuth does not display magic angles since the Fermi surface is closed. The main Fermi surface parameters that we observe: Fermi wavevector, charge density, and interplanar coupling will be discussed.

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Keywords: *topological insulator, Bi bilayers, quantum size effect, transverse magnetoresistance.*

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MEASURING APPROACH FOR SEMICONDUCTOR NANOSTRUCTURED GAS SENSORS PARAMETERS

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Extended Abstract

The development of new technologies for extracting and testing the parameters of nanostructures based on semiconductor oxides required the development of special instruments for measuring the parameters of such structures [1], in particular, measuring the temperature dependences of their electrical resistances. The small size of the nanostructures determines the restrictions imposed on the permissible values of currents, voltages, and powers that can be applied to such nanostructures [2]. Classical resistance measurement methods, for example, a multimeter, voltmeter and ammeter [3], as a rule, apply rather high voltages and currents to the measured element, which can change their properties with respect to nanostructures, distort the measurement results or lead to failure.

The main objective of this work is to provide the ability to measure high resistances of micro- and nanostructures using differential amplifiers of general purpose [4]. The task was achieved by the fact that to determine the resistance of nanostructured sensors, the voltage of the reference voltage source and the voltage at the additional resistor, which is connected in series with the measured resistance of the nanostructure, are used. The input resistance of the measuring amplifier can be significantly less than the resistance of the nanostructures.

The proposed method for measuring the resistances of nanostructured sensors makes it possible to apply the minimum values of currents and voltages to the studied nanostructured sensors [5-6].

The result consists in eliminating the influence of the input resistances of instrumental amplifiers on the measurement results and replacing them with general-purpose amplifiers with relatively small input resistances.

Keywords: *nanostructured semiconductor oxides, gas sensors, gas concentration*

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TiO₂/ZnO COLUMNAR HETEROSTRUCTURES

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Researchers from different countries are looking for the best ways to prevent pollution by detecting various species at low concentrations in environment. Different heterostructure-based devices and technical approaches are investigated to detect the gases polluting the atmosphere. In this work we synthesized TiO₂/ZnO columnar films and studied their characteristics, including the sensor structures based on zinc oxide doped with different impurities. The effects of nano-heterogeneous formation of non-planar junctions of titania (TiO₂) and zinc oxides on sensory selectivity are also investigated. The properties of these materials were measured using XRD, XPS, EDX, SEM and electrical techniques. These sensor structures were tested at low concentrations of hydrogen and ethanol. To tune and improve the selectivity of the gases, a thin layer of titania was sprayed. It was studied the response to different gases and volatile organic compounds, in order to determine the best sensor material, it was also determined the lowest operating temperature. In the paper, the dynamic gas behaviors are presented to confirm that the developed sensor has the same gas response after a certain time interval, and then the response and recovery times have been calculated after the test gas was applied. The results are important for the further development of oxide semiconductors for sensory devices and to have own cost-efficient technologies for device fabrication.

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MAGNETO- SEEBECK COEFFICIENT $\text{Bi}_{1-x}\text{Sb}_x$ MICROWIRES FOR THERMOELECTRIC APPLICATIONS

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Due to development of new concepts such as the low- dimensional structures [1] and influence the quantum confinement of charge carrier acoustic phonon –boundary scattering for increase figure of merit $ZT = \alpha^2 \sigma / \chi(T)$ opened up a completely different strategy for ZT enhancement in one- dimensional structures [1].

We study the thermoelectric properties of $\text{Bi}_{1-x}\text{Sb}_x$ in semimetal and semiconductor wires with different diameter in the presence of magnetic field in the temperature range 4.2-300 K.

Single- crystal $\text{Bi}_{1-x}\text{Sb}_x$ micro- and nanowires with orientation (1011) with diameter 60 – 1000 nm in glass capillary were prepared by Ulitovsky method [2].

Semimetal Bi-2at%Sb nanowires exhibited a semimetal- semiconductor transition (SMSCT) (according effect size quantization) at $d_c = 300$ nm which is on five times higher, than d_c for pure Bi nanowires. The reason is that the electron (L), hole (T) energy overlap- according calculations, received from Shubnikov de Haas oscillations in 2 times less then in pure bismuth.

It was establish that at the SMSCT the thermopower becomes positive and considerably increase with reduction of wire diameters.

Here we demonstrate experimentally that $\text{Bi}_{1-x}\text{Sb}_x$ micro and nanowires display positive shifts in longitudinal and transverse magneto-thermopower in slowly magnetic field (0.4 T), at high range temperature ($T < 200$ K).

It is know that the production p- branches in thermoelectric converters is a challenge, especially at $T < 150$ K.

This approach may enable the development of low- cost thermoelectric materials and providing access to high powder thermal energy conversation applications.

Keywords: *nanowires, quantum size effect, magnetothermopower, thermoelectric efficiency.*

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EXFOLIATION AND THERMOELECTRIC PROPERTIES OF BISMUTH TELLURIDE AND BISMUTH CHALCOGENIDES LAYERS N- AND P- TYPE

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Bismuth telluride and its alloys are the best thermoelectric material at room temperature.

Bulk thermoelectric modules are used widely in industry as Peltier cooling devices and only bismuth telluride materials are commercially available for power generation.

Last years the development of new concepts- topological insulators (TI) have been made, that predicted the enhancement thermoelectric efficiency $ZT = \alpha^2 \sigma / \chi$ in TI [1].

In this presentation we describe a "mechanical exfoliation" method of single crystal bismuth telluride layers with thickness 10-20 μm n- and p- type [2].

X- Ray diffraction studies showed that the layers were single- crystal with C_3 axis was perpendicular to the plane layers. From Shubnikov de Haas (SdH) oscillations, cyclotron effective mass and quantum mobility are calculated. It was shown high mobilities $\mu = 12 \cdot 10^3 \text{ cm}^2/\text{V}\cdot\text{s}$, that is substantially higher than in the bulk alloy and also surpasses Hall mobilities.

It was revealed the phase shift of the Landau levels index SdH oscillations in longitudinal and transverse magnetic field $\gamma = 0.5$. That connected with Barry's phase and is characteristic surface state [3].

Thermoelectric properties in temperature range 2.2- 300 K indicate the high thermoelectric efficiency at room temperature. Using n- and p- type layers as n- and p- legs in microcoolers we receive cooling $\approx 4^\circ$ from one pair. Segmentation n- and p- branches leads to increase temperature gradient at 300 K.

The composition of the layers in thermoelectric carriers material made of bismuth-chalcogenide and Bi- telluride layers at thickness of about 10 μm for applications in room temperatures.

Micro- peltier coolers with efficient cooling capacity, small areas and short response time are in high demand on the telecommunication markets and of the future.

Keywords: *topological insulators, layers, surface state, thermoelectricity, magnetopeltier coolers.*

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INFLUENCE ELASTIC DEFORMATION AND MAGNETIC FIELD ON MAGNETO- THERMOELECTRIC PROPERTIES Bi, Bi_{1-x}Sb_x SEMIMETAL WIRES

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We report on the experimental observation of the electron topological transition (ETT) in the semimetal Bi_{1-x}Sb_x wires induced by the electric deformation and magnetic field and its influence on thermoelectric efficiency $ZT = \alpha^2 \sigma / \chi$, where α - is thermopower, σ - , χ - electrical and thermal conductivity.

Individual semimetal single- crystal Bi_{1-x}Sb_x micro- and nanowires in glass cover with diameter from 100 nm to 2000 nm were fabricated by the liquid phase casting [1].

It was establish, that the essential influence of elastic deformation on magneto - thermoelectric properties of the micro-wires, connected with qualitative change of the topology of the Fermi surface.

Change of topology of a Fermi surface of, at elastic deformation was estimated with the help Shubnikov de Haas oscillations.

