SUMMARY
"INFORMATION SYSTEMS AND NETWORKS" BULLETIN

INFORMATION SYSTEMS, NETWORKS AND TECHNOLOGY

Андруник В.А. **Пакет програм "АпроКріо" для апроксимації температурної характеристики та чутливості сенсора**

SOFTWARE PACKAGE "APPROKRIO" FOR APPROXIMATION TEMPERATURE CHARACTERISTICS AND SENSITIVITY OF SENSOR

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To describe sensor static characteristics, rupture minimax polynomial splines, in which approximations on distinct links are selected in such a way that a characteristic approximation error does not exceed a priory of certain value at any range point, are used frequently. The application expediency of such splines with dividing minimax approximation on the distinct parts of the measurement range could be justified by the possibility of gaining the approximation of the necessary accuracy at small values of parameters' quantity in polynomial approximation. Such approximations continued on distinct links (parts of the measurement range) could be used if a determining condition is the provision of function value of reproduction with an error only. The example of such a task is the determination of a functional dependence for the description of thermotransducer static characteristics. However, to explore sensor sensitivity, these rupture approximations could not be employed, since derivative values at rupture points have considerable discrepancies. To approximate the thermometric characteristic of silicon diode temperature sensors and their sensitivity, Chebyshov's polynomial approximations by the method of the smallest squares, meanwhile, the satisfactory accuracy of sensor thermometric characteristic and its sensitivity approximation is being reached at hundredth and higher Chebyshov polynomial degree, which complicates the practical implementations of such approximations due to pulsations relevant to high degrees.

It is important to develop a software algorithm of the construction of continued and smooth minimax spline-approximation with the given error. Therefore, the developed software package "AproKrio" is intended for solving optimization problems given in a tabular presentation of analytical precision of low temperature (cryogenic) characteristics of the sensor means uniform (Chebyshov) approximation. Core package "ApproKrio" are approximation modules focused on determining Chebyshov approximation expressions with specific interpolation conditions. 52 modules of approximation which implement the methods of calculation of parameters with Chebyshov approximation, are included in the package. In addition, 17 more interpolation modules are given to determine the interpolation expressions, of which 15 provide the definition of Hermitian interpolation. The research contains the functionality package "ApproKrio". Its purpose and features of application are discussed in it.

Key words: Chebyshov approximation, continuous and smooth minimaximal spline approximation, spline approximation, package "AproKrio"

Бомба А.Я., Шпортько О.В., Шпортько Л.В. **Особливості застосування арифметичного кодування в процесі прогресуючого ієрархічного стиснення зображень без втрат**

ENCODING IN THE PROCESS OF PROGRESSING HIERARCHICAL COMPRESSION OF IMAGES WITHOUT LOSSES

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A method and proper algorithms of the use of the arithmetic encoding in the process of progressing hierarchical compression of images without losses are discussed in the research, the predictions for the separated encoding of groups of elements with highest probability and design of relative frequencies of elements after

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application of predictors are explored. The implementation of the proposed approaches instead of encoding of Huffman, for example, enables us to decrease the aspect of images of the set of ACT ratios on average by 2.13 % without application of context-depended algorithms.

Conclusions:

1. In the formats of graphic files, byte-oriented arithmetic coding with static strategy of forming of intervals of elements is an effective alternative the code of Huffman. For realization of such code, the structure of ARIC is taken into account. In the compressed blocks it is necessary to provide separated storage of arithmetic codes of every division.

2. To implement static strategy of forming intervals of elements of ARIC in the formats of graphic files in the title of every block of the compressed data, it is reasonable to keep the quantity of bits for the record of lengths of intervals, and to keep binary codes of these lengths without the first bit after the title.

3. Data of different layers and passage-ways of a hierarchical round of pixels after the application of predictors of different blocks of ARIC should be squeezed, as they have different entropy. It is reasonable to apply ARIC to the elements directly, without the selection of sequences of identical values. The sizes of small blocks of ARIC can be decreased insignificantly, on condition that only the most credible elements are kept in their given titles, and probabilities of the other elements can be designed by indexes or function.

4. Accelerating decoding of arithmetic codes with the static forming of intervals by more than 40 % enables the use of an auxiliary array in which for every value of generic interval the number of the element corresponding to it is saved.

In future, with the purpose of the subsequent diminishing of AC in the process of progressing hierarchical compression of images without losses, it is planned to develop the methods of the prior diminishing of entropy and adjust the complex-dependent methods of compression for this method of the round of pixels.

Key words: progressing hierarchical compression of images without losses, arithmetic coding.

Василюк А.С., Басюк Т.М. **Підсистема знищення формул алгоритмів**

A SUBSYSTEM OF DELETION OF FORMULAS OF ALGORITHMS

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The purpose of the publication is to develop mathematical and software editor of formula of algorithms which will delete the algorithms of formula. For the purpose of the research it is necessary to solve the following problems:

– to perform analysis of mathematical model and software for the deletion of the formulas in the universal and specialized systems;

– to perform synthesis and minimization of a software subsystem of deletion of formulas of algorithms;

– to build and explore a mathematical model of an abstract algorithm of subsystem for deletion of formulas of algorithms;

– to perform software implementation and testing of software developed;

The object of the research is a mathematical model and a subsystem for deletion of formulas of algorithms software

The subject is the synthesis and study of minimization of subsystem of deletion of formulas of algorithms.

Newest are synthesized, research software of the subsystem of deletion of formulas of algorithms.

The practical value of the research lies in the fact that it enables us to use mathematics and software to create an algorithms editor, which enhances the level of automation of the process of deletion of the formulas algorithms in comparison with the known system.

Mathematical formulas and software algorithms were developed. Mathematics and subsystem of deletion of formulas of algorithms software were synthesized, minimized and studied

The research aims at solving the problem of synthesis of relevant scientific and mathematical research and software subsystems deletion of algorithms and formulas yielded the following results:

– Analysis and mathematical software of the known universal and specialized systems proved that the destruction of their means of formulas or algorithms is not implemented or partially implemented .

– Minimization algorithm subsystem of destruction algorithms reduces the number of formulas of uniterms on average by half.

Key words: deleting, algorithms, mathematical model.

Верес О.М., Микіч X.I. **Концептуальна модель інтелектуальної інформаційної системи малого підприємства**

CONCEPTUAL MODEL OF INTELLECTUAL INFORMATION SYSTEM OF SMALL ENTERPRISE

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To research the design of intellectual information systems of a small enterprise the comparative analysis of management systems and their application in business was carried out.

The aim of the research is to create intellectual information system that would allow all types of enterprises (as small and medium-sized businesses) to operate more efficiently, store and search for the required information in the process of using more sustainable methods of access.

The main task of the research is to develop strategies for building intellectual information systems as an extension of CRM-systems.

The object of research is a process management of a small enterprise.

The subjects of research are methods, tools and principles of construction and operation of intellectual information systems management of a small enterprise.

Under the conditions of an economic crisis effective solutions of the problems of small businesses depend on the sufficient implementation of information systems based on the standard configuration of CRM-systems.

The novelty of the research is the design of an intellectual component of this information system.

The practical value of the research is to build a conceptual model of intellectual information system of a small enterprise that is ready to use. The economic effect is expected from the introduction of a model of results of an intellectual system, which was elaborated and the main processes were described. A conceptual domain model was presented in the form of class diagrams, and also the predicate semantic network of information of the research. It has to increase profits.

The generic system was described. To improve the process of maintenance of decision-making of the company a set of production rules was given.

The introduction of CRM-system that considers both internal communications and communications with customers is more effective then introduction of management systems that focus only on internal processes. Therefore the developed system is not only an ERP system based purely on internal relations of the enterprise, but it is a CRM-system that uses a "customer-centric" approach, the result of which is the improvement of the competitiveness of enterprises and the profits increase.

Key words: CRM-system, conceptual model, diagram of classes, production rules, intellectual system.

Висоцька В.А., Чирун Л.В. **Архітектура систем електронної контент-комерції**

AN ARCHITECTURE FOR ELECTRONIC CONTENT COMMERCE SYSTEMS

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The research discusses the development of unified methods and software tools for processing information resources in the electronic content commerce systems. A new detailed classification of electronic commerce systems and electronic content commerce systems is proposed. A formal model and generalized typical architecture of electronic content commerce systems are proposed. Architecture and models of electronic content commerce systems are built. A new approach to application and implementation of business processes is formulated for the construction of systems of electronic content commerce. A complex method of content creation, the operational method of content management and complex method of content support are developed. Software tools for content creation, management and support are developed. Design and implementation methods of electronic content commerce systems are based on online newspapers, which reflect the results of theoretical research, are developed.

From the perspective of a systemic approach, the principles of applying information resources processing in electronic content commerce systems for content lifecycle implementation made the development of methods for the commercial content formation, management and support possible. An integrated method of commercial content

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formation for the time and resources reduction of content production is developed. This makes it possible to create a means of information resources processing and implement subsystem of automatically generated content. An operational method of commercial content management for the time and resources reduction of content sales was created, which makes it possible to implement commercial content management subsystem. A comprehensive method of commercial content support for the time and resource reduction of the target audience analysis in electronic content commerce systems is implemented, which makes it possible to develop a commercial content support subsystem. A content lifecycle model in electronic commerce systems is proposed in the research. The model describes the processes of information resources processing in the electronic content commerce systems and simplifies the content automation management technology. In the given paper the main problems of e-commerce and content function management services are analyzed.

Key words: information resources, content, content management system, content lifecycle, electronic content commerce system.

Годич О.В., Прокопів Ю.О. **Візуальна предметно-орієнтована мова запитів**

A VISUAL DOMAIN-ORIENTED QUERY LANGUAGE

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In recent years the subject of domain-specific languages (DSL) gained a substantial interest in both software research and engineering circles. Domain-specific languages promise to significantly simplify the development and support of software systems. This is achieved by shifting the development paradigm from programming towards modelling using concepts from the problem domain addressed by the system rather than Turing complete programming languages.

The majority of the current approaches to use DSLs pertain to the creation phase of software systems, whereby the actual software systems are the artefacts of this process. In our opinion the process of building and using software systems, especially in case of business applications, should be seamlessly integrated. This would provide domain experts with necessary tools to enhance a live system in order to meet dynamically changing real-life requirements without a tedious and often complex development/deployment cycle that is currently used in the software industry.

