



## INFORMATION TECHNOLOGIES

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## ONTOLOGICAL APPROACH TO DEVELOPMENT OF WEB-CONTENT GENERATION METHOD

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The object of research is the process of automated creation of web content based on information presented in an ontological form. One of the most problematic places in web development is the process of creating a user interface. This is due to the fact that this process is complex and requires more time and money than other development stages.

During the study, there was applied a software development model, which is, based on the development of an ontology, and then a software application for its processing. This approach is called «Ontology-driven development» (or the software development process controlled by the ontology).

An intellectual model is obtained for representing the elements of web resources, which is represented in the form of an ontology, as well as the software core of the system for generating web pages, based on information stored in the ontology. This is due to the process, which is need to obtain a set of finite elements of the user interface (HTML, CSS, JS elements) from which web pages are formed.

Setting addressing between pages of a web resource has a number of features. In particular, an appropriate approach was proposed for linking the address of the final web page with the controller, which is responsible for generating its content. These functions are similarly to the so-called «router», which is used in classical web-based systems (e. g. JSP for Java). A distinctive feature of this approach is in the set of information from which the web page is formed. This information, as well as its address is stored and loaded from the ontology.

Due to the presented approach, the process of designing and developing of the user interface is simplified in comparison with classical ones. This approach is effective for web projects and, in the perspective, for other applications (desktop, mobile, etc.). Also, the proposed method will increase the possibility of reusing already developed elements of the user interface, as well as ensure the creation of a base of ready-made solutions for the developers in the form of corporate memory.

**Keywords:** knowledge base, intellectual model, memory management model, data mining, ontology-driven development, corporate memory.

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#### DETERMINATION OF INTELLECTUAL ACTIVITY IN SOLVING THE PROBLEMS OF BANK FUNCTIONING OPTIMIZATION

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The object of research is the process of functioning of a commercial bank. One of the most problematic places is optimization of the bank's work in accordance with the requirements of customers in conditions of limited resources, that is, how to distribute a certain amount of investment in various areas of the bank's business in an optimal way. This should be understood as the maximum customer satisfaction with the Bank's functioning process. It is also necessary to the importance of areas of activity depending on customer feedback – by collecting customer information, such as complaints, suggestions, survey results, etc. Such data are not intelligent, they must be formalized and on this basis a strategy for the functioning of the bank for a certain period of time should be built.

During the study, an upward approach to the creation of artificial intelligence systems was used. On the basis of non-intellectual data (bank subsystems, client data, statistics), information is determined for building intellectual activity regarding decision-making on optimizing the functioning of the bank as a whole, as a unified system, that is, building the optimal strategy for the bank.

As a research result, a project of an intellectual system is obtained, which is designed to build an optimal strategy of activity in the conditions of limited resources. Structuring and formalizing knowledge are made to fill the knowledge base of this system. The optimal option for this research is recognized as a formal logical model based on the construction of first-order predicates.

Thanks to this, it is possible to implement an intelligent system to solve the problem of the distribution of bank domestic investments in an optimal way, that is, with the maximum increase in customer satisfaction. Using this system in practice should help the bank management to allocate a certain amount of domestic investment in the bank's business areas in an optimal way, guided by the wishes of customers.

**Keywords:** effective bank-client relations, intelligent system, optimization of the bank's functioning, investment distribution.

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# SYSTEMS AND CONTROL PROCESSES

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## DEVELOPMENT OF A MATHEMATICAL MODEL OF SCRAMBLER-TYPE SPEECH-LIKE INTERFERENCE GENERATOR FOR SYSTEM OF PREVENT SPEECH INFORMATION FROM LEAKING VIA ACOUSTIC AND VIBRATION CHANNELS

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The protection of speech information is one of the main tasks of information protection and is a sign of a responsible attitude of an organization (company) both to its information resources and respect for partners. The object of research is the process of protecting speech information from leakage by acoustic and vibrational technical channels at the objects of information activity. An exceptional feature of such facilities is the circulation, processing and discussion of issues containing information of limited access, including state secrets. A peculiarity of Ukraine is the requirement to use exclusively technical means that have passed the relevant certification at such facilities.

The basis of the active noise jamming system is a noise generator. At the same time, one of the most problematic issues is that in Ukraine only noise interference generators of the «white» noise type and its clones are allowed to be used. The systems have a number of significant drawbacks – the low protection level of intercepted speech signals from noise filtering (interference), a significant noise level in the premises to be protected, and others.