Considerable change thermopower not only quantitative, but also qualitative (change of a sign from negative on the positive) it was observed in the field of temperatures 150 – 10K and amplifies in weak magnetic field (0.4T). That leads to considerable increase of the power factor $\alpha^2 \sigma$.

The possibility of application the revealed effect in thermoelectric converters of energy is discussed.

Keywords: *micro-wires, elastic deformation, thermoelectric efficiency.*

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SENSITIVITY INVESTIGATION TO FORMALDEHYDE OF THE VAPORS OF NANOSTRUCTURED FILMS FROM ZnO SEMICONDUCTOR OXIDES FOR MEDICAL APPLICATION

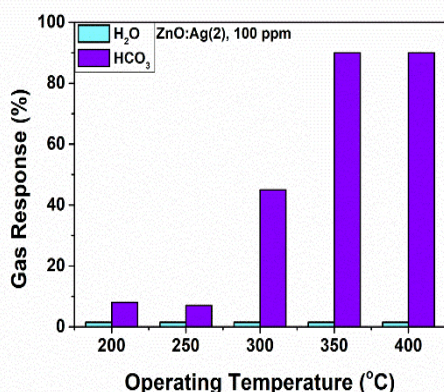
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Formaldehyde (CH_2O) of 40% is widely used in medicine as a substance applied in processes for sterilization of bone grafts for further use as implants. The efficiency of sterilization depends on the amount of CH_2O remaining in the graft pores [1]. Thus, the purpose of washing grafts with CH_2O being the lack of CH_2O at the end of the sterilization process. The purpose of the investigations is to establish the changes / response of the resistivity of ZnO-type semiconductor oxide films to the action of CH_2O vapors, preventively subjected to rapid thermal treatment regimes. Similar investigations have been carried out on ZnO films doped with Ga and Sn, in which the mechanisms of the sensitization processes are discussed. [2,3].

The researches at different concentrations (5-1000 ppm) of CH_2O vapor allowed to establish the concentration limit, which is obtained at the operating temperature of about 300 °C. Based on the results we propose the mechanism of sensitization to the circle of (CuO-Cu₂O) -ZnO-Ag of the n type which have the sensorial features to vapors of CH_2O .



Of the ZnO: Sn film samples, the ones most sensitive to CH_2O vapors are those subjected to operation at a temperature of 400 °C (Fig.1). For all the measured samples, the sensitization of the CH_2O vapors starts after 22-23 sec.

Fig.1 Response to H_2O and CH_2O vapors of nanostructured films from ZnO-Ag (2), obtained for the purpose of excluding sensitivity to water vapors.

Keywords: nanostructured semiconductors films, gas sensors, formaldehyde sensors

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THE PLASTICITY INDEX OF THE "SOFT-FILM/SOFT-SUBSTRATE" COATED SYSTEMS

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The advanced devices from the last years contain thin films deposited on substrates of materials with different properties, thus forming coated systems (CS) of film/substrate type. Scientists, as well as engineering staff are increasingly interested in knowing the mechanical properties of CS used in micro- and nanoelectromechanical systems [1].

In this paper, we investigate CS of the type „soft-film/soft-substrate” – *Cu/LiF* with different thickness of films: nanometric ($t_1=85$ nm), submicronic ($t_2=470$ nm) and micrometric ($t_3=1000$ nm), obtained by the magnetron sputtering method. The mechanical properties of the CS mentioned above were investigated by using the nanoindentation (NI) tester equipped with a trihedral diamond Berkovich pyramid as an indenter [2]. Along the hardness (H) and Young's module (E), the mechanical properties of CS are also characterized by the H/E ratio called "plasticity index" [3]. We show that for the studied materials, the values of H and H/E change with the P_{\max} load increase. We show these dependences in Fig. 1.

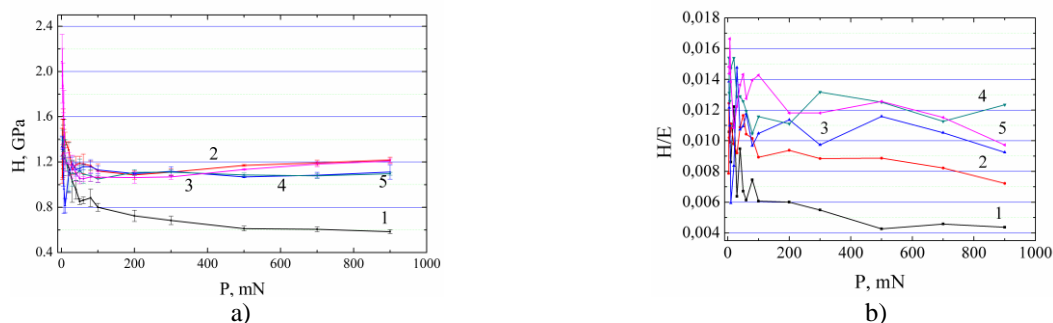


Fig. 1. Dependencies reflecting the variations of the hardness (H) a) and plasticity index H/E b) of the load P_{\max} value in the range (5 ± 900) mN at NI tester for all CS *Cu/LiF* and monolithic crystals. The respective curves are characterized by: 1 – the polycrystal *Cu*, 2 – the single crystals *LiF*, 3 – *Cu/LiF*, $t_1=85$ nm, 4 – *Cu/LiF*, $t_2=470$ nm, 5 – *Cu/LiF*, $t_3=1000$ nm.

From Fig. 1a) one can see that the $H(P)$ CS dependences have the form similar to the hardness $H(P)$ of the *LiF* substrate, however, they have higher values compared to the polycrystalline *Cu*.

The values of the plasticity index, H/E , of the CS (Fig. 1b) demonstrate the higher values compared with materials used for the creation of these structures that indicates their higher resistance to plastic deformation.

Keywords: coated systems, nanoindentation. mechanical properties, plasticity index.

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NANOSENSORS BASED ON INDIVIDUAL HIBRID STRUCTURES AND THEIR APPLICATION IN GAS SENSING AT ROOM TEMPERATURE

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Extended Abstract

During the last decades, the progress of bottom-up technologies has emerged in fabrication of high-performance nanodevices based on individual nano- and microstructures [1-3]. A special attention has been paid for metal oxide structures due to their unique structural, chemical and electrical properties [4]. Due to high surface-to-volume ratio of individual nanostructures, the charge transport through the conduction channel is highly influenced by surface phenomena, such as adsorption/desorption of gaseous and biological species [3-5]. This makes them ideal candidates for chemical and biological sensors, even at room temperature [3,5]. Different individual metal oxide nanostructures such as ZnO and CuO were integrated into devices for application in gas sensing using bottom-up technology developed by Lupan *et al.*, which is based on focused ion beam/scanning electron microscopy (FIB/SEM) [3-5]. The further improvement in gas sensing performances of such devices, namely based on ZnO was performed by integration of three-dimensional individual hybrid structures such as Fe₂O₃/ZnO, ZnAl₂O₄/ZnO, carbon nanotubes (CNT)/ZnO and Buckminster fullerene (C₆₀)/ZnO. Herein are summarized the gas sensing properties of the mentioned above individual hybrid structures, showing the possibility of rational change in selectivity from hydrogen gas to volatile organic compounds and ammonia by surface functionalization of ZnO structures using materials with excellent catalytic properties and carbon based nanomaterials with high room temperature selectivity to ammonia.

Keywords: *hybrid materials, nanosensors, gas sensor, ZnO, room temperature.*

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NOTE:

- D. Communications:**
- Technology, Networks & Software for Telecommunications;**
 - Operations, Administration & Maintenance on Electronics and Telecommunications.**

ACTIVE LEARNING OF NETWORKING IN THE GNS3 VIRTUALIZED ENVIRONMENT

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Extended Abstract

The practical activities during networking learning are usually done in the specialized laboratories including computers and special network equipment (cables, switches, routers, etc.). This approach is quite expensive, needs a long time for configuration and maintenance. These activities are usually performed in teams of 3-4 students because it is impossible to provide each of them a real network for experimentation.