This article discusses a visual domain-specific query language (VDSQL) that supports data interaction and composition of business rules as part of a software system. It can be used directly by domain experts. The core purpose of any DSL is to provide a convenient way to interact with an underlying semantic model. VDSQL is an interactive DSL to query the underlying business model and to specify rules for monitoring the state of the system. The basic building components of VDSQL is a set of predefined blocks that can be snapped together in order to form more complex expressions. There are strict compatibility rules between blocks, which take into account their semantic context and type. Compatibility is determined dynamically and indicated to the user during interaction. The provided blocks consist of two main groups: one represents business model metadata such as entities and their properties, another – provides elements to compose expressions (e.g. comparison operators, aggregation functions). User interaction with VDSQL occurs in a workspace with advanced interaction capabilities. This includes features of Zooming User Interface, dynamic semantic compatibility indication when interacting with blocks, and context sensitive fluent interface in a form of a pallet of compatible blocks. An intuitive zoom in/out capability provides a way to include a large number of blocks into the same workspace, which streamlines reuse of pre-built expressions. The context sensitive fluent interface assists users by providing selection choices of only those blocks that are applicable at the specified location – a slot. The use of aggregation functions, conditions, logical operations, and conditional operators greatly facilitates the construction of complex rules.

An important aspect of the proposed approach is the semantic transparency between VDSQL expressions composed by software users and the Entity Query Language (EQL) expressions used by developers in a form of an internal Java DSL during a software construction phase. EQL represents a computation model for VDSQL. Such approach removes the discrepancy between the running system and its code, which greatly facilitates communication between domain experts and software developers.

Key words: domain-specific language, data querying, projectional editing, HCI.

Григорович А.Г., Григорович В.Г. **Подання реляційних операцій засобами реляційного числення доменів для ненормалізованих відношень**

PRESENTING OF RELATIONAL OPERATIONS BY MEANS OF RELATIONAL DOMAINS CALCULUS FOR NON NORMALIZED RELATIONS

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The aim of the paper is to present extended relational algebra operations by means of relational calculus of domain for non normalized relations.

To achieve this goal it is necessary to use a second-order predicate calculus, to submit expressions of relational calculus of domains for non normalized relations, equivalent to:
• special relational operations;
• operations of change the state of relations;
• operations on relations schemes.

Equivalent expressions are called relational calculus of domains for non normalized relations and the extended relational algebra, which give the same result if the arguments there are of the same relations.

The process of submitting normalized relations is the object of the research.

The subject of the research is: the methods and tools for submissions of non normalized relations using the relational domains calculus.

The novelty of the paper is the fact that the relational domains calculus for non normalized relations were developed, that helped to formalize the methods of representing and processing the data in data warehouses based on non normalized relations and establish the principles of logical modeling the composite objects.

The practical value of the work: the mathematical software has become a basis for creating software for submission and processing of data on composite objects by non normalized relations in data warehouses, and for storage, searching the data in data warehouses with non normalized relations.

The contribution of the authors: all the results are obtained by the authors personally.

Conclusions. Using the second-order predicate calculus, relational domains calculus expressions are given for non normalized relations, equivalent to the operations of the extended relational algebra (to the special relational operations, the operations of the change in the state of relations, the operations on relations schemes). The examples of using the expressions of relational domain calculus for non normalized relations are given. The expressions, built here, allow us to formalize the notation the methods of processing the non normalized relations in databases and data warehouses.

This calculation makes it possible to use, for example, marketing data directly in the course of support of making administrative decisions, and to do the search in data warehouses more time-efficiently.

Key words: nested relations, relational calculus of domains, relational operations, relational algebra.

Гринчишин Т.М. **Покращення ефективності формування сигнальних кодів на основі кодової послідовності Галуа**

IMPROVEMENT OF EFFICIENCY OF ALARM KODAS FORMATION BASED ON THE CODE SEQUENCE OF GALOIS

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The codes of the field of Galois after general classification belong to subclasses of cyclic sectional codes which own all basic properties of codes. In sectional codes sequence of elementary reports broken up on the blocks of characters (B1, B2, B3, …, Bn) of the fixed length K, to each of which certain combination of characters of code word belongs in accordance (b1, b2, b3, …, bn). Cyclic codes behave to the class of systematic codes.

Formation of alarm code of without excessive is based on the principle of creation of code with possibility of exposure and correction of errors, which does not result in the increase of number of signals when transmitting bit-oriented flows of data.

Essence of methods of without excess of alarm codes with possibility of exposure and correction of errors consists in the formation of such a class of codes to five alarm signs of the following type: front of growth __↑‾ (∧) ; front of slump ‾↓__ (∨) ; to positive potential |━━| (+); to subzero potential |━━| (–); zero potential |━| (S).

The followings possible methods of formation of such a class of codes are set:

– Position alarm code.

– An asymmetrical recurrent alarm code.

– A recurrent symmetric alarm code.

– Quasi-symbols alarm code.

The exposure and correction of errors on the basis of the proposed method and methods of alarm code of reports will be realized on the receiving end of informative channel, by the use of recurrent properties of codes there are the fields of Galois, which modulate bit-oriented information which are passed additionally. In case if the code of "1" in information is accepted wrong and in place of a "1" decoder is formed by a zero, it means that in the environment of information there are more zeros (at the same time code "00" at the end of transmission contains 8 zeros). The appearance of any number of errors in the passed information the eventual code of Galois of zeros will not answer the number of accepted, which allows finding an error.

On the basis of research of existing methods of manipulation and alarm spaces the new methods of unsurplus of alarm code of bit-oriented informative streams are proposed with the use of codes of the fields of Galois, which, as compared to the existing methods allow a completer to use information of alarm spaces and provide possibility, without introduction of redundant information of streams given, which are passed, to discover and correct single errors.

Investigational descriptions of protection of data from errors on the basis of the proposed alarm codes of type positions alarm, asymmetrically recurrent and quasi-symbols code, result in the asymmetrical alarm codes, which are provided by the exposures of all possible single errors.

The proposed methods allow realizing without excessive code of information in computer networks for their more effective work.

Key words: Communication channel, methods of manipulation, recurrent codes, unsurplus codes.

Грицик В.В., Грицик В.В. **Оцінка якості зображення**

IMAGE QUALITY EVALUATION

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'Most surveillance software operates only at a very low level…in order to bridge the gap it is necessary to build an artificial cognitive solution that operates at a much higher level, which is able to analyse footage, describe the events taking place and reason about what is going on'.

The research has enabled to develop mechanisms based on measures for evaluating the quality of images. The probability-based method of evaluating image quality is shown in this paper.

The video produces a glut of material daily. Refining that ore into the gold of useful information requires new approaches. We have now made automated video analysis much smarter.

Influence of using of probability-based metric for task automation for evaluating the quality of the video stream is investigated in the work. The factors affecting on image quality are investigated. The research of American scientists is investigated in the research. Topicality of the research is shown in relevance of direction, based on publications in the reports of the European research program FP7.

The choice of metric (on a scale from speed up to quality) is dependent on the task and is shown in article.

The creation of a sophisticated computer vision technology necessitates the development of automated assessment of what the robot sees. This problem includes an assessment of factors influencing image quality. Influence of industrial factors and factors of lighting is described in paper. The probability-based methods for solving specific problems and their relationship are shown.

The use of automated image evaluation which analyzes the system of recognition and identification, enables us to realize a flexible approach to the selection of factors (impact factors) in selection and error tolerances in the recognition algorithm. This will make the computer vision more adaptive to external influence.

Of particular importance, this estimate is for recognition problem, because according to a recognized system object's path – the robot receives different images for classifier or system verification.

Key words: quality evaluation for video, automatic information, analytic systems.

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Камінський Р.М., Нич Л.Я. **Ієрархічний агломеративний кластерний аналіз одновимірних асиметрично розподілених даних у середовищі MS Excel**

HIERARCHICAL AGGLOMERATIVE CLUSTER ANALYSIS OF ONE-DIMENSIONAL ASYMMETRICALLY DISTRIBUTED DATA IN THE ENVIRONMENT OF MS EXCEL

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The purpose of this study is to develop an approach to the implementation of the method of hierarchical agglomerative cluster analysis by means of spreadsheet Microsoft Excel 2003 and its later versions. Implementation of this method in the Excel environment solved a number of problems. These are: forming of the Table "object – property" normalization of values and bringing them into a single interval, calculate the values of matrix similarity determining the numerical values of the parameters dendrogram , dendrogram construction and allocation of required clusters.

This technique was used to split the group into subgroups of personnel carrier in terms of speed of decision making. All the band members have been trained on the same scenario. The script is a series of test images with the desired object search. The objects were test images localized randomly. The samples of these values were provided for cluster analysis as follows. To form the table "object-property" as objects of thirteen operators were featured as well as eleven properties of statistical characteristics of individual samples were given. Quantitative characteristics were obtained using descriptive statistics and parameters were defined by distributions of a histogram. To calculate the similarity matrix the table "object-property " and its copy were used. The table is the original fixed characteristics of a specific operator, which were compared with the characteristics of all other operators using the Euclidean metric. To determine the parameters a dendrogram of flexible strategies by Williams-Lance was used. For auxiliary the dendrogram clearly identified three clusters , which are very good in terms of compactness hypothesis. Comparison of clusters was made by calculating the average value of the properties which have physical significance and relationship to efficiency.

This technique is a new, easy to learn, has great practical value and complements the spreadsheet Excel significantly.

Key words: cluster analysis, table object-property, proximity matrix, dendrohrama, clusters.

Кравець П.О. **Модель стохастичної гри нейроагентів**

A MODEL OF STOCHASTIC GAME OF NEUGENTS

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The model development of stochastic game of neural network agents (neugents) for collective decision-making in the conditions of uncertainty is the purpose of this work.

Training processes in multiagent systems for optimisation of collective decision-making in the conditions of uncertainty are object of research.

The model of matrix game of neugents with random prizes is a subject of research.

Neugents are constructed on the basis of artificial neural networks (neuronets) with feedbacks and with training without a teacher. The current collective decision appears after an independent choice of personal options of decisions of all players. Each player forms a current variant of the decision on values of outputs of a neuronet. The choice of variants of decisions is carried out by neugents in the random way, is independent in time and of other agents. The random choice provides calculation of probabilities of a choice of variants of decisions by optimum projection of neuronet outputs on the unit simplex.