A block diagram of an interference generator is proposed. And its mathematical model is also developed and researched in Matlab. In the course of the research, a comparative analysis of the signals input and synthesized by the generator was carried out, their temporal and spectral characteristics were investigated. The obtained results indicate the high efficiency of the proposed method of protecting speech information. This is due to the fact that the method of forming a speech-like interference has a number of features that provide a significant destructive effect on speech information, namely the use of a combined scrambler model with time and frequency transforms. The method takes into account the use of dynamic keys for coding systems, and the connection of third-party sources of speech signals, as well as ringing (mixing of the input and output signals) at the input of the scrambling unit. This decision excludes reengineering.

The results are confirmed by the research of an experimental sample. The destructive effect of typical noise interference

(«white» noise and its clones) and the noise interference created by the proposed method are compared by the criterion of residual speech intelligibility of the speaker's speech. Studies have shown that, provided that no more than 10 % of the level of residual intelligibility is provided, the volume level of the output signal of the noise interference generator can be reduced by almost 6 dBA.

**Keywords:** scrambler-type speech-like generator, protection of speech information, information protection.

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## REPORTS ON RESEARCH PROJECTS

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### IMPACT OF PERFUSION ROI DETECTION TO THE QUALITY OF CBV PERFUSION MAP

page 27–30

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The object of research in this study is quality of CBV perfusion map, considering detection of perfusion ROI as a key component in processing of dynamic susceptibility contrast magnetic resonance images of a human head. CBV map is generally accepted to be the best among others to evaluate location and size of stroke lesions and angiogenesis of brain tumors. Its poor accuracy can cause failed results for both quantitative measurements and visual assessment of cerebral blood volume.

The impact of perfusion ROI detection on the quality of maps was analyzed through comparison of maps produced from threshold and reference images of the same datasets from 12 patients with cerebrovascular disease. Brain perfusion ROI was placed to exclude low intensity (air and non-brain tissues regions) and high intensity (cerebrospinal fluid regions) pixels. Maps were produced using area under the curve and deconvolution methods.

For both methods compared maps were primarily correlational according to Pearson correlation analysis:  $r=0.8752$  and  $r=0.8706$  for area under the curve and deconvolution, respectively,  $p<2.2\cdot 10^{-16}$ . In spite of this, for both methods scatter plots had data points associated with missed blood regions and regression lines indicated presence of scale and offset errors for maps produced from threshold images.

Obtained results indicate that thresholding is an ineffective way to detect brain perfusion ROI, which usage can cause degradation of CBV map quality. Perfusion ROI detection should be standardized and accepted into validation protocols of new systems for perfusion data analysis.

**Keywords:** dynamic susceptibility contrast magnetic resonance imaging, cerebral blood volume, region of interest, thresholding.

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**NUMERICAL AND EXPERIMENTAL INVESTIGATION OF THE CAVE PASSAGE MODEL**

page 31–33

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The object of research is the soil model of the cave site, which approximates part of the underground structure of the Kyiv Pechersk Lavra (Kyiv, Ukraine). Long-term operation of underground historical buildings in cramped conditions at 100 % humidity and under the influence of aggressive influences of internal and external factors leads to the exhaustion of their structural reliability. When restoring historical objects, it is advisable to combine the residual resources together with local structural reinforcements. Thanks to this concept, the original state is restored, and the structures can still perform their functions for a long time in the existing environment. Such amplifications create strong and rigid cells that combine the object into a single whole.

This approach was tested by full-scale testing of a model of a fragment of the underground passage of the Far Caves, made of sandy loam in full size. The studies were carried out on the basis of the Test Center for Building Structures of the Kyiv National University of Construction and Architecture from 2012 to 2019. A technique for strengthening the soil mass with internal basalt reinforcement – flat frames – was developed. It was used in the restoration of certain sections of the underground structures of the Kyiv Pechersk Lavra. At the same time, numerous studies of the corresponding mathematical model were carried out with full-scale tests. A numerical-experimental approach to the analysis of the stress-strain state (SSS) of an underground structure model allows one to correctly determine the design parameters that will allow as close as possible to approximate a real underground structure.

To increase the efficiency of using basalt reinforcement, the method of introducing individual rods into the damaged soil layer, which is under load, is investigated. Thus, it is proposed to use the reinforcements during the restoration of Variazhski caves of the Kyiv Pechersk Lavra, which received numerous damages in the form of vertical and inclined cracks in the ceiling and walls with soil outcrops.