An alternative solution may be the use of specialized network simulation software such as ns2, OPNET, OMNeT ++, NetSim, REAL, QualNet [1] or the Cisco Packet Tracer. All these solutions are based on the simulation models that are often far from reality and they don't allow learners to acquire practical skills to work with real networks.

A much more interesting solution concerns the network virtualization techniques using network emulators in order to provide a working environment close to the real one [2]. Network nodes (special equipment, routers, switches, but also workstations and servers) can be also virtualized by using specialized software such as QEMU, VirtualBox and VMware. All they provide a generic platform to install operating systems exactly as we do on real computers. They also offer the possibility to emulate a small internal network on the host machine but don't provide tools for more complex network topologies. The GNS3 network emulator [3,4] offers the possibility to federate most popular platforms for virtualizing operating systems, providing them a tool to define the topology of the network and many other tools like the packet analyzer, some models of network equipment, appliances developed by GNS team and by the community, etc.

The main purpose of this article is to share our experience in the use of GNS3 software for active network learning. GNS3 allows us to use nodes in the network on which real operating systems are installed and between which real data flows. All protocols that are implemented in the operating systems can be emulated under very close conditions to the real ones. It is possible to emulate communication links with losses and with defined parameters which makes it possible to study various advanced domains of networks such as the quality of services (QoS), traffic management, multimedia transmission, network security, etc.

Keywords: *Networking, virtual networks, network emulator, graphical network simulator, active learning*

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ANALYSIS OF THE ENERGY CHARACTERISTICS OF M – QAM SIGNALS AT TURNING OF SIGNAL CONSTELLATIONS

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The paper considers the effect of the rotation of the signal constellation on the energy characteristics (signal to noise ratio) of quadrature multi-point modulation methods. Based on the error vector in the Matlab + Simulink simulation environment, models of M - QAM modulators and demodulators with rotation of the signal constellations at an arbitrary angle are elaborated. The most commonly used in digital data transmission systems modulation: 4-QAM, 16-QAM, 64-QAM and 256-QAM are considered. The simulation results of the proposed models confirmed the coincidence of the values of the rotation angles of the signal constellations recommended by the DVB-T2 standard, and also revealed the new additional values of the angles that can be used to improve the energy characteristics (signal to noise ratio) of multipositional quadrature modulation methods. This, in turn, allows to reduce the power of the transmitting station, creating a system with more economical performances.

Keywords: *error vector, noise immunity, signal constellation, quadrature reception, rotation of the signal constellation.*

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AN ALGORITHM OF EXTENDING EEPROM WRITE CYCLES

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Actually EEPROM is commonly used to store configuration parameters and operating history information in embedded processors. For example, to record the most recent operating data in case there is a system failure or power loss. This sort of things might require recording data every few seconds [1].

The issue here is that EEPROM works for a limited number of write cycles. After from 100,000 to 1,000,000 (depending on particular chip), some of deployed systems will start exhibiting EEPROM wearout and a field failure might be get. A million writes sounds like a lot, but they go by pretty quickly [1].

If certain EEPROM cells are periodically updated a danger of EEPROM wearout arise. Reducing per-cell write frequency (sometimes more than about once per hour) the problem can be solved.

If the set values, recorded in EPROM at power loss forms a 'data frame', abovementioned problem might be solved by organizing a consecutive data frames in EEPROM (named Consecutive FIFO). An additional counter, stored into EEPROM, pinpoint most recent data frame in CFIFO [1].

In [1] Microchip suggests to use Gray code so that only one byte out of a multi-byte counter has to be updated on each count. It is recommended also to use error correcting code to compensate wear-out.

Another idea is to use Hamming code, depend upon whether bit failures are independent within the counter data bytes. Analyzing the Gray code, it was concluded that the number of registrations can increase twice.

These solutions reduces EEPROM wearout proportionally to the number of data frames stored in CFIFO. For example, if 10 spaces for data frames are used to record data, each frame space is modified 1/10th times and EEPROM wearout is improved by a factor of 10, but wearout of EEPROM .

The authors of article propose an algorithm to avoid frequent storing of pinpoint counter in EEPROM, even more extending its write cycles. The idea is to use one bit of 'data frame' to pinpoint the last written cell in EEPROM.

Keywords: *EEPROM, divide et impera, bit, data, wearout*

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ELABORATION OF A HIGH-SPEED MICROPROCESSOR RELAY PROTECTION DEVICE

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Microprocessor relay protection devices (MP RPD) are an integral part of the automated control system (SCADA) of the electrical part of energy networks and systems, because they provide a high degree of informatization of electric power processes. MP RPD are intelligent systems with the ability to be improved by changing software and using more advanced principles and algorithms for the protection. Such algorithms are signal filtering algorithms that are difficult to implement due to the large volume of operations for processing the input signal.

An effective algorithm for extracting symmetrical components for MP RPD was developed. The filtration of symmetrical components is based on well-known relationships, which are generally presented as follows:

$$3\bar{A}0 = \bar{A} + \bar{B} + \bar{C}, \quad 3\bar{A}1 = \bar{A} + \underline{a}\bar{B} + \underline{a}^*\bar{C}, \quad 3\bar{A}2 = \bar{A} + \underline{a}\bar{B} + \underline{a}^*\bar{C}, \quad (1)$$

where \underline{a} is a phase operator; A, B, C is a 3-phase system of values of currents and voltages; A0, A1 and A2 are zero, forward and reverse sequences.

The existing relay protection and automation equipment mainly analyze only currents and voltages of the zero sequence A0, while more than 50% of the accidents occur during 2 and 3 phase failures, which require analysis of the values of currents and voltages of the negative sequence A2 [2].

Therefore, the urgent task is to develop effective algorithms for calculating A2, providing high speed and accuracy when using industrial microcontrollers. For A2 calculations, it is proposed the following expression:

$$3X2i = 3 * (Xci - Xbi) + Xa(i-30^\circ) + Xb(i-30^\circ) - 2 * Xc(i-30^\circ), \quad (2)$$

where Xci , Xbi is the instantaneous value of the current (voltage) of phase c and phase b ;

$Xa(i-30^\circ)$, $Xb(i-30^\circ)$, $Xc(i-30^\circ)$ - instantaneous value of current (voltage) of phase a, b, c of 1/12 of the period back;

The proposed algorithm for A2 calculating was implemented in MP RZA LIRA (Local measuring and recording device). The following results were obtained: the error in measuring of currents and voltages amplitudes of zero A0 and inverse sequences of A2 was no more than 2%, speed - not less than 0.8 ms, that shows the effectiveness of the proposed algorithm. The pilot operation at MOLDELECTRICA confirmed the efficiency of the use of the developed devices.

Keywords: *high speed algorithm, microprocessor, relay protection, symmetric digital filters.*

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DISTURBANCE STABILITY IMPROVEMENT OF THE DEVICE FOR DETECTING DEFECTS OF ELECTRIC CABLE

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When carrying out preventive maintenance and repair, it is necessary to localize and identify defects in power cables under conditions of an increased level of industrial interference.

Most of the known devices for localization and detection of defects in electric cables are vulnerable to such interference, which limits their effectiveness and application area. In the proposed device, methods of increasing noise immunity in the electrical tract of the receiving part are considered. The localization of the cable and the identification of the location of the defect in the cable in most known devices is based on a comparative analysis of the level of intensity of the electric field emitted by the cable under voltage [1], less often by the level of electromagnetic radiation. When determining the location of the cable in a concrete wall and the simultaneous influence of interference, for example from switching power supplies, the accuracy of determining the location of the electric cable decreases.

In this paper, it is proposed to reduce the level of emitted harmonics of the transmitter of the device by means of a filter between the output stage of the radio frequency and the connector for the antenna [2]. In the receiving part of the device, it was proposed to change the input selective circuit in order to increase the selectivity of obtaining a narrower radiation pattern of its antenna [3]. In addition, in the electrical tract of the receiver is proposed to use a noise-resistant detector to improve the signal-to-noise ratio [4].