After a choice of a collective variant a response of the environment of decision-making as a set of values of current prizes of neugents is defined. The current prize of each neugent goes to the inputs of a corresponding two-layer neuronet. Further training of neugents by change of weights of communications between neurons on one of the algorithms of training without the teacher is carried out. Training process repeats in time before stabilisation of weights of communications between neurons with the set accuracy. The training course is directed at the maximisation of average prizes of neugents. The game decision is reached in one of points of a collective optimality or balance depending on values of parametres of the chosen method of training of neugents.

The developed program model confirms convergence of a game neugent method of decision-making. Efficiency of a method is estimated by means of characteristic functions of average prizes and errors of a collective choice of an optimum variant of decision-making. Convergence of a game neugent method depends on quantity of players, quantity of variants of decisions and parameters of a method and parameters of the environment of decision-making. The result of increase in quantity of players, quantities of variants of decisions and a dispersion of estimations of current decisions are the reduction of convergence rate of a game neugent method.

Reliability of the received results is confirmed by repeatability of values of the calculated characteristics of a game neugent method of decision-making for different sequences of random variables.

Results of this work can be used for construction of the distributed control systems and decision-making under the conditions of uncertainty.

The research can be continued in a direction of use of other configuration of neugents and other methods of their training, information interchange between agents of stochastic game, increase in quantity of players and quantities of their pure strategies, definitions of theoretical conditions of convergence of a game neugent method.

Key words: collective decision making, uncertainty conditions, neuroagent stochastic game, adaptive learning methods.

Кут В.І. **Модель консолідованих даних дистанційного навчально-консультаційного центру осіб із особливими потребами**

A MODEL OF CONSOLIDATED DATA FOR DISTANCE LEARNING AND CONSULTING A CENTER FOR PEOPLE WITH SPECIAL NEEDS

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This paper investigates ways to improve the education of persons with disabilities through the development and implementation of consolidated data model for distance learning systems such as the category of persons. The issue of the specific model of creation of consolidated data for remote teaching and Counseling Center of persons with disabilities is discussed. In this case, the traditional Educational Technology, which makes use of modern information technologies of interactive learning, transformed into the distance.

The question of the development of technology use consolidated information for building the directory data in order to further their integration into the system of distance education of people with special needs. The architecture of the system integration of remote training and consulting a center for persons with disabilities must maintain a high level of generality, consistency and interoperability between system components. It should provide the minimum number of products to support various modes of data delivery, a single metadata repository with the ability to divide them among all the components and all modes of delivery and the overall development environment for all of these modes. Using consolidated data model in education for people with special needs will the help of improving the quality of education, teachers interact better with students and significantly improve the effectiveness of the learning process for this category of students.

Key words: complex software Moodle, a model repository, consolidated data.

Кушнірецька І.І., Кушнірецька О.І., Берко А.Ю. **Застосування онтологій і метамоделей для динамічної інтеграції слабкоструктурованих даних**

ONTOLOGIES AND META-MODELS APPLICATION FOR DYNAMIC INTEGRATION OF SEMISTRUCTURED DATA

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This paper discusses the use of ontologies and meta-models for the creation of the system of dynamic integration semi-structured data.

The aim of this work is the usage of existing technologies to create a tool that allows end users to extract the unified information from multiple heterogeneous data sources, providing the necessary data transformation and use concepts that are understandable to the user.

The task of data integration is to connect data from different sources and provide users with a unified representation of the data, including the possibility of giving the user interesting information upon request. Data integration system frees the user from having to select different data sources, which contains the information the user needs, to refer to each source separately and manually compare and merge data from different sources.

The object of research is the process of dynamic integration of semi-structured data in web-systems. The process of converting semi-structured data into structured information has been described. The subject of research is the use of ontologies and meta-models for dynamic integration of semi-structured data in web-systems.

Scientific novelty and practical value are in the use of ontologies and meta-models for the creation of dynamic integration of semi-structured data in web-systems, taking into account the integration of data at different levels of complexity: physical, logical and global.

The article shows the functioning of the Universal Browser of dynamic integration of semi-structured data in web-systems. The conceptual model of a universal data storage structure has been described. The principles of work of the Universal Browser, which has been described in the paper, can be used for creating the web-systems of dynamic integration of semi-structured data of various nature.

Key words: dynamic integration, ontology, meta-model, web-system.

Литвин В.В. **Метод використання онтологій у петлі OODA**

A METHOD OF USING ONTOLOGIES IN OODA LOOPS

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The research discusses behavior modeling of the intelligent agent which functions in a competitive environment. To simulate the behavior OODA loop (observation, orientation, decision support, action) is selected. To improve the efficiency of OODA loop the use of the domain ontology is proposed, which operates within the intelligent agent and problem area ontology. The influence of stages of OODA loops on content ontology and vice versa as the content of the course ontology passing phases are given. An interaction between ontology and stages loops OODA is described. The task of planning of intelligent agent in a competitive environment is reduced to the problem of dynamic programming.

There are two main ways to achieve competitive advantage in the implementation of various types of professional activities. The first one is to make their cycles act faster quantitatively. This allows deciding and force competitors to respond to our actions. The other way is to improve the quality of decisions, i.e. make decisions that correspond to a greater extent to the situation than competing solutions.

Improving the quality of their solutions can be achieved in various ways, which include usage of modern formal mathematical methods, automated control systems, decision support systems and expert systems. If you prefer the last one, a modern approach to their construction is used as the core ontology's knowledge base. Therefore, the challenge is to develop methods for the use of ontologies in OODA loops.

It is proposed to use the intelligent system for OODA loop simulation. The ontology is the core of knowledge base in intelligent system. It consists of a domain ontology and ontology of applications. Content ontology directly affects the second and third stages of the OODA cycle, and the structure and content of the ontology depends on the 1st and 2nd stages.

Key words: OODA loop, observation, orientation, analysis, synthesis, decision support, action, ontology.

Лупенко С.А., Луцик Н.С., Лупенко А.М., Стадник Н.Б. **Лінійний циклічний випадковий процес як математична модель тестових коливних сигналів у інформаційних системах діагностики, аутентифікації та прогнозування**

CYCLIC LINEAR RANDOM PROCESS AS A MATHEMATICAL MODEL OF TEST OSCILLATING SIGNALS IN DIAGNOSTICS, AUTHENTICATION AND PREDICTION OF INFORMATION SYSTEMS

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The study is concerned with solving the actual scientific problem of developing mathematical models of a wide class of cyclic signals, which takes into account more subtle regularities of spatio-temporal patterns of simulated signals that should have a common, universal nature and, as a result of the generation algorithm parametrical

identification means availability, would provide the ability to manage morphological characteristics and properties of cyclic rhythm simulated signals that are necessary in the design and testing of information systems of different nature and purpose (infocommunication, information-measuring and diagnostic information systems).

To achieve study purpose it was necessary to solve the following tasks: to set the conditions to be met by the kernel and probabilistic characteristics of linear stochastic process generated process to be cyclic random process, to give the definition of cyclic linear random process which combines the properties of a linear stochastic process and cyclic random process, allowing the extension of using the constructive approach to the description of cyclic signals in the theory of linear stochastic processes and their generalized mathematical model as a linear periodic random process, and also to give the specific examples of cyclic linear stochastic processes.

The object of the study in this paper is the simulation of cyclic signals using the theory of linear stochastic processes and theory of cyclic random processes. The subject of the study is a mathematical model of a broad class of cyclic signals, taking into account their repetitive nature, stochasticity, variability of fluctuations rate and is suitable for the tasks of simulation modelling on a computer or on a specialized hardware and software cyclic signals generator. In this paper for the first time the cyclic linear random process is defined which combines the properties of linear and cyclic stochastic process. This enhances the possibilities of cyclic signals description in the theory of linear stochastic processes and their generalized mathematical model known as a linear periodic random process. Linear cyclic stochastic process is characterized by ample opportunities for its use as a mathematical model of testing oscillatory signals in the problems of training and testing of information systems for cardiac diagnostic decision-making, information systems, biometric person authentication, and econometric information systems for decision-making on the basis of predicted data. The conditions to be met by the kernel were discussed and probabilistic characteristics of linear stochastic process generated process to be a random cyclic process. Examples of cyclic linear modelling of random processes with factorized kernel were presented.

Key words: information systems, cyclic test, linear cyclic stochastic process, mathematical model, the function of rhythm, factorized core

Любінський Б.Б., Пеняк І.О. **Архітектура спеціалізованого програмного модуля ГІС: побудова карт векторного формату**

THE GIS-MODULE ARCHITECTURE: VECTOR FORMAT CONSTRUCTION

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A modern geographic information system has a possibility to reflect the relevant cartographic information with a further analysis. The specialized greenhouse gas inventory system predicts the development of the displaying, analysing and saving modules along with the similar ones for the construction of appropriate digital maps. The general approach to the preparation for such a construction in terms of computer science lies in the respective digital vector cartographic data transformation. For the maps digitizing purposes the specialized software usage is needed. It's required for the raster maps digitizing into the vector ones as well as for the received cartographic data classification. On the other hand, for the initialization of the Spatial GHG inventory the respective digital maps as well as various statistical information with numerous parameters become an input data. It should be noted that appropriate economic activity statistic info can be retrieved free from the centralized statistical offices whereas digital maps service for the analyzed area is paid for. That's why creation of algorithms along with the respective design of the modules for the vector format maps constructing are an urgent tasks. Thereby the main aim is the design with further development of an entire architecture for the vector format maps construction module needs. We should consider that it can be achieved only with the respective physical maps analysis with subsequent attribute information binding. The output maps are commonly used for the analysis and spatial GHG Inventory at the regional level as well as for the visualization of the obtained results. In this paper the basic requirements for the vector format maps constructing module is formulated. The appropriate algorithm of digitized raster maps into the vector ones is described. The flexible architecture of the converting module along with the ability to assign attribute information is designed. An algorithm for the graphics map primitives scaling and positioning is built as well as the features of functioning of such a module in terms of specialized software are caused.

Key words: software, geoinformation technology, vector format, architecture, inventory, spatial analysis.

Мельникова Н.І., Шаховська Н.Б., Кісь Я.П. **Застосування теорії автомата Мілі для формування стану пацієнта**

AN APPLICATION OF THE THEORY OF MEALY MACHINE FOR MODELLING OF THE PATIENT'S MEDICAL CONDITION

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This article discusses the implementation of the decision making process in support systems of medical decision (SSMD) by means of the theory of finite Mealy machine, which allows adequate treatmentby evaluating the patient's current state.