**Keywords:** restoration of historical objects, basalt reinforcement, soil model of a cave site, physical non-linearity, finite element model.

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**RESEARCH OF METHODS FOR IDENTIFICATION OF EMERGENCY MODES OF POWER SUPPLY SYSTEM IN TRANSPORT INFRASTRUCTURE PROJECTS**

page 34–36

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The object of research is the operating modes of the railway power supply system. Classification of emergency conditions based on the determination of damage for each of the feeders or phases is classic. The main causes of emergency conditions include various kinds of short circuits arising from damage to the insulation of phases, breaks and overvoltages. Damage to equipment occurs due to the natural aging of insulation, weathering and mechanical damage, switching overvoltages.

A systematic approach, methods of system analysis, set theory, modern methods of image processing and intelligent data processing, ensuring the scalability of the developed methods are used.

The methods for algorithmic solutions are investigated and mathematical models of processing and organizing the information space represented by sets of multidimensional data arrays with reference to the time domain, which is formed at the hierarchical levels of the corporate computer diagnostic system, are presented. The considered information space in its original form forms data that are considered as parametric images of processes received from microprocessor-based devices for recording system parameters. This is due to the fact that the methods for identifying emergency modes of electric power systems based on the corresponding parametric images of processes make it possible to obtain similar in structure algorithms for identifying modes for power systems of various types and purposes.

This provides preliminary data processing for raising the parametric image of the emergency mode to the standard form of the matrix representation in the frequency domain. Compared with similar methods, this provides such advantages as the ability to run the diagnostic system both in «off-line» and in «on-line» modes. And the implementation of algorithmic solutions can be provided both at the lower level of diagnostic systems, and at the upper levels of power supply sections, as well as at the corporate level and can be characterized by the properties of

scalability and flexibility with respect to the considered sections of power systems.

**Keywords:** mode identification algorithms, railway power supply system, computer systems, information space.

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**DEVELOPMENT OF A METHODOLOGY FOR ASSESSING RELIABILITY OF DATABASES USED IN RADIO NETWORK MANAGEMENT**

page 37–40

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The paper analyzes the tasks that are performed during the processing of distributed data. The object of research is the process of automation of control in distributed systems and the organization of processing distributed data. During the study, a data replication method was used, providing for their duplication in different nodes of the information-analytical system. This is due to the fact that this method allows to bring several databases with the same structure into the same consistent state, which is accompanied by a mutual introduction of changes. This

ensures effective informational and intellectual (analytical) support for geographically distributed, but functionally interconnected groups of officials in the process of developing managerial decisions. The analysis of the stages of the elementary cycle of managing complex systems – the collection of situation data, the development of solutions, the generation of control commands for the network component – reveals a common feature for all stages. Namely, all of them are complex information processes (the first three are the exchange of information in the data transmission system and its processing in data management systems, the last is the change in the network parameters for generating control commands of the network component). The high speed of these processes and the logical complexity of their structure led to the need to automate the management of these processes, when a significant part of the information functions of the control center is transferred by technical means – information and logic devices of an automated control system. As a result of the study, experimental results are obtained, on the basis of which it is possible to significantly increase the level of functional reliability of databases of information-analytical systems. It also became possible to reduce the time for processing and synchronization of distributed data of information-analytical systems. The research results should be used in calculating the functional reliability of distributed databases of information-analytical systems, information and telecommunication networks. It is planned to use this methodology when building large arrays of distributed databases in information networks built on modern wireless radio technologies.

**Keywords:** information network, data replication technology, database management system, distributed data processing.

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#### INFLUENCE OF WELDING PROCESSES FOR UNDERGROUND PIPELINE REPAIR ON WELDER SAFETY

page 41–44

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The object of research is the welder safety during the repair and construction of underground pipelines. It is established that manual electric welding is characterized by significant influence on the human body, since the distance from the place of welding to the welder is 20–30 cm, the temperature in the pillar of the welding arc reaches 6500 K. It contributes to the allocation of the surrounding space of a significant amount of metal vapor and fine particles (welding aerosol and toxic gases). Theoretical and experimental investigations of the initial part of the welding torch (at a height of 0.4–0.5 m) using manual, semi-automatic welding in the environment of protective gases and welding under a layer of flux have been carried out.