Keywords: *transmitter, receiver, electric cable, defects, electromagnetic interference, radiation pattern.*

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ELABORATION OF A TRAINING SYSTEM AND ALGORITHM TO IMPROVE BATTERIES PERFORMANCE

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In the process of battery operation, an important factor is the identity of the individual elements characteristics, on which the lifetime of the entire battery depends. In charge-discharge cycles, an element with worse characteristics leads to a deviation of the charge parameters of the entire battery, as a rule it does not receive a full charge. Most well known battery training systems control a limited list of parameters, such as charge current, initial and final voltage, and electrolyte temperature. Automatic control of the density of the electrolyte and the moment of gas evolution is quite difficult to perform; they are performed manually by the operator or are excluded for non-served batteries.

The elaborated system allows to perform individual training for each element (cell) of the battery with the ability to monitor and remote control. The individual setting of the charge-discharge parameters of each battery element (cell) provides a minimum deviation in characteristics, which extends the battery life up to 50% additionally. This system permits to train rechargeable batteries with up to 50 cells and more connected in series, which allows it to be used for autonomous electric transport: electric forklift, electric bus, trolley with autonomous travel, wheelchair with electric drive, etc. Monitoring the density of the electrolyte and the moment of gas evolution in the system allows to obtain more accurate characteristics data, on the basis of which an updated training mode of the battery cells is set. The hardware of the system allows you to provide the whole set of battery training algorithms: a fixed charge current, a multistage change in the charge current, reverse charge current, etc. with simultaneous monitoring of the regime.

Keywords: *battery, charge current, discharge current, electrolysis, discharge-charge cycle, battery capacity.*

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PARTICULARITIES OF THE IMPLEMENTATION OF TERRESTRIAL DIGITAL TELEVISION IN THE REPUBLIC OF MOLDOVA

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In accordance with the provisions of the Regional Agreement on the Planning of Digital Broadcasting Services (ITU-R Conference, Geneva, 2006), starting from 17 June 2015, the Republic of Moldova assumed the obligation to introduce digital terrestrial broadcasting systems. This article provides a brief overview of the stages of the introduction of digital terrestrial broadcasting in the Republic of Moldova [2,3]. In 2003 S.E. "Radiocomunicatii" has put into operation the first H.262 type coding station, which together with the DVB-T system has provided digital terrestrial television services in Chisinau for 8 years. At the beginning of 2011, H.264 type encoders were put into operation, which are still in operation, providing with signal Chisinau municipality and at the same time the first national digital television multiplex. Therefore, starting with the year 2003 in Chisinau the works were started to implement the pilot project for digital terrestrial emission. Currently, in Chisinau, in test mode, 2 digital DVB-T and DVB-T2 [1] transmitters operate, which broadcast digital packages with TV and RD programs on channels 56 and 58 accordingly. In 2015 Î.S. "Radiocomunicatii" built the first national multiplex MUX-A, which later in 2016 was put into operation, based on the H.264 AVC / MPEG-4 coding system. The mentioned multiplex provides with the DVB-T2 signal 6 national coverage areas located throughout the country. The transmitters in the component of each zone operate with a single frequency. Currently, television broadcasting is in Simulcast mode, when both analog and digital transmitters are working at the same time. As of September 1, 2019, 98% of the country's population has access to the DVB-T2 signal. By March 1, 2020, when it is planned to completely turn off analog television, the coverage of the population with a digital television signal by this time will be 99%. To do this, it is planned to install about 60 transmitters of low power in the shadow zones.

Keywords: *Service zone; DVB-T2; SISO; SFN; MER; CBER, LBER, T2 Gateway, Guard Interval, T2-MI interface.*

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ESTIMATION OF PARAMETERS OF A RECEIVED SIGNAL IN A SINGLE-FREQUENCY NETWORK DVB-T2

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The second-generation digital terrestrial television broadcasting system DVB-T2 [1] provides greater flexibility and spectral efficiency of the system compared to its predecessor DVB-T, and is most focused on the deployment of single-frequency networks SFN (Single Frequency Network) [2]. Important advantages of the SFN cluster are such as efficient use of the allocated radio frequency spectrum, the ability to receive a signal from an alternative direction, reducing the area of shadow zones, etc. However, in the service area of the SFN cluster, mutual interference of the signals transmitted in the combined frequency channel of the group of transmitters occurs. The aim of this study is to evaluate the effect of frequency selective fading of the total signal at the input of the DVB-T2 receiver on the quality of the received signal. This article provides a brief description of the architectural model of the SFN DVB-T2 cluster [1,3,4,5]. In the practical part of the study, an assessment was made of the quality indicators of the received signal in a SFN DVB-T2. In order to fulfill the research task, in laboratory conditions, was mounted a circuit simulating the operation of the SFN cluster. Applying two signals simultaneously to the input of the measuring device made it possible to identify how the qualitative parameters of the DVB-T2 received signal change, depending on the difference in levels and time delays of the signal at the input of the measuring device. As a result of the analysis of the obtained measurement results [6], conclusions are drawn regarding methods for assessing the quality of the received signal in single-frequency digital terrestrial broadcasting networks.

Keywords: *Service zone; DVB-T2; SISO; SFN; MER; CBER, LBER, T2 Gateway, Guard Interval, T2-MI interface.*

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- E. Research and Education for knowledge - based Society:**
- Education methods based on ICT;**
 - e-Government and Society;**
 - Open data.**

THE PBL MODEL IMPLEMENTATION WITHIN THE SOFTWARE ENGINEERING STUDY PROGRAM

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PBL (Problem Based Learning) is the learning philosophy that involves students in finding problems and identifying solutions to overcome them. There is no one PBL model suitable for all purposes. However, the PBL-based models are mainly substantiated on two key assumptions. The first hypothesis is that work on the project is in the *center*, and consists of the problem discovery and analysis, problem solving and project report. The second hypothesis is that other teaching and learning (face-to-face) activities, such as literature, lectures, group studies, and tutorials, are designed to *support* work on the project.

The above-mentioned aspects lie the basis of the PBL model development used in the Software Engineering Program Study, inspired from Illiris, Knud [1] (Figure 1). The given model involves problem solving through the implementation of interdisciplinary projects, with the introduction of the research aspects, where the process of education and assimilation of knowledge is accomplished in parallel through the process of teaching the course hours and assigning group or individual tasks contributing to developing student creativity.

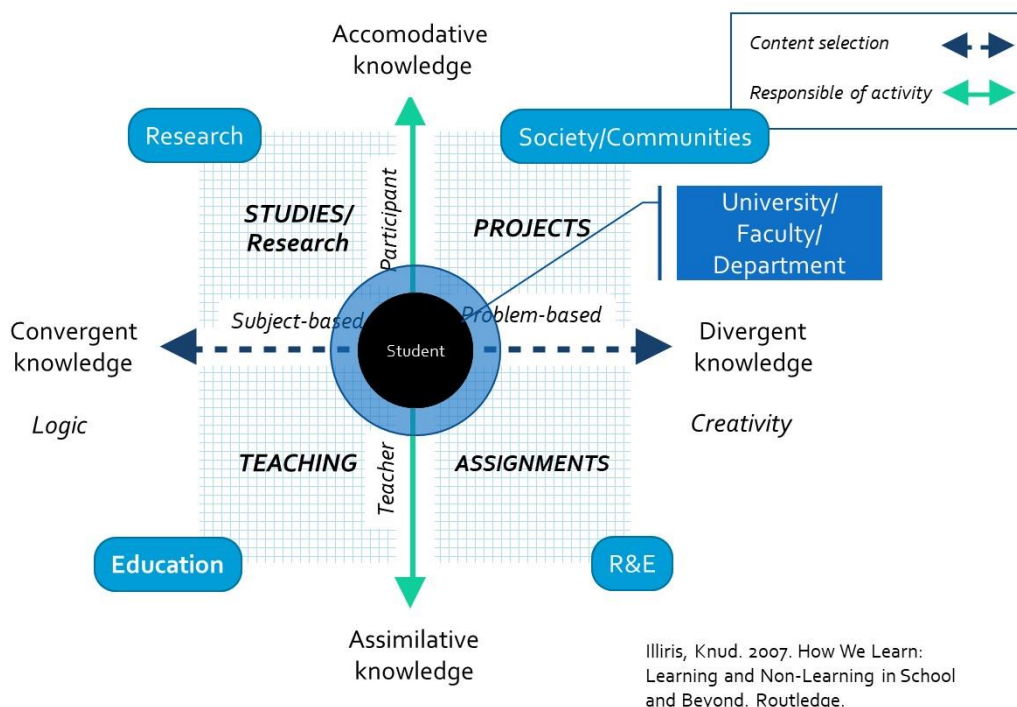


Fig. 1. The PBL model implemented within the Software Engineering Study Program.