Creation and implementation of the new technologies of personalized medicine contribute to the further study of new personalized approaches during the analysis of individual patient's data; development of new methods for treatment assignment and personal risk assessment of diseases based on the quality of patients' life; development of recommendations regarding drug therapy based on patient characteristics.

To improve the effective treatment of patients it is important to introduce quantitative criteria for evaluating the patient, according to which a valid approach in decision-making of determining the diagnosis or choice of treatment schemes is made. Based on this, a full examination of the patient should be carried out, and then his/her overall condition is evaluated. The evaluation of the general patient's condition is based on a comprehensive assessment of number of indicators that characterize: the state of consciousness, motor activity and social dependence.

When developing methods for personalized approach for assignment of treatment there is a need in the use the indicators of integrated assessment of the patient's condition during the treatment will allow objectify these dynamic changes taking place in the patient's condition under the influence of therapy and to choose the most appropriate therapeutic interventions in the treatment of the patient. The assessment after treatment compared with original data showing the efficiency spent therapy.

So using a tabular representation of transitions and outputs of MLS2-finite machine for example, enables SSMD formalize the characteristics of the patient, which appear as input parameters , and specify the raw signals to the pharmacological treatment prescription schemes, while the system's state corresponds to the patient's medical condition. Coding of the signal MLS2-machine that characterizes decision making in SSMD is based on the concept of theory of Mealy machine and provides an opportunity to correct treatments by evaluating the current patient's condition and determining the weight of outputs of MLS2-machine which changed the therapeutic scheme.

Taking into account the paradigm of the theory of automata, we propose the implementation of the decision making process with SSMD tools that give input signals in the form of the data of the patient, and their processing of the internal state of the machine that is the patient's medical condition and create the final conclusion in the form of the output signals, which are standard conservative treatment schemes.

Key words: support systems of medical decision, Mealy machine, patient's current state.

Різник В.В. **Багатовимірні моделі систем кодування на симетричних та асиметричних групах**

MULTIDIMENSIONAL MODELS OF CODING SYSTEMS BASED ON SYMMETRIC AND NON-SYMMETRIC GROUPS

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The objective of the paper is improving the qualitative indices of vector data coding systems with respect to reliability, and other significant operating characteristics of the systems based on the combinatorial configurations theory, namely the principle of optimal cyclic proportions (OCP). Research into the underlying mathematical models relates to the optimal placement of multidimensional digit weights in vector code combinations. Some problems of computer engineering and information technologies which deal with profitable use of mathematical models and methods for optimization of systems based on the multidimensional combinatorial configurations such as multidimensional Ideal Ring Bundles (IRB)s are discussed. Properties of underlying models function favorably with

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fundamental laws of symmetry and asymmetry interrelation taken into account. Special attention is paid to geometric interpretation of symmetric groups and its asymmetric subgroups interrelations. The combinatorial model of the complementary relations of 2D uniform fields and its multidimensional transformations with an ability to reproduce the maximum number of combinatorial varieties of complementary non-uniform subfields of the fields as the hypothetically informative field of harmony is discussed. In this reasoning the model is preceded from the remarkable properties of circular symmetry as the complementary combinatorial asymmetrical structures and multivariable of its ensembles. The possibility of application of a new class of spatial groups using multidimensional symmetrical and non-symmetrical combinatorial configurations for vector data coding design with minimal number of the digit weights is shown. Mutual connection of the symmetrical and asymmetrical groups with algebraic structures in Galois fields is discussed. A new multidimensional conceptual model of profitable vector data coding systems based on application of symmetry and non-symmetry relationship combinatorial properties was proposed.

The optimal cyclic proportions (OCP)s and multidimensional Ideal Ring Bundles (IRB)s provide new conceptual models of the optimum coding systems. The optimization has been embedded in the underlying combinatorial models, which provide an ability to reproduce the maximum number of vector code combinations in the coding systems with a limited number of vector data digits, while all consecutive symbols "1" as well as "0" in the cyclic combinations are arranged together as so-called "IRB-monolithic code". This property allows improving reliability of code because all combinations as being non identical in consecutive symbols are forbidden combinations. The favorable qualities of the multidimensional Ideal Ring Bundles (IRB)s are based on the underlying symmetrical and non-symmetrical combinatorial relationships provide opportunities to apply them to advanced vector data information technology, including applications to coded design of 3D signals for communications and multidimensional vector processors.

Key words: information technology, mathematical model, system, combinatorial configuration, optimization, structure, symmetry and asymmetry interrelation, group, Galois field, vector data coding.

Ришковець Ю.В. **Архітектура програмного комплексу побудови адаптивних Веб-галерей**

INFORMATION MODEL OF ADAPTIVE WEB-GALLERY

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This article aims at describing the architecture development of software suite for building Web-galleries with both adaptive and dynamic structure.

The Web-galleries functioning processes are the object.

Methods and means of developing Web-galleries with adaptive structure are the subject of the article.

Scientific novelty of the article consists in contriving the methodology of the adaptive formation of the Web-gallery structure method use in the software suite.

The development of the architecture of Web-gallery software suite that implements the dynamic structure of the content personally for each user is the practical value of the article.

The architecture and functionality of a standard Web-gallery are considered. The architecture of software suite for building adaptive Web-galleries is introduced. It is argued that it should be supplemented by the components determining user's interests, such as: the component processing fuzzy time parameters allowing to determine user's interests based on areas of interest, searches and viewing exhibits, expositions and themes; the component of building the gallery that takes into account user's interests that enabled to implement the mechanism of the content adaptation to the user's interests based on influence, coefficients of interest and disinterest; and the component of consolidation of the content allowing to implement an automated consolidation of data from XML-document of various syntactic structure. This approach to the organization of Web-galleries aids in providing high adaptation of their structures and the information content to individual interests of each user. Besides, it facilitates to improve the relevance of such content. The user's interests model of Web-gallery in the software suite is adequate, since the obtained results show a high level of the system adaptation to the user's interests.

Key words: Web-gallery, user's interests, adaptation.

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Савчук Т.О., Петришин С.І. **Ідентифікація проблемних ситуацій та їх станів у складних технічних системах з використанням модифікованого алгоритму ФОРЕЛ**

PROBLEM SITUATIONS AND THEIR STATES IDENTIFICATION IN COMPLEX TECHNICAL SYSTEMS USING MODIFIED FOREL ALGORITHM

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The article describes the peculiarities of the problem situations and their states identification that is done via the use of modified FOREL algorithm of clasterization. The main difference of the modified algorithm from the classical one is in the user's ability to set the value of the quality indicator for clusters, which makes the algorithm flexible in analyzing problem situations and states in complex technical systems.

The study aims to improve the accuracy of identification of problem situations and states in complex technical systems by modifying the FOREL algorithm.

The main objective is to break the set of problem situations in complex technical systems and their states into disjoint subsets called clusters.

The object of research is the process of identifying problem situations and states in complex technical systems.

The subject of the study are the identification technologies of problem situations and states in complex technical systems.

Classical FOREL algorithm has been modified, so that the radius of the cluster is calculated based on the quality of clustering, which is entered by the user. To exclude the possibility of the emission in clusters (such problematic situations and their states that according to selected parameters and characteristics are remote from the main cluster of objects in the cluster), the analysis of each cluster and retrieval of problem situations are conducted after cluster formation. The retrieved problem situations are defined as emissions and referred to another cluster.

The proposed modified algorithm of clustering problem situations and states in complex technical systems, based on the FOREL algorithm, enables the identification improvement of the relative quality index partition by 4.6 %.

Key words: cluster analysis, FOREL algorithm.

Сєдушев О.Ю., Буров Є.В. **Методи видобування даних з баз нечітких знань**

METHODS FOR DATA MINING FROM FUZZY KNOWLEDGE BASES

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Fuzziness is an undeniable feature of real-world data captured and used as an input for information bases. Modeling of complex fuzzy dependencies is the main goal of using fuzzy knowledge bases. Intelligent analysis of such knowledge bases is impossible without special, fuzzy data mining methods and techniques. With their assistance, hidden knowledge, rules and patterns can be uncovered, internal contents can be refined and optimized. The paper aims to study and generalize such fuzzy methods and techniques, analyze their strengths and usage patterns, constraints, pros and cons compared with direct fuzzy knowledge bases mining, show simple examples of their usage and the output they produce. This work does not consider all existing fuzzy methods for data mining, but rather focuses on the set of the most effective and appropriate for paper's purpose. Therefore, an emphasis is put on fuzzy clustering, fuzzy decisions trees, fuzzy associative analysis, neuro-fuzzy networks and genetic fuzzy techniques. All of them are popular and definitely important for data mining problems nowadays. Paper describes in detail those methods, their usage patterns and applicability. It is shown that they are fully usable for specified tasks of mining fuzzy knowledge bases. As a recommendation, every fuzzy method and technique considered here has to be used with prior analysis due to always specific user needs, changeable data domains and environments, and dissimilar tasks. There is no universal method to solve every possible issue concerning intelligent analysis of fuzzy knowledge bases. As a result of this paper, generalized comparison of fuzzy models is provided, including the purpose and features of every model type, and also common use cases in the context of mining fuzzy knowledge bases. In general, these models can be utilized to accomplish a great variety of objectives such as building fuzzy clusters and fuzzy associative rules to reveal complex patterns of customer activities from sales databases.

Key words: fuzzy data mining methods, fuzzy rule base, fuzzy logic, knowledge base.

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Сікора Л.С., Лиса Н.К., Якимчук Б.Л., Марцишин Р.С., Міюшкович Ю.Г. **Термінальні та ситуаційні проблемні задачі інформаційного забезпечення опрацювання даних оператором від інформаційно-вимірювальних систем для АСУ-ТП складними об'єктами**

TERMINAL AND SITUATIONAL PROBLEM TASKS OF INFORMATION SUPPLY FOR HUMAN-OPERATOR DATA PROCESSING FROM INFORMATION-MEASURING SYSTEMS FOR COMPLEX OBJECTS SCADA

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The relevance of the research lies in the fact that the corporate production systems are characterized by a hierarchical structure of the process, multi-level operational and administrative control. In such systems, when the unit is in the boundary modes (in the process of energy-active resources transformation), there is a crisis mode threat. Inadequate methods of situation assessment due to a failure of indicators measuring systems can lead to disorientation operational staff of SCADA, emergency. Similar situations may arise due to incorrect control. Therefore, the development of new information technologies for data selection, data processing and presentation of these data is an urgent task.