Dependencies for determining axial temperatures and velocities are proposed. It is substantiated that the spreading of aerosols during welding of pipelines in the trench is determined by the physical processes of spreading the welding torch. The hygienic characteristics of the electrodes of the ANO type in the welding processes are investigated. It is established that the total amount of aerosol in the process of welding using ANO-4 electrodes with basic coating reaches 31 g/kg and toxic substances in aerosol up to 9 g/kg. The amount of gases in front of the welder shield during the welding of electrodes by ANO-8 reaches 20 mg/m<sup>3</sup>.

Empirical equations for determination of aerosols concentration and gaseous concentration of harmful substances are obtained. In addition, an equation for determining the index of workplace pollution of welders, which made it possible to predict individual parameters of working conditions, is obtained.

The mechanism of propagation of aerosols in the trench requires a special consideration, which can be carried out by the method of mathematical modeling, because such physical and chemical processes, as longitudinal and transverse dispersion, molecular diffusion play a role.

The analysis of empirical formulas which can be recommended for determination of parameters in the initial section

of a welding torch using flash welding of a pipeline in a trench is done.

**Keywords:** welder safety, welding torch, main gas pipelines, convective heat, concentration of aerosol.

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### DEVELOPMENT OF AUTOMATIC CONTROL SYSTEM OF MOTION OF AN UNMANNED SURFACE SHIPS WITH A SAILING INSTALLATION

page 45–49

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The object of research is an unmanned surface ship with a sailing installation. One of the problems in controlling a sailing

ship using automatic systems is the almost infinite number of static and dynamic states of traditional sails, which are difficult to detect and difficult to predict. In addition, the ability of traditional sails to twist and engage is known, and all operations with sails are performed through the operation of a running and standing rigging, that is, indirectly. Given the need for continuous deployment and cleaning of conventional sails, building an automatic control system for them will obviously be an extremely difficult task.

The paper considers an alternative to the traditional sail – a rigid sail-wing. For unmanned surface ships, the sail-wing is proposed to be made on the basis of symmetrical aerodynamic profiles. Such a sail-wing will simplify such a procedure as cleaning the sail, that is, ensuring its inactivity, as well as simplify the procedure for the transition of a sailing ship by moving the right or left tacks.

The study presents relatively simple control algorithms that are possible when using symmetrical aerodynamic profiles for rigid sails. Such sails will make it relatively easy to implement the modes of motion of unmanned ships with tacks, as well as the mode of inactivity of the sail. Also shown is the need to build a system that combines the functions of controlling the angle of attack of the wing-sail and course control. In this case, the control system of the angle of attack does not depend on the heading control system, and the heading control system must take into account the sailing mode. Overcoming the critical transition points of the ship from one tack to another is possible using an additional propulsion device. The control of the sail-wing can be carried out using one single electric drive returns it relative to the wind at a given angle of attack, which ensures its driving force.

**Keywords:** unmanned surface ship, heading control, sail angle control, integrated control system, autocontrol.

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#### FINANCIAL TIME SERIES MODELLING: RETURN ON ASSETS

page 50–55

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The paper discovers certain aspects of financial time series, in particular, modeling of return on assets. The object of research is a system of indicators for analyzing the returns of financial time series. There is a key feature that distinguishes the analysis of financial time series from the analysis of other time series, as financial theory and its empirical time series contain an element of uncertainty. As a result of this additional uncertainty, statistical theory and its methods and models play an important role in the analysis of financial time series.

One of the most problematic places is the use of asset prices and their volatility in the analysis and forecasting of financial time series, which is false because such series contain an element of uncertainty. Therefore, the so-called return on financial assets and instruments should be used in tasks of this type.

The paper deals with the types of return on financial assets that can be used in mathematical modeling and forecasting of stock indices. Static methods are used to eliminate the disadvantages of using financial asset prices in the analysis and forecasting of financial time series. The empirical properties of financial time series are examined using the PFTS (First Stock Trading System) and S&P 500 indices.

A comprehensive system of indicators of time series analysis of financial assets is obtained. The proposed system involves the use of numerous methods of calculating the profitability (return)

of assets in order to determine significant statistical characteristics of the data. Compared to similarly known methods of using prices (rather than profitability) of assets, this provides a key advantage that allows elements of uncertainty in financial and economic data.

**Keywords:** financial time series, profitability of assets, mathematical modeling of stock indices.

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