Keywords: Problem Based Learning, project, Software Engineering Program Study.

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THE BENEFICIAL EFFECTS OF E-GOVERNANCE FOR MOLDOVAN SOCIETY

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The changes that take place in the information society determine the consolidation of a new type of social relations and also of a new legal framework that is regulating the interaction between citizens and their representatives. As the relations between the Government, the civil society and the business adapt to the information society, the establishment and consolidation of the electronic democracy takes place. E-governance is a basic component of the information society and constitutes a complex system of informational governance assurance through the application of information and communication technologies. Consequently, e-government becomes a social and economic necessity by the beneficial effects it brings, directly and indirectly, to the whole society.

The article proves the necessity of the e-governance implementation in modern society, it describes what are the main beneficial effects of e-Governance in Moldova and which are the obstacles that are met. It also emphasizes the most important objectives that were achieved by e-Government Center under the Government of the Republic of Moldova.

Starting with 2010, the Government of the Republic of Moldova has committed itself to the e-transformation process, aiming to make the government more efficient by using information technology intensively. To this end, in August 2010, the State Chancellery established the e-Government Center of the public entity - which aims to modernize the public services in order to bring the Government closer to the Moldovan citizens. Since 2011, Moldova e-Government Center has successfully implemented lots of digital transformation projects, building a sustainable platform for the further modernization of public services and other governance related innovations.

Due to e-governance the public sector will cease to be a fragmented one, the government agencies acting more coherently, changing the way of providing services - from traditional to modern methods, involving the use of information technologies. Citizens and business will be able to benefit from lower costs for information and services, which will become more accessible, integrated, inclusive and customer-oriented. Online participation in government will become a norm for citizens, who will benefit, at the same time, from an advanced level of information education and extended access to state services. In addition, governance processes will be more transparent, impartial and more efficient.

In conclusion, the implementation of electronic governance in the Republic of Moldova created a favorable environment for the transition to the information society. E-government allows citizens easy and fast access to public services and government data, in electronic format, thus eliminating the bureaucracy encountered in this type of relationship and, in addition, ensuring transparency, quality and trust. It is also an instrument that contributes to the consolidation of relations between citizens and public authorities, based on mutual respect and interested cooperation between the state and citizens. As a result, our country will be able to fortify its position among European countries with a high level of use of new technologies.

Keywords: *e-governance, communication networks, information society, e-services, benefit.*

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COMPUTER ETHICS – PROBLEMS AND SOLUTIONS

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In the last decades of the 20th century, since computer technologies have become part of many aspects of daily life, in the specialized literature more and more insistent were promoted the ideas, which supported the existence of all the grounds for constituting *computer ethics*, as a field attributed to applied ethics. Like other "exponents" of the ethical domain - bioethics, ecological ethics, engineering ethics - computer ethics focuses on the issues regarding behavior and moral choice, generated by the intensive development of science, technology and economics.

It is known that the first attempts of computer ethics as an intellectual direction were constituted in relation to the problem of creating and using computer systems. From the very beginning, attention was drawn to the fact that many of the problems of computer technology development, usually perceived as technical, mathematical or epistemological problems, are essentially ethical in nature.

The approval of the philosophical component in computer ethics was warned by the publication of a special edition of the American magazine "Metaphilosophy", where the articles of such specialists in the field as J. Moor, W. Bethel, D. Lioid and J. Snapper were published (1). Thus, computer ethics is seen as a dynamic and multi-level field of research which studies the facts, the conceptualization methods, the conduct limits and values, related to the ever changing computer technology. The mentioned issue is determined by the final purpose of the ethical-computer research - the elaboration of the human's code of conduct in relation to the technology.

The widening of the circle of unprofessional users and the development of networks led to the fact that new types of *subjects* appeared in the field of computer ethics. The tendency to "diversify the subject" finds its demonstration, in particular, by publishing in 2005 the anthology "*Computers, ethics and social values*" (2). In this book there is a special chapter dedicated to social networks, as well as a series of articles that are focused on analyzing the behavior of *hackers*. Now, in the field of computer ethics, are also included the ethics of e-mail communication, the problems of access to pornography, the rules of conduct on online forums and chats, the problems of the quality of websites' content and much more.

In present, the tendency to consider computer ethics as part of a broader direction, namely, *information ethics*, has been quite clear. In information ethics, as a field of applied ethics, a particular attention is given to the problem that addresses the creation, control and use of information. All of these legitimately lead to the study of the phenomenon of online social network communication, information ownership and access to intellectual property.

Thus, the establishment of such a direction as computer ethics is full of learning, in addition to all the others, it demonstrates the dependence of the humanist approaches to global technologies, not only on the level of development and spread of these technologies, but also on professional traditions, from the cultural and social context.

Keywords: *computer ethics, information quality, anonymity, programmer, user.*

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MENTORING ENGINEERING STUDENTS

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Extended Abstract

Today successful teaching is not about holding and sending information to students, neither is efficient learning about passively processing and memorizing significant amounts of text in order to get higher test scores.

The 21st century is full of supportive resources; this is the reason why the teaching-learning process should be addressed differently. The instructors know already how to combine the technology, pedagogy, and content to create meaningful learning opportunities for all students, but still, this is not enough.

In this context it becomes an imperative to the teacher's practice to expand his activity by taking over the role of *mentor*, an activity that involves more than the previous ones.

The first year at university is considered to be quite difficult for the students in terms of adapting to a new environment, new rules, new colleagues and new academic staff. This is a crucial moment when students need someone to be taken care of, they need mentors' help, highly empathetic people who will guide and support them along this new beginning.

Mentoring is a two-way process of learning. It is defined as a relationship between an experienced and a less experienced individual, where the mentor provides guidance, direction, advice, support, help and constructive feedback to his students.

Nowadays, the idea of mentoring has discovered application in basically every dimension of life. According to Morris Zelditch, "Mentors are:

- *advisors*, people with career experience willing to share their knowledge;
- *supporters*, people who give emotional and moral encouragement;
- *tutors*, people who give specific feedback on one's performance;
- *masters*, in the sense of employers to who one is apprenticed;
- *sponsors*, sources of information about and aid in obtaining opportunities;
- *models of identity*, of the kind of person one should be to be an academic."

The paper clarifies to what extent the teacher in higher education is able to take on any of the roles above. The article considers the ways academic staff can perform the roles of a mentor, guide and facilitator of the learning process in collaborative learning. It also explores and analyzes how the impact of *mentors* on engineering students can influence their personal and professional development.

Keywords: *mentoring, personal and professional development, empathy, guidance, collaborative learning.*

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THE ROLE OF HUMANITARIAN DISCIPLINES FOR ENGINEERS

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The mission of the university, in the Knowledge Society, is to produce, capitalize and transmit knowledge in order to adapt to the current demands and challenges of the society, but also to establish the competences necessary to determine the performance, promoting quality.