The purpose of the article is to consider the methods of scale information systems devices construction used for constructive data classification and decision-making process SCADA operator depending on the cognitive characteristics.

The object of the research is to study the information processes of the physical parameters that represent the state of energy technology units active in working structures and boundary modes of operation, as well as the possibility to represent this data to the operator attention by the display systems.

The subject are the methods and information technology of streams processing and their classification based on the use of regulatory and stochastic scales for measurement in measuring systems. The peculiarities of data perception by SCADA operator to control the current mode and extreme mode in the process of technological production structures are considered.

Novelty of the research is substantiation of the situation mapping model by the operator in the state space. The necessity to carry out the structuring of data for effective perception is suggested to increase the effectiveness of decision-making for the SCADA system.

The described model of situational data display can be applied as the basis for the development of a new type of display systems for SCADA.

Key words: information, the data, measurement.

Струбицька І.П. **Особливості програмної реалізації розпаралелення процесу побудови дискретних динамічних моделей**

SOFTWARE IMPLEMENTATION FEATURES OF PARALLELIZATION IN DISCRETE DYNAMIC MODELS CONSTRUCTION PROCESS

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The article is devoted to the analysis of the software implementation features of parallelization in discrete dynamic models construction process based on graphical multi-core processors.

Construction of dynamic models is a complex optimization problem which is difficult to solve in a reasonable time, even with the use of modern computer technology. So the creation of methods for building models that would provide the required performance and could be implemented on the available computer technology is important. Parallelization of the computational process which reduces the complexity of the algorithm is one of such methods.

SIMD-architecture was used for the task of parallelization. This architecture allows one to perform the same command stream for many data streams. Efficiency of the use of graphics processors for the discrete dynamical models construction task is justified. Using graphics processors for non-graphical computing is an emerging area of research. Technology CUDA and GPU NVIDIA was used for this software implementation. The benefits of CUDA

are shown in the article. This technology works on a large number of video processors NVIDIA, improves programming model of GPU, simplifies it and adds a lot of possibilities. The model of parallel computation using this technology is considered.

Features of the memory and copy data between graphical and central processors are analyzed because performance of applications depends on the speed of work with memory. The synchronization use in the program is analyzed. The generalized scheme of discrete dynamic models construction using GPU is shown.

New software for discrete dynamic models construction which uses GPUs is characterized by lower time complexity as opposed to sequential.

Key words: GPU, CUDA, parallel computing, parallelization, discrete dynamic models.

Струбицький Р.П., Шаховська Н.Б. **Аналіз інфраструктури та моделей організації хмаркових сховищ даних**

INFRASTRUCTURE AND MODELS ANALYSIS OF CLOUD DATA WAREHOUSE

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The paper analyzes the architectural approaches to building cloud data warehouses. The different approaches, including concentrated and distributed storages, were examined and effectiveness of their use was analyzed.

Cloud storage is a model of networked enterprise storage where data is stored in virtualized pools of storage which are generally hosted by third parties. Hosting companies operate large data centers, and people who require their data to be hosted buy or lease storage capacity from them. The data centre operators, in the background, virtualizes the resources according to the requirements of the customer and expose them as storage pools, which the customers can themselves use to store files or data objects. Physically, the resource may span across multiple servers and multiple locations. The safety of the files depends upon the hosting companies, and on the applications that leverage the cloud storage.

Cloud storage services may be accessed through a web service application programming interface (API) or by applications that utilize the API, such as cloud desktop storage, a cloud storage gateway or Web-based content management systems.

As shown in the analysis of different approaches to the storage infrastructure and storage of models, currently there are highlighted several major directions in the design of cloud repositories. Choosing the best embodiment mainly depends from the implementation of the logical storage and calculation load, as the rapid development of communication constantly reduces prices for inter-network communications. In turn, the cloud storage logical structure is determined by its functional purpose such as quick and widespread access to data, regardless of user location data.

Key words: STaaS, cloud computing, cloud data warehousing

Ткачук Р.Л., Сікора Л.С. **Системні та інформаційні динамічні компоненти і логіко-когнітивні моделі темпоральної дійсності при прийнятті оперативних рішень**

SYSTEM AND INFORMATION DYNAMIC COMPONENTS AND LOGICAL-COGNITIVE MODELS OF TEMPORAL REALITY IN MAKING OPERATIONAL DECISIONS

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The interest in the phenomenon of psychological time is due to the active principle of human life and the basic need of the individual to be the organizer of his/her own living space. This phenomenon is of utmost importance at the time when a person faces important decision making, especially within a short time interval in stressful situations.

The purpose of the article is the exploration of problematic task of evaluating the time perception in arriving at goal-oriented solutions by the automated control systems provider.

The object of research is time.

The subject of the study is formation of operational decisions.

Novelty lies in the description of the logic-cognitive model of decision making in the context of the target space of time, which is based on the composition of two types of components, that is: the component of the logical data processing and cognitive component. The first type includes information to select the strategy of human behavior under conditions of threats, the second one incorporates incomplete and unclear polytypic data that reflect the operational situation.

The practical value lies in the approach considering the man as a system creature whom a temporal structure (individual immanent dynamic layer which is based on physiological processes and activities including conscious and unconscious diverse structures and mechanisms) is inherent. Thus, it is possible to predict the timing of the final objective goal-oriented solutions and implement appropriate actions planned.

Conclusion. In the paper we analyzed and showed that the cognitive structure of the individual contains immanent temporal layer of personality that deepens with the development of consciousness. Due to the temporal structure a people have the capability to constructively – in accordance with the terms of the technological situation – take their bearings in temporal space: objectively reflect in mind the duration and the sequence of phenomena; refer to their own experience; simultaneously predict and design the future; apprehend and influence upon certain events; and use their own history in present modus by means of subconscious mechanisms, which allows to build brand new experience in the current moment.

Key words: logical and cognitive model, time interval, temporal structure, information, data processing, situation.

Цмоць І.Г., Теслюк В.В., Ваврук І.Є. **Архітектура та модель управління рухом мобільної робототехнічної системи**

ARCHITECTURE AND MODEL OF MOBILE ROBOTIC SYSTEM MOTION CONTROL

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The purpose of the paper is to formulate requirements, choose approaches and design principles, develop architecture and the motion control model for the mobile robotic system which takes into account the basic kinematic and dynamic characteristics of the system.

The main objectives of the paper are: the development of the architecture for the mobile robotic system, which is based on combining two types of architectures and the motion control model development for such mobile robotic system.

The object of the research is the process of the mobile robotic system motion control.

The subject of research is the architecture and the control model of the mobile robotic system.

The architecture and the model of the mobile robotic systems motion control are developed on the basis of the research. The new results are obtained, such as:

• The architecture of the mobile robotic system is developed based on an integrated approach, taking into account modern components and tools of the mobile robotic system, methods and algorithms for intelligent control and for data evaluation from sensors in terms of noise and incomplete information, methods and tools for computer-aided design of hardware and software for the mobile robotic system.

• The model for the motion control of a wheeled mobile robotic system is developed that takes into account the environment parameter and the parameter of the robotic system for determining the velocity of the wheels to prevent skidding.

The practical value of the results:

• The usage of the developed architecture for the mobile robotic system provides its adaptation to the requirements of specific applications;

• The usage of the developed model for the motion control enhances the control precision when the environment parameters or the parameters of the mobile robotic system are undergoing changes.

The main results are obtained by the authors independently and include the following: the basic requirements for the mobile robotic system and its individual components are formulated; the construction principles of the mobile robotic system that takes into account the basic requirements for the mobile robotic system are defined; the architecture of the mobile robotic system that consists of a kernel and hardware and software interchangeable modules is developed; the motion control model that takes into account the environment parameter and the parameter of the robotic system is proposed.

Conclusions:

1. The requirements for the mobile robotic system and its individual components are formulated. The main are: size and weight reduction; high mobility; reduction of energy consumption and the increase in the mobile robotic system autonomous movement; high reliability and real time motion control.

2. We propose to use the following construction principles for the remote objects research mobile robotic system: hierarchy, the systematic, variable composition of equipment, modularity, openness, compatibility, coordination of data acquisition intensity with computing power of tools and the ability to use the basic set of design decisions.

3. The architecture of the remote objects research mobile robotic system is variable in composition, consisting of core and variable hardware and software modules that provide the adaptation to the requirements of specific applications.

4. The motion control model is developed to prevent the drift and to improve the accuracy of the mobile robotic system control, based on consideration basic parameters of the mobile robotic system and parameters of the environment.

Key words: mobile robotic system, model of motion control system, vision systems, ultrasonic distance sensors.

Шестакевич Т.В. **Інформаційно-технологічний супровід освітніх процесів для осіб з особ-ливими потребами**

INFORMATION TECHNOLOGY SUPPORT OF EDUCATIONAL PROCESSES FOR INDIVIDUALS WITH SPECIAL NEEDS

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The development and verification of the corresponding mathematical model is based on a comprehensive study of problems occurred in IT support of the education for individuals with special needs. The purpose of this paper is to analyze basic educational processes with the focus on people with special needs. To achieve this aim it is necessary to investigate the functional stages of the educational process for individuals with special needs, taking into account its specific characteristics. The educational processes for people with special needs are selected as an object of this study. The subject of the presented study is information technology support of the educational process for individuals with special needs. Scientific innovation of the results, achieved in this study, lies in substantiation of the applied scientific problem of educational process support for individuals with disabilities using modern information technologies. The methodological basis for the creation and application of the IT support complex of educational processes for individuals with special needs has been developed.

The author of this paper analysed the level of development of IT support, used to maintain educational process for individuals with special needs. Both in Ukraine and abroad the IT support of such process for this category is irregular, unsystematic. Algorithmic tools that are used to maintain the educational process are not linked; there is no systematic management of educational environment for persons with special needs. The author stresses the need of an integrated system of IT support for all phases of the educational process for individuals with special needs. The requirement of the personalization of individual educational requirements for this category of people is emphasized.

The study of the educational process for people with special needs allowed to distinguish its four stages: the collection of personal data, the analysis of collected data, a personal curriculum development and the assessment of individual educational progress. Moreover, the performance of each next stage depends on the results, obtained in the previous stage. Based on the results of this study, description and formal continuous model of education process management for persons with special needs were formulated. Such formal model allows individual planning of the educational process for persons with special needs, taking into account a large number of crucial factors.

Qualitative information and technological support of the educational processes for people with special needs is the latest scientific and practical task, accomplishment of which will help to facilitate the social adaptation process of individuals with special needs.

Key words: information and technological support, educational process for individuals with disabilities, special educational needs, inclusive education, individual curriculum.

Шпортько О.В. **Аналіз ефективності модифікацій алгоритмів графічного формату PNG**

ANALYSIS OF GRAPHIC FORMAT PNG ALGORITHMS MODIFICATIONS EFFICIENCY

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The principles of graphic format PNG algorithms for implementation of previous transformations and compression of images without losses are described.

The algorithm of the LZPR curriculum development is introduced, which, unlike the context-de algorithm LZ77, executes the search of the longest identical sequence simultaneously in a few sliding windows of the results of different predictors applied. In case of effective search in the coded information three of numbers are introduced "length of identical sequence; displacement to the identical sequence; the number of the predictor used" and a sliding window is moved to the first element after an identical sequence. If identical sequences in the coded information are absent, the code of duty element is written down from a buffer predictor with the least entropy. Then, the coding proceeds from the next element.

The method and proper algorithm for determination of the optimum different coloured model with whole coefficients during the compression of RGB-images without losses with application of predictors is proposed. They allow to promote efficiency of context-independent compression. The algorithm estimates the expedience of replacement of each component based on the differences between two other components and elects at most two from these differences for the maximal reduction of entropy of brightness of the components of pixels of the image.

The influence of different combination variants of modifications of algorithms of previous processing and compression on compression efficiency is explored. As experiment shows, applications of all considered modifications enable additionally to decrease aspects of the compression of the set ACT in the format of PNG on average on 8.26 %, for example.

Key words: lossless compression of images, dynamic Huffman's codes, format of graphic files of PNG.

COMPUTING AND MATHEMATICAL LINGUISTICS

Висоцька В.А. **Особливості генерування семантики речення природною мовою за допомогою породжувальних необмежених та контекстозалежних граматик**

PECULIARITIES OF SENTENCE SEMANTICS GENERATION IN NATURAL LANGUAGE VIA GENERATIVE UNRESTRAINED AND CONTEXT-SENSITIVE GRAMMARS

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The research of the application of mathematical methods to the texts analysis and synthesis in natural language is of paramount importance in the mathematical algorithms and software development of natural language texts processing. The generative grammars device (introduced by Noam Chomsky) simulates processes at the syntactic level of natural language. The structural elements of the sentence describe syntactic constructions, regardless of their content. The article provides a profound insight into the peculiarities of the sentences synthesis process in different languages that makes use of generative grammars. The paper considers the influence of language norms and rules on grammars construction stages. The generative grammars assistance has great potential in the development and creation of automated systems for multilingual information processing and linguistic software for linguistic computer systems, etc. There are cases in natural languages where the phenomena (that depend on context) are described as independent of the context, i.e., in terms of context-free grammars. These are the cases in which the description is complicated due to the new categories and rules creation. This paper introduces the process peculiarities of the new restrictions on the introduction of the grammars classes through the new rules introduction. Provided the symbols number in the right side of the rules is not less than in the left one, unabbreviated grammars have been attained. Then context-sensitive grammars have been produced on replacing only one symbol. Having the one symbol only rule in the left side, has resulted in context-free grammars. No other natural constraints on the left side of the rules could be further imposed.

The application of the generative grammars theory to problems solving in applied and computational linguistics at the level of morphology and syntax allows:

- to develop systems of language and texts synthesis;
- to create textbooks with practical morphology;
- to form derivational tables;
- to compile the morphemes lists (the affixes, the words basis and roots);
- to determine the performance and frequency of morphemes;
- to calculate the realization frequency of different grammatical categories in texts (genus, case, number categories, etc.) for specific languages.

The developed models on the basis of generative grammar are used for functioning maintenance of the analytical-synthetic processing of documents in computer linguistic systems, information search systems and other. It is useful to introduce newer and newer restrictions on these grammars, yielding narrower and narrower classes of them. Describing the complex range of phenomena, the set of description tools used is restricted, and tools that are obviously insufficient in the general case are considered. The research is started with minimal resources and tools and whenever they appear insufficient, new tools (possibly a restricted number) are gradually introduced. This leads to the possibility to determine exactly what tools can / can not be sufficient in a particular phenomenon description, and thus – to better understanding of its nature. Prior to the advent of mathematical language models, this approach was not applied in linguistics. Its consistent implementation is due to grammar theory and mathematical linguistics in general.

The known methods and approaches for the problem solving of automatic processing of natural language information are considered in the article. Also, advantages and disadvantages of existing approaches and results in the syntactic aspects of computational linguistics are identified in the paper. The general conceptual principles of derivational modelling processes in the texts corpus formation of Ukrainian and German sentences examples are introduced in this work. Besides, the author has proposed the syntactic models and derivational classification of lexical structure for Ukrainian and German sentences, lexicographical rules of syntax type for automated processing of these sentences are formulated. The proposed methodology achieves higher reliability standards compared with known analogues. And they also demonstrate the high efficiency of the new information technology applied applications design in lexicography and the inflectional effects research of natural language. The work has practical value, since the proposed model and rules allow effectively organize the process of the development of lexicographical systems of syntactic type.

Key words: generative grammar, structured scheme sentences, computer linguistic system.

Вовк О.Б. **Аналіз та обгрунтування вибору методів дослідження інформаційного продукту**

ANALYSIS AND RATIONALE FOR METHODS SELECTION OF INFORMATION PRODUCT RESEARCH

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The development of high-quality information products (IP) based on technical criteria is not difficult, and for each IP class default design decisions are defined. However, the prediction of its future condition based on the analysis of its past and present, systematic information about the qualitative and quantitative characteristics of this information product, its prospective behavior and consideration of additional criteria trigger significant complications. They are related to the IPs being conflicting or complete/partial similarity of different groups criteria, etc.

Thus, it is important to choose methods of the information products research, analyze opportunities of their application to information products in general, and websites in particular. Also, it is necessary to outline the main difficulties that arise in this case, in order to predict future states of an information product.

Summarizing the above mentioned, it can be argued that in modeling and predicting future states of information products, a combination of these methods should be used. This will counter the fuzzy objects that have vague meaning with well-defined modeled elements via distinguishing the provision of simple representations and commitment of its elements.

The article is dedicated to the research methods of an information product, methods of analysis of its performances, methods of forecasting future states of an information product. The major complexities involved have been outlined.

Key words: an information product, information technology, a web-site.

Вовнянка Р.В., Досин Д.Г, Ковалевич В.В. **Метод видобування знань з текстових документів**

DATA MINING FROM TEXT DOCUMENTS

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The approach to creating a computer system of an automated development of basic ontology is described in the article. This approach is based on natural language text documents analysis. The method for semantic analysis of documents using the software Link Grammar Parser and machine learning techniques is discussed. Machine learning tools operate along with OWL-ontology. Ontology provides grammatical and semantic structure patterns for the statements recognition (logic predicates of 1st order) in researched and / or educational texts. As a result of such recognition, new items are added to the ontology.

The text corpus consists of different text documents, each of them containing from 1 to 10–20 sentences. These sentences are in sequential logical connection. The text is divided into an ordered set of sentences. The sentences consecutively undergo the basic procedure of recognition. Complex sentences are divided to simple sentences by means of parsing. Substitution of pronouns by nouns of the first part of the sentence to which these pronouns refer to is performed in the process of separation. The preparation of sentence proposals is carried out so that the algorithm can clearly identify all the concepts involved in the formulated sentences in future. There are also differentiated generalized concepts (classes) and specific concepts (instances of the corresponding classes).

The architecture of ontology synthesis system is designed. The basic modules of the system and their purposes are described. The choice of software tools for the practical implementation of the system is justified and practical implementation of the proposed method is done. The functionality of the developed system has been tested. The system allows in automatic mode to fill in the ontology of a domain.

It is proposed to use the intelligent system for OODA loop simulation. Ontology is the core of knowledge base in the intelligent system. It consists of the domain ontology and the ontology of applications. The content ontology directly affects the second and third stages of the OODA cycle, and the structure and content of the ontology depends on the 1st and 2nd stages.

Key words: ontology, learning ontologies, intelligent agent, knowledge base, text document.

Голощук Р.О., Федорів М.Л. **Консолідований інформаційний ресурс маркетингової діяльності книготорговельної мережі Видавництва Львівської політехніки**

CONSOLIDATED MARKETING INFORMATION RESOURCE OF LVIV POLYTECHNIC PUBLISHING HOUSE

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This paper studies the methods of modeling of consolidated marketing information resource at the Lviv Polytechnic publishing house bookselling chain.

The notion of information resources consolidation is associated with the need to make effective decisions using modern information technology.

While working with large volumes of data their image and visibility plays an important role, thus increasing work efficiency and quality. Consolidated marketing information resource at the Lviv Polytechnic publishing house bookselling chain helps to promote its business opportunities and increases its competitive edge.

The obtained results that are of scientific value help to demonstrate further need to develop consolidated marketing resource activity at bookstore chain of Lviv Polytechnic.

We stress the following aspects:

– the consolidation of information resources of marketing activity at bookstore chain of the Lviv Polytechnic publishing house is developed for the first time;

– simulation of the information system based on information resources consolidation.

The author of the presented paper reports the information system development. The model of bookselling which is the alternative to the existing one and provides time economy and boost of work quality is proposed through resource consolidation.

Obtained results can be of practical value in registering information on books and their publishing houses at the Lviv Polytechnic publishing house. Besides, findings give the possibility to conduct a full and comprehensive analysis of data and ensure the information access without delay. The profitability of cooperation analysis can be conducted by the system as well as the provision of the necessary information on request in the form of a spreadsheet, reports.

Key words: the publishing house of Lviv Polytechnic, bookselling network, consolidated information resource, marketing activity.

Давидов М.В. **Граматична корекція речень з використанням графу взаємовиключних гіпотез**

GRAMMAR BASED CORRECTION OF SENTENCES USING MUTUALLY EXCLUSIVE HYPOTHESES GRAPH

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The main goal of this article is to study possibility of word correction in Ukrainian sentences based on grammar and context knowledge. The problem of automatic word correction is a common problem for speech recognition, OCR applications and word processors. Known approaches for word correction are based primarily on word input model and dictionary. However the benefit from using context and sentence grammar is not completely studied for this purpose.