Education plays a vital role in creating the premises for sustainable human development and building a knowledge-based society.

In this regard, both Dorogan V., and Todos P. consider that the supreme obligation of the society towards young people is to ensure an education adequate to the rigors of time [2, p.11].

If we were to mention just a few of them, then these are:

- “Our era is one of post-indebtedness, in which people recognize the need for a minimum ethic, a weak debt, and liberal, pluralistic norms that make the existence of post-modern society possible [3, p.97].

- The problems of the contemporary world [4, pp.9-11] show that due to the technique or how it is used, self-destruction, ethics, moral behavior (respectively) is an obvious necessity. The 21st century will be moral / ethical or it will not be at all [attachment 5, p .4.; clause 3, p.97], or the fact that we will not survive as a civilization.

Ethical behavior, philosophical thinking expressed in communication has become an incisive and universal requirement for the survival of mankind. If we admit that the world we live in has a political problem, an ecological problem, or a world security problem, etc., we can conclude - the solution of all these problems depends on how the moral problem, perceived and resolved intensely by philosophies, is solved. The mode of communication and argumentation, thanks to competition in the labor market, shows that the specialist can be very good in his field, but if he cannot communicate eloquently, does not argue, he will not be able to sell his/her product or services, he/she will have difficulties in relationship etc;

In conclusion, both the big and the small problems compulsorily demand the recourse to ethics and morals, a fact promoted by the EU Council since 1999 [1, p.4]. Due to artificial intelligence, to be successful, the engineer needs to have skills such as: emotional intelligence and social intelligence. The arguments presented above prove that through the disciplined Ethics, the Basics of communication, Philosophy is educated to the future specialist, that science, the development of technique, etc. are for man - universal paradigm and not vice versa.

Keywords: *ethics, emotional intelligence, artificial intelligence.*

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THE THEORY OF INVENTIVE PROBLEM SOLVING

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A modern engineer should have a fairly serious set of system competencies. Today, in the qualification of an engineer, knowledge and skills in ensuring the relations of production with the market are valued, in the future such a specialist will be helpless without knowledge of the methods of analysis and forecasting of the situation that become the most important component of the training of an engineer of the 21st century. TRIZ provides a tool to help you successfully cope with both practical and theoretical problems from the most diverse areas of human knowledge. TRIZ is not only a tool that allows an engineer, inventor to predict a problem situation and purposefully search for an optimal solution to a problem, it is also a tool for subtle, bold, highly organized mental operations.

The theory of inventive problem solving, (TRIZ), is a set of methods for solving technical problems and improving technical systems. TRIZ is a science that allows not only to identify and solve creative problems in any field of knowledge, but also to develop creative (inventive) thinking, to develop the qualities of a creative person. TRIZ is a unique tool for: search for non-trivial ideas; identifying and solving many creative problems; selection of promising areas for the development of equipment, technology and cost reduction for their development and production; development of creative thinking; the formation of a creative personality and teams.

TRIZ methods. In the process of solving TRIZ problems, several approaches are used at once: brainstorming method; synectics (comparison and finding similarities in objects and phenomena); morphological analysis (identification of all possible solutions); the method of focal objects (establishing associative relations with various objects).

TRIZ has two goals: 1) training a new technology for solving inventive problems; 2) the education of the qualities inherent in a creative person. The goal of TRIZ is the development of flexible thinking and imagination, the ability to solve complex problems in elegant and effective ways. Psychologists have made great efforts to analyze the quality that is called the need for creativity or ingenuity. It is believed that the ability to invent, in turn, depends on: heredity; environment; previously obtained overall development; level of scientific and technical training. Psychologists conducted a variety of studies in order to determine the most characteristic features of the inventors. As a result, the following patterns were established: 1. The ability to boldly choose a Worthy Goal (even if it is considered completely unrealistic) and make it the main vector of your life; 2. The ability to see problems whose solution is necessary and sufficient to achieve a Worthy Goal; 3. The presence of a set of real work plans. Availability of a package of work plans for a month, for a year, for a lifetime. Regular monitoring of the implementation of these plans; 4. High performance. (in the implementation of plans); 5. A good technique for solving creative problems that are part of the problem; 6. The ability in all circumstances to uphold one's ideas and developments; ability to "hold a punch".

To educate these qualities is much more difficult than to teach creative solutions. TRIZ is a tactic of creativity. Nurturing a set of six qualities is an operational art. We also need a creative strategy for life. If we want to learn TRIZ well, if we want to get maximum results from training, we need to cultivate a set of creative qualities. If we want to conduct it effectively - must in turn be based on a life-long creative strategy.

Keywords: *TRIZ, technical problems, creative thinking, creative person.*

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INFORMATION TECHNOLOGIES AS A MEANS OF ACTIVATING THE TRAINING ACTIVITY

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New information technology in education is a pedagogical technology that uses special means of programming and technical (film, audio, video means, computers and networks) telecommunications) for information activity.

Analysis of the problem researched on the application of information technologies in education (informational education at the modern stage allowed to deduce the following):

- one of the main problems of the education system is the formation of a creative active personality, which is possible by activating the cognitive activity by studying the psychological and pedagogical disciplines;
- the period of fundamental changes in which the educational system has passed in our country is characterized by a new understanding of the objectives and values of education, the awareness of the necessity of passing on to continuous training, the new conceptual attitudes in the development and use of the training technologies, etc.
- the development of the modern education system is characterized by the transition to continuous training, the necessity of which is conditioned by the fact that the pace of innovation of technology and technology considerably exceeded the pace of change of human generations;
- the process of forming the information society is carried out in the computerization account, the part of which is the computerization of education;
- under the action of information technologies, new objectives, principles, training methods are developed;
- information technologies allow for a new level, an achievement of the important objective of training-the creation of man;
- unlike traditional education, where the main figure is the teacher, the center of gravity in the use of new information technologies gradually translates into the student, who actively builds his training process, forming a certain trajectory in the developed educational environment;
- modern person-oriented learning is only possible under the conditions of joint work of the teacher with the student in the use of information technologies.

Key words: *information technologies, computer, informational training, electronic manual.*

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VIRTUAL CLASSROOM IN THE DIGITAL AGE: CONCEPT, PRODUCT AND APPLICABILITY

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Given paper presents itself as a descriptive ascertaining study that comes with the analysis of the phenomenon of virtual classrooms' using at the different educational levels and / or in the different educational situations in the digital age, characterized by the migration of the implementation of certain ICT instruments, which have already become traditional, to the so-called online learning platforms of various types and configurations.

The research is carried out on several dimensions, in particular, conceptual, but also application-functional, reviewing several platforms dedicated to virtual learning. The comparative analysis of the set of tools offered by various virtual classroom platforms comes with a description of its special operating characteristics which depends on the typology of the teaching activities to be implemented in the online environment, in the during the of direct and indirect hours of contact with the contingent of students enrolled in a virtual course.

Although, in this article, the model of using virtual platforms for learning management system will be focused on professionalization courses, correlated with computer science in the field of IT engineering training and/or others related to it, the general methodology for implementing the virtual classes will be presented here according to the age, the curricular area of the taught-learned-evaluated disciplines and the level of studies of the potential beneficiaries.

There is presents, also, the author's personal experience in practicing the use of virtual classes in the didactic approach of certain university disciplines in the article. The author makes a comparison of her particular practice with some local and international experiences of transposing the teaching-learning activities in the virtual environment, through the tools of the reviewed applications.

Keywords: *Digital Skills, Educational Software, Web-Based.*

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Poster Presentation

ACCELERATED VECTOR ANIMATION SOFTWARE

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This article describes a newly created desktop application - AVAS, designed to work with animated vector graphics.

AVAS (*Accelerated Vector Animation Software*) is a system for creation of the 2d digital animation. The system is primarily oriented towards creating traditional frame-by-frame animation, where animators usually draw separate frames that make up the entire movement, changing one by one with a delay of 1/24 seconds or more, if the animator decides so.