A context model based on word form repeat rate and grammar model based on dependency grammar is utilized to imply correct word correction from a set of dictionary based suggestions. The idea of using word context is based on assumption that words repeat in text fragment in the same of other word form. In order to verify this assumption an experiment with legislation, scientific and fiction texts was conducted. The experiment shows that probability of word from repetition in 1000 words fragment is near 80 % for legislation, 7 5% for scientific and 60 % for fiction texts. The use of context model based on word repetition rate increases automatic word correction rate from 14 % up to 32 % for ambiguous corrections.

The use of dependency grammar model for word correction requires processing of sentences induced by word correction suggestions from dictionary. The plurality of word suggestions greatly increases number of grammar parsing variants. Mutually exclusive hypothesis graph is used to combine all word grammar cases into one graph that is used to find the most appropriate word correction that increases probability of correct sentence grammar model. The use of grammar model leads to further increase in automatic word correction rate from 32 % to 37 % with use of context model and from 14 % to 22 % without.

The increase in word correction rate in conducted experiments shows prospects of using context and grammar models for automatic word correction. However the used context and grammar models require further improvements to incorporate information about widely used word structures. Knowledge mining from the text and subject area can also help to increase correction rate.

Key words: natural language processing, dependency grammars, automatic error correction.

Демчук А.Б. **Основні прийоми і способи тифлокоментування**

BASIC RECEPTIONS AND METHODS OF TYPHLOCOMMENTS

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In the article the problem of video access of people with total or partial loss of vision are analyzed. Due to the growing number of applied research a development of the newest technologies for situation improvement of the people with physical disabilities is taking place. Therefore, development of methods and means of access to video content for blind people is a promising area of research. Typhlocomment considered as a method for blind adaptation of video content. When researching the problem of access of weak-sight people to the video content, it is required to understand that more than a most part of the information is provided to the viewer in the form of an image. Yes, blind

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people hear all words of actors, sounds of the environment, processes at the screen, but it is difficult for them to identify the person to whom the specific words belong, what happens with heroes at the very specific moment, what is depicted in the given scene, it is difficult for them to understand reaction of actors, which the latter often express with the help of movements or mimics. Typhlocomments to video content for blind people are one of the real steps towards solution of the problem of limitation of access to such content. This is not only way of adapting the visually impaired, as this method provides equality of opportunities in access to heritage society, popular culture, art and science.

The model problem of manufacturing quality videocontent to people with visual impairments, systematized appropriate rules and methods to create typhlocomments to be followed by screenwriters, typhlocommentators in preparation for the creation of video content for the blind people. There are specific requirements in the preparation typhlocomments sports telecasts and competition, foreign movies and concerts. The mathematical model of this problem, developed an approach to solving it. The mathematic model of such a task is given and an approach of solving it has been worked out.

Key words: typhlocomment, typhlocommentator, films for sightless, informational technologies, description of the subject, videocontent.

Жежнич П.І., Сопрунюк О.О. **Особливості формування інформаційного забезпечення туристичної діяльності**

FORMATION PECULIARITIES OF TOURISM
ACTIVITY INFORMATION SUPPORT

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The purpose of the paper is to analyse formation features of tourism activity information support; justify the use expedience of data consolidation as integration method of heterogeneous information in tourism sphere; clarify importance of the analysis and monitoring of tourism product consumer opinion; create generalized scheme of formation process of tourism documentation by identifying and filling its gaps.

According to the paper purpose objectives of the paper are the following: to highlight the main characteristics of the tourism activity information support; to compare advantages and disadvantages of existing methods of data integration by using them in tourism information processing; to present the basic stages of tourism documentation gaps filling based on the analysis and monitoring of tourism product consumer opinion.

The object of the paper is formation peculiarities of tourism activity information support.

The subject of the paper is the formation process of tourism documentation.

The novelty of the paper lies in the fact that in the result of comparative analysis of data integration methods in the tourism sector the most expedient one, tourism data consolidation, was choosen. Also formation method of tourism documentation by using gap filling on the basis of analysis and monitoring of tourism product consumer opinion was suggested.

The practical value lies in the fact that the peculiarities list of information support of tourism activity gives the opportunity to choose the most appropriate integration method of tourism information and formation method of tourism documentation.

Information support of tourism activity is formed as a specific information product in the form of tourism documentation, which should meet the needs of tourism product consumer.

The most expedient integration method of tourism information is data consolidation, which allows to create the unique tourism information resource regardless the structure of the initial data sources.

One of the formation methods of tourism documentation is its gap filling on the basis of analysis and monitoring of tourism product consumer opinion.

Key words: information support, tourism documentation, data integration, consolidated information, open web-resources, information quality, gaps.

Кульчицький І.М. **Технічні аспекти опрацювання комп'ютером природномовної інформації**

TECHNICAL ASPECTS OF COMPUTER PROCESSING OF NATURAL LANGUAGE INFORMATION

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The article deals with technical problems of natural language information processing by computer.

A large part of the modern world society — is its information space based upon the physical media, the lion's share of which exists in electronic verbal form. This space from one (let's call it "humanitarian") perspective is explored by the specialists in cultural studies, sociology, philosophy, journalism, philology and library science etc., and from the other ("technical") perspective — by the specialists in social communication (in our opinion, the technical component prevails in their studies) and informatics. The sphere of interests of the latter ones — is mostly internal representation of information in the electronic environment, its protection and transmission via information channels, technical side of information retrieval, and creation of the necessary linguistic software. However, experts of these two groups rarely contact with each other on a scientific level. As a result — each group has superficial and sometimes false representation of another's group problem, which, in turn, does not contribute at all to the functioning efficiency of the information space. The purpose of this article — is to partially eliminate this barrier.

In this article the specifics of natural language texts processing by computer are determined, the basic methods of their internal representation are overviewed, and the problems that accompany the creation and processing of texts in electronic form are presented. As a result, the following conclusions were made.

During automated processing of electronic texts computer deals not with symbols but with their bit sequences, organized in special codes.

There are a number of established and partially standardized code tables. Therefore, a set of texts, obtained from various sources, which is planned either to be used in scientific researches, or to be put in a particular repository, must be normalized – reduce all texts to one code table, check texts against correct punctuation (for example, check whether an apostrophe is always indicated as the same character), remove extra characters (such as multiple spaces in a row, empty paragraphs, etc.), unify the means and ways of text formatting and so on.

When typing texts it is necessary to use the polygraph rules of typing texts. To this end, the appropriate professionals should generalize these rules and harmonize them with the available code tables (ideally Unicode) and features of the most popular text editing programs and bring them to the widest possible audience.

Key words: information space, information environment, information society, computer technologies, character encoding, encoding standards.

Кунанець Н.Е., Веретеннікова Н.В. **Відкритий доступ до наукових інформаційних ресурсів: американський досвід**

OPEN ACCESS TO SCIENTIFIC INFORMATIVE RESOURCES: AMERICAN EXPERIENCE

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This article presents the detailed description of the basic linguistic concepts that are paid attention by American researchers in the pages of U.S. magazine "The Journal of Librarianship and Scholarly Communication", i.e. scholarly communication, open access, data citation, accessibility quotient, and institutional repository. Nowadays, the scholarly communication is becoming more accessible and sensitive to environmental changes in different scientific and cultural centres; the conceptual apparatus and the terminological principals in this field are also changing, as well as the new terms are emerging and need the investigation. Therefore, the librarian profession should promote the implementation of honest dialogue and the introduction of new terms and concepts into the scientific circulation. Some researchers believe that the information is disseminated among the scientific community through a process known as a scholarly communication. Furthermore, American specialists confirm that "open access" to scientific publications is an unobstructed access without financial, legal, or technical barriers, i.e. the access to scientific articles in the Internet. Also, American scientists introduce such concept as institutional

repositories that was borrowed by Ukrainian specialists. Institutional repositories are digital collections, in which the intellectual products of one academic community are processed and stored, their distribution is provided and the open access is given to them. In addition, such well-known concept as data citation should become a necessary final result of any author's publication and the reusing of it. American information workers have introduced the concept of accessibility quotient. This new measure helps authors and librarians in assessing and characterizing the degree of accessibility for a group of papers for individuals or interested scientific communities and it becomes the criterion that assesses the accessibility of peer-reviewed research produced by an individual or a group. In general, the academic libraries play an important role in the social and communicative process of qualitative information support for the American society, particularly on the campus area, providing the verified data and services for researchers of an institution. Therefore, there was appeared the increased need for providing "e-science" with qualitative data.

Key words: scholarly communication, open access, data citation, accessibility quotient, institutional repository.

Литвин В.В., Хрущ С.Б. **Підхід до автоматичної побудови функцій інтерпретації під час навчання онтологій**

THE APPROACH TO AUTOMATIC BUILDING OF FUNCTIONS INTERPRETATION DURING LEARNING ONTOLOGIES

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Research and development in the field of data mining in natural language texts and ontology's machine learning are analyzed. The necessity of automation building features for interpretations of concepts and relations in the ontology is given. The method of selection descriptive logics (DL) predicates from natural text is described. There is shown that this algorithm must be multistage and involve hierarchical multilevel recognition procedure for concepts, relations, predicates and rules are taken to the resulting ontology. English words correspond to some built-in predicates software tool Protégé-OWL are defined.

The text corpus consists of some text documents; each of them contains one to 10-20 sentences. These sentences are in sequential logical connection. The text is divided into an ordered set of sentences. Above these sentences consecutively basic procedure of recognition are executed. Complex sentences are divided to simple sentences by parsing tools. In the process of separation there is performed substitution of pronouns nouns of the first part of the sentence to which these pronouns refer. Preparation of proposals is carried out so as in the future the algorithm can clearly identify all the concepts involved in the allegations contained in the sentences. There are different generalized concepts (classes) and specific concepts (instances of the corresponding classes). After that there is finding the relationships corresponded to built-in predicates DL.

Key words: ontology, learning ontologies, intelligent system, knowledge base, interpretation, descriptive logic.