The main purpose of this software is to achieve the most efficient way to create images using a variety of tools for manipulation with the vector graphic elements.

The software was developed in Visual Studio environment, programming language being C#.

AVAS requires a computer or laptop working with a connected digital graphics tablet, although certain functions such as color fill in separate areas can be performed with mouse.

The unique features of this application compared to other existing software include cost-effective enhancements to animation production, such as curvature blending, auto shading, multi-frame color filling and more, in addition to standard animation software features such as the toolbar, canvas and timeline.

Keywords: 2d-animation, software, vector, graphics, editor.

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PROGRAMMING THE NAO ROBOT FOR HUMAN INTERACTION

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Humanoid robotics is an emerging and challenging research field, which has received significant attention during the past years and will continue to play a central role in robotics research and in many applications of the 21st century. Designed to entertain and interact with humans, Nao is one of the most common robotic platforms used in research and education today. This project consists in the implementation of 2 software applications for the Aldebaran Robotics NAO Humanoid Robot, in order to increase the robot's agility and mobility, and expand its human interaction possibilities. The paper has two parts, the description of the application that allows the user to control the robot's movement from a remote computer using a keyboard and image processing for an application that enables the robot to engage in a "Tic-Tac-Toe" game with the user. The two key development environments that are used are the NAOqi framework and its APIs (mainly ALMotion, ALMemory, ALRobotPosture, ALSonar modules) and OpenCV. The project was completed with the Java language under Windows 10 operating system and a 5th generation NAO robot with an NAOqi 2.1 operating system.

Keywords: *NAO robot, image processing, human-robot interaction, navigation.*

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MODELING OF SENSOR NETWORKS WITH LIMITED ACCESS TO THE COMMUNICATION RESOURCES

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The technological development, in the last years, ensures the design and implementation process of sensor networks for different fields of the economy [1] with hardware devices and software solutions. Nowadays, it's impossible to imagine the activity of different companies, which don't have, information, decision-making and automatization systems based on sensor networks. A particular case of the sensor networks application is the Multi-Agent systems which are made up of hundreds and thousands of devices for data acquisition, storage and processing. One of the fundamental problems of these systems is the efficient organization of the information exchange process which will be able to ensure the functionality and the correctness of the taken decisions.

In this paper are presented some results obtained in modeling the sensor networks with limited access to communication resources, especially oriented for Multi-Agent systems.

The sensor network model $SNM = \{SN, CH, T\}$ presents a set of interconnected objects that repeat the network topology, where: $SN = \{SN_i, \forall i = \overline{1, I}\}$ - set of Objects – nodes, of the sensor network, with functions of the acquisition, processing, storage and communication modeling in the network; $CH = \{CH_j, \forall j = \overline{1, J}\}$ - set of communication Objects – channels destined to model the access and delays generated by the communication resources; $L = \{L_{i,j}, \forall i = \overline{1, I}, j = \overline{1, J}\}$ - the set of connections between the Objects – nodes of the sensor network SN and communication Objects-channels CH .

Objects – nodes SN are defined by the multitude of variables and relations between them: $SN_i = \{P(t, a_i), RAM[1...N_i], P(t, C_i), CT_T, CT_R, CT_L\}$, where: $P(t, a_i)$ - the probability of data acquisition from the sensor i , in the time interval t ; $RAM[1...N_i]$ - stack memory for data storage, of N_i variable size; $P(t, C_i)$ - probability (algorithmic complexity) of data processing in time t , where $P(t, a_i) \xrightarrow{P(t, C_i)} RAM[1...N_i]$; CT_T - call counting of data transmission in the network; CT_R - call counting of the successful data reception in network; CT_L - counting of missed calls of data in the network.

Keywords: *Sensor Networks; Modeling of Systems; Communications Resources; Limited Access; Object Model.*

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MONITORING OF RIVER-TYPE AQUATIC ECOSYSTEMS FOR FORECASTING THE POLLUTANT SPREADING PROCESS

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The given work is dedicated to the development of a system for real-time monitoring of river-type aquatic ecosystems. The developed system can be applied to forecast the dispersion of pollutants on the surface and on the river banks [1]. The monitoring system presents a network of mobile sensors, which are located on the surface of the river water, moving along its course, carrying out operations of occurrence of pollutants in water, data processing and storage. When approaching the reference stations (Access Points) the mobile sensors transmit the data accumulated on a server for their centralized storage, processing and analysis.

For modeling the process of pollutants' spread, in the paper work, the aquatic ecosystem of river type, is defined as a dynamic process $P \in R^4$, where $R^4 = \{x, y, z, t\}$ is a system of space-time coordinates [2]. The surface of the water is defined as a set of discrete nodes in which the respective calculations are performed. The mathematical models of interpolation or extrapolation are applied to calculate the intermediate values between the nodes.

If in the process of the evolution of the aquatic ecosystem is satisfied the condition:

$$\frac{dx}{dt} + \frac{dy}{dt} + \frac{dz}{dt} \neq 0,$$

then the dynamic of pollutants' spread is defined by the expression:

$$\sqrt{\left(\frac{\partial p}{\partial x}\right)^2 + \left(\frac{\partial p}{\partial y}\right)^2 + \left(\frac{\partial p}{\partial z}\right)^2} = \frac{dp}{dt}$$

The ratio $\frac{d^2 p}{dt^2}$ allows to calculate the amount of pollutants that have been dispersed on the surface and on the river banks.

The method of monitoring the aquatic ecosystems, presented in the paper work, allows locating in space and time the source of pollution in the coordinate system $\{x, y, z, t\}$ and the amount of pollutants dispersed on the surface and on the river banks.

Keywords: *monitoring systems; aquatic ecosystems; transport of pollutants; distributed nodes; interpolation; extrapolation.*

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PARALLEL COMPUTING FOR MULTI-DIMENSIONAL SIGNALS ACQUISITION AND PROCESSING

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This paper presents the design and research results of the digital systems with parallel computing for the acquisition and processing of multi-dimensional signals. The obtained results can be applied to solve the problem of parametric and functional testing of Printed Circuit Board (PCB), in which concurrent processes are specific for real-time data acquisition and processing [1,2,3].

For this aim, the Printed Circuit Board (PCB) is defined based on a two-dimensional space with: a set of nodes for the test signals generating $U^{In} = \{u_i^{In}, \forall i = \overline{1, N}\}$ and a set of nodes for acquisition of state signals $U^{Out} = \{u_j^{Out}, \forall j = \overline{1, K}\}$.

The state signals acquisition is performed by approximating them by applying the Fuzzy logic method determined by the equation $Y_{j,l} = \begin{cases} 1 & |A_l \dot{u}_j^{Out} \in \Delta u_l, \\ 0 & |A_l \dot{u}_j^{Out} \notin \Delta u_l \end{cases}, \forall l = \overline{1, L}$, where L is the number of bits for the speed approximating of the input signal increase.

Parametric and functional analysis of Printed Circuit Board is performed based on mathematical models [2,3]:

$$F\left(\frac{U^{Out}}{U^{In}}\right) = \begin{bmatrix} \frac{\partial u_1^{Out}}{\partial u_1^{In}} & \dots & \frac{\partial u_K^{Out}}{\partial u_1^{In}} \\ \dots & \dots & \dots \\ \frac{\partial u_1^{Out}}{\partial u_N^{In}} & \dots & \frac{\partial u_K^{Out}}{\partial u_N^{In}} \end{bmatrix} \text{ and } F\left(\frac{U^{Out}}{U^{Out}}\right) = \begin{bmatrix} \frac{\partial u_1^{Out}}{\partial u_1^{Out}} & \dots & \frac{\partial u_K^{Out}}{\partial u_1^{Out}} \\ \dots & \dots & \dots \\ \frac{\partial u_1^{Out}}{\partial u_K^{Out}} & \dots & \frac{\partial u_K^{Out}}{\partial u_K^{Out}} \end{bmatrix}, \forall i = \overline{1, N}, j = \overline{1, K}$$

Keywords: *Parallel computing; Data acquisition and processing; Multi-dimensional signals; Printed Circuit Boards.*

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COGNITIVE COMPUTING SYSTEM BASED ON DISTRIBUTED KNOWLEDGE

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In the current paper the results of research and development of a computational system with cognitive properties based on inhomogeneous knowledge distributed by a set of Intelligent Agents are presented [1, 2, 4]. The Multi-Agent system represents a network with the Mesh topology in which each Agent $A_i, \forall i = \overline{1, I}$ is defined by: the initial state $X_i(t_0)$, where $X \in \mathbf{R}^N$; a strategy S_i , or a set of data processing rules for system evolution; and a target $X_i^{opt}(T)$, which also determines the purpose of the Multi-Agent system evolution.

An Agent is defined as a computing structure with Wireless communication properties that manages two data structures: the knowledge storage model and the knowledge search model [3, 4]:

The knowledge storage model of an Agent presents a data structure in XML that includes: Agent's name $A_i, \forall i = \overline{1, I}$; keyword list (target goal) $X_i^{opt}(T)$; and the list of knowledge (the status of the Agent $X_i(t)$), where $t_0 \leq t \leq T$:

The knowledge search model presents a data structure in the XML that includes: Agent name $A_i, \forall i = \overline{1, I}$; list of keywords $X_i^{opt}(T)$; and the list of rules for data processing (S_i strategy), for searching the knowledge, in order to reach the target objective $X_i^{opt}(T)$.

The evolution of the Multi-Agent system over time is determined by the expression:

$$X(t_0) \xrightarrow{S} X(t_1) \xrightarrow{S} X(t_2) \cdots \xrightarrow{S} X^{opt}(T) .$$

Keywords: *Multi-Agent system; cognitive computing; distributed knowledge; initial state; strategy; target goal.*

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DEVELOPED AND IMPLEMENTED THE PROGRAMMER FOR AVR AND PIC MICROCONTROLLERS, BASED ON PIC32MX MICROCONTROLLER THROUGH SPI + DMA

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The purpose of this study is to develop an embedded system, that will have the role of programmer for different microcontrollers from the AVR and PIC family. Two methods of implementing this system have been chosen. The first method aims to read data from an SD Card using the PIC32MX controller and further processing the data at the highest possible speeds using the DMA + SPI module of the microcontroller. The second method aims the source code from the computer via the USB to SPI FT4222H (Master SPI) controller to the PIC32MX microcontroller (SPI slave), which has the role of simulating the reprogramming process. The basic criterion for choosing the type of system is the stability and correctness of the data transmitted at the high speed, such as 5-6Mbit/s, namely for the aforementioned hardware equipment. In order to simulate the sending of the reprogramming code it was necessary to create an automated software system that consist of the receiving and consuming buffers, this software simulate the process of receiving and loading the code on the desired microcontroller. To increase data processing speed and release CPU resources, we used Direct Memory Access (DMA) mode. The Direct Memory Access (DMA) controller is a bus master module that is useful for data transfers between different peripherals without intervention from the CPU. The source and destination of a DMA transfer can be any of the memory-mapped modules included in the PIC32 family of devices. For example, memory, or one of the Peripheral Bus (PB) devices such as the SPI or UART, among others.

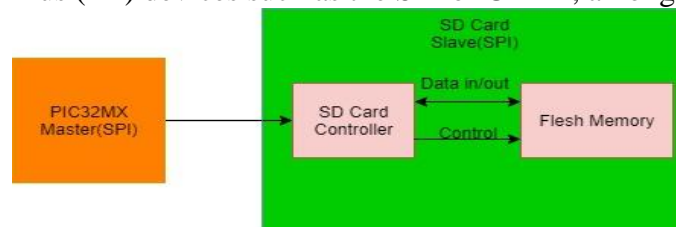


Fig. 1. Block diagram of the system (SD_CARD).

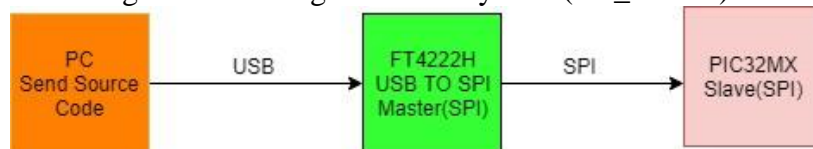


Fig. 2. Block diagram of the system (USB to SPI).

Keywords: *Programmer, DMA, PIC32MX, SPI+DMA, SD Card with PIC32MX.*

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HARDWARE-SOFTWARE COMPLEX FOR DEFINING THE CRITICAL FLICKER FUSION FREQUENCY (CFSM) USING RASPBERRY PI

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In this work, it is considered a device for determining the critical fusion frequency of light flickers (CFSM), implemented using a single-board computer Raspberry PI. CFSM is a function of light and distinctive sensitivity of the eye, which characterizes the functional mobility of the visual analyzer.

There are numerous ways to measure CFSM.

The proposed device can carry out almost all methods for determining the critical frequency described in [8].

Keywords: *CFSM, Raspberry PI, study of the visual analyzer, devices for assessing human fatigue.*

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ADAPTIVE COMPUTING ARCHITECTURES FOR REAL-TIME APPLICATIONS

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Computing systems, which are based only on the technological concept, have already entered in a development deadlock. An alternative development direction of the computing systems is offered by the adaptive computing architectures application, which are able to self-adaptive, for solving each problem separately, implying for it an optimal configuration of Hardware devices and Software applications as price and time.

An important direction today is the development of computing systems for real-time applications [1,2], where the time constraints require some performance criteria for Hardware devices and Software applications involving processing of large volumes of data stored on decentralized resources (like Cloud Computing). These problems are specific for embedded systems and IoT, that are based on computing systems with limited resources, access to communication media and simplified algorithms of data processing.

In this paper is described the problem of developing adaptive computing architectures for real-time applications designed to solve complex problems based on high volume data processing and limited response time.

The system architecture has a lot of heterogeneous computing devices, interconnected, that form a Mesh network. Each device has necessary resources to solve a part of problem solving global algorithm and to store limited volume of data required only to initiate the reconfiguration process, to obtain an optimal algorithmic and data architecture.

The interaction between the devices in the system architecture is presented based on the sequence diagram UML. The modeling of the concurrent processes of data processing and transfer was performed based on the Timed Petri Nets models.

As a result of performed modeling, was obtained the graph "the relation between the data processing time and the result requested convergence". The concept of optimal time for generating a satisfying response is defined.

Keywords: *Adaptive Computing; Self-Adaptive Architectures; Real-Time Applications; Embedded Systems; IoT; Cloud Computing; Concurrent Data Processing.*

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DETERMINATION OF THE CHARGE CARRIER SYSTEM PARAMETERS IN $\text{Pb}_{0.82}\text{Sn}_{0.18}\text{Te}$

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The temperature dependences of electrical conductivity (σ), Hall coefficient (R), thermopower (α), and Nernst–Ettingshausen coefficient (Q) for five $\text{Pb}_{0.82}\text{Sn}_{0.18}\text{Te}$ samples with different charge carrier concentrations in a temperature range of 100–300 K have been studied. According to the obtained experimental data, the temperature dependences of the mobility and the effective scattering parameter have been calculated. The main features of the experimental data can be interpreted in terms of a two-band model of the valence band structure with several groups of holes involved in the transport phenomena. It has been found that the behavior of the temperature dependence of the effective scattering parameter significantly depends on the charge carrier concentration. The determined quantitative values of the effective scattering parameter are consistent with the concepts of a mixed scattering mechanism.

Keywords: Electrical conductivity, The Hall effect, The Nernst–Ettingshausen effect, The Seebeck effect

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