Лозинська О.В. **Застосування методу машинного перекладу на основі правил для перекладу з української жестової мови**

USING THE METHOD OF RULE-BASED MACHINE TRANSLATION FOR TRANSLATION FROM UKRAINIAN SIGN LANGUAGE

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Due to the growing number of applied research a development of the newest technologies for situation improvement of the people with physical disabilities is taking place. Therefore, development of methods and means of Sign Language (SL) translation into the text is a promising area of research. For easy communication with deaf people it is enough to develop a system of sign language translation into the text and vice versa. It is necessary to provide comfortable access to modern information resources presented in the information systems and networks for people who communicate using sign language. In order to achieve this objective a difficult problem of translation videos with a Sign Language into the text entry is to be solved. One of the striking differences between signed and

spoken languages is the lack of a formally adopted writing system for SLs. Translation of Ukrainian Sign Language (USL) is a complex task, that requires the analysis grammar of USL, building rules for translation of Ukrainian Sign Language into text and vice versa. Sign Language is characterized by its interactivity and multimodality, which cause difficulties in data collection and annotation. For our research we built a corpus that contains 220 sentences on Ukrainian Spoken Language and their respective translations on Ukrainian Sign Language. They are stored in a text file. Ukrainian Sign Language is annotated by gloss. Glosses are written words, where one gloss represents one sign. Ukrainian Sign Language nouns and verbs do not have any case endings, so it is mostly the word order that tells you where things are in a sentence, and how they interact. Using of the rule-based machine translation for the Ukrainian Sign Language are considered. The basic principles of transforming from Ukrainian Sign Language into Ukrainian Spoken Language are described. The rules for translating into Ukrainian Spoken Language including grammatical features of Ukrainian Sign and Spoken Languages are selected. For evaluating the performance of the system, the following evaluation measures have been considered: WER (Word Error Rate) and PER (Position Independent Error Rate). In our experiments, a rule-based translation module reaching a 58,42 % WER and 36,67 % PER.

Key words: Ukrainian Sign Language, bilingual corpora, rule-based machine translation, grammar.

Лупенко С.А., Хомів Б.А. **Інформаційна технологія та програмна система оцінювання опінії висловлювань**

INFORMATION TECHNOLOGY AND SOFTWARE FOR SENTIMENT ANALYSIS OF MENTIONS

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Over the past few years the number of researches and publications in the field of opinion mining has extremely increased. This is due to the rapid growth of Internet resources, the increasing number of discussion boards, using social networks, which in turn led to an increase in the analyzed data and growth into an era of BigData. Thus a new industry of Opinion Mining and Sentiment Analysis in text data of online resources was formed. The article describes the following approaches to opinion mining as machine learning methods, using vocabulary sets and templates of sentences, semantic relations and understanding the meaning of sentences.

The aim and objective of this article is the development of information technology and software for evaluation value of opinion.

Subject of research – the process of decision-making problems in opinion mining and sentiment analysis.

Object of research – mathematical models, methods and tools for the classification of text documents in problems of opinion mining.

Research methods are based on the methods of set theory, graph theory methods, methods of probability theory, fuzzy logic methods, methods of classification of text documents, opinion mining.

Scientific novelty of the results:

1. The first time a generic algorithm for evaluating of opinion of object and the bringing together of numerical values of sentiment into a single integrated parameter using linguistic variables and weights was proposed.

2. The first time the information technology of opinion mining using linguistic variables and calculating the integral index of components of the object and the object in general was proposed.

The practical significance of the results:

1. Web-oriented system to calculate the weighting coefficients and integral index of opinion of object and compare objects according to quantitative indicators of user's opinion was designed and implemented. API was implemented which allowing a connection to a third-party software.

2. Information technology of opinion mining of textual information for the analysis of comments on the Internet was proposed.

Personal contribution of the applicant. The author got the basic statements and the results of scientific research on his own. Generalized algorithm of opinion mining and the bringing together of numerical values of sentiment into a single integrated parameter using linguistic variables and weights was substantiated. Software of the algorithm for calculating weighting coefficients and integral index by positive, negative and neutral mentions of users was developed.

Conclusions:

1. Information technology of opinion mining that allows to figure on the following important steps in calculating of opinion as semantic analysis of sentences and using linguistic variables for the purpose of expanding the range of possible values of opinion of object to improve the calculation of the generalized evaluation of the object was proposed and developed.

2. Software based on described information technology of opinion mining allows to calculate the weights component of object and integral indicator to compare multiple objects was developed.

Key words: opinion, sentiment, sentiment analysis, object, integral indicator, linguistic variable, weighting coefficient.

Марковець О.В., Олійник І.І. **Моделювання процесів опрацювання електронних звернень громадян до органів місцевого самоврядування за допомогою засобів GPSS на основі консолі-дованої інформації**

PROCESS MODELLING OF THE CITIZENS' E-APPEALS HANDLING SYSTEM USING GPSS TOOLS ON THE BASE OF COMPETITIVE INTELLIGENCE.

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The behavior reproduction of the system which handles citizens' e-appeals considering the results of basic relationships between its elements for providing different experiments is the main goal of the paper. Other purposes are to analyze quantitative indicators of the investigated system's work and to make management decisions for improvement the effectiveness of its functioning.

Effectuation of the main goal requires carrying out these tasks:

- Functioning effectiveness analysis of the system which handles citizens' e-appeals.
- Structural and functional modeling of the system.
- Making a conceptual model of the system.
- Building a scheme which shows the functioning of real processes of receipt and processing the appeals.
- Making a mathematical description of the system which handles citizens' e-appeals.
- Making an simulation model description.
- Programming of the model.
- Obtaining quantitative indicators of the system's work and making the check of model's adequacy.
- Checking the quality of system's work.
- Making management decisions towards further work planning of the system which handles citizens' e-appeals.

One of the most effective ways of management decision preparation under conditions of uncertainty and high dynamism of environment parameters is using the computer modeling. It helps to simplify and accelerate the system parameters identification, to accelerate and automate the process of system creation in accordance with set deadlines and parameters, to improve quality and to reduce the cost of the system. This approach allows setting quantitative indicators among main parameters of the system, to calculate possible consequences of made decisions in terms of operative and strategic purposes of system's owner.

Using the services which allow sending of e-appeals to local governments aims to improve effective interaction between governments and public, effective realization of state politics and government in the field of proceeding the citizens' appeals to executive agencies. Successful implementation of the services which allow sending of e-appeals and proper resource allocation in the system allows making faster and radically bettering the processes of citizens serving. That is the reason for making functional analysis of this system which aims to identify potential problems related to resources overloading on the early stages of system's work and making appropriate effective decisions.

Key words: computer simulation, GPSS, e-claim, queuing system

PROGRAM AND PROJECT MANAGEMENT

Алєксєєв В.І., Алєксєєва К.А. **Вироблення підходів до визначення загальної структури веб-сайтів**

DEVELOPMENT OF APPROACHES TO DEFINE WEB SITE STRUCTURE

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The problem of misunderstanding the definition of web site structure and related definitions is discussed. On one hand, the problem source is found both in difference between practices of English terminology and Russian and Ukrainian terminology. On the other hand, the issue is caused by different types of web-design practices. The three approaches to understand the problem were offered: spatial, functional and role-based. The most appropriate way of understanding of the web site structure definition is offered.

The research is aimed to formulate and substantiate approaches for more accurate understanding of the concept of "structure of the web site" and describe the contents of a number of derivative concepts for the development of websites (in web design).

The area of the problem is in web sites development and web design.

The subject under consideration is the web site structure.

The premise of the problem goes from different aspects of web site structure in meaning of its derivatives. It is common practice in web design (and in Russian and in Ukrainian terminology particularly) to use some related treatments of web site structure – physical structure and logical structure (logical schema), internal structure and external structure. While the physical structure is considered generally as artifact of technical details, the logical structure or logical schema is considered mostly as artifact of web design. Both technicians (like system administrators) and developers (like web designers) are involved in establishing web site structure in their particular way. Such misunderstand of web site structure begets the problem of accurate definition of web site stricter and its derivatives. So we used three approaches to clarify the meaning and the purpose of "web site structure" as a concept: spatial, functional and role-based. The spatial approach led us to typical schema of web site as a physical structure mapping mostly (see Fig. 1). The functional approach discovered the complexity of logical structure (schema) and its appearance in particular passive and active content in web browser. Also the functional approach allows one to understand the formation for visitors of mental structure of web site. The role-based approach gave us the aspects of web sites structure which are meaningful for the most common user groups.

Therefore, to characterize web site in terms of logical structure, external or internal structure, understanding the context of their application is required. So, under the structure of the website it is preferably to be understood the whole set of models/schemas and methods of handling of content, including physical structure, logical structure (logical schema), a conceptual scheme and a design (as a page layout). It becomes clear the difference in understanding the logical structure (logical schema) from the points of view of different user groups. This yields the need of complement logical structure with the structure of modules, structure of components, structure of views, content structure, structure of users and their credentials, etc. The use of term "external structure" of web sites is considered to be inexpedient because of its ambiguity – page layout sounds better to describe the appearance of the web site in web browser. The use of term "internal structure" of web sites can be possibly used as server-side view contrary to client-side view of web site.

Key words: web site structure, logical schema, physical structure, internal and external structure, web design, spatial approach, functional approach, role-based approach.

Артеменко О.І., Гаць Б.М., Іванущак Н.М., Угрин Д.І. **Особливості побудови інформаційних технологій моделювання процесів розвитку туристичних та інфокомунікаційних комплексів**

PECULIARITIES OF CONSTRUCTION OF INFORMATION TECHNOLOGIES FOR MODELING DEVELOPMENT PROCESSES OF TOURIST AND INFORMATION COMMUNICATION SYSTEMS

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The purpose of research is to develop new, improved, and adapting existing methods and tools for mathematical modeling of effective tourism and information and communication infrastructure in the region, which enable the study of their structure and parameters based on fragmentary data observations, modeling and prediction of their development and structuring based on physical analogies .

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The scientific novelty of the research is developed methods and tools for modeling complex objects and tourism infrastructure, information and communication systems based on specific physical analogies phenomena and processes. In particular, by modeling and prediction of the spatial form of tourist infrastructure of settlements based on fractal theory and analogy diffusion processes using mathematical tools of cellular automata . Based on the statistical physics analogy, a new method for generating patterns of high-tech information and communication networks with a given density function of the distribution of degrees of nodes with the use of the theory of complex networks, which makes it possible to play infocommunication network as a stochastic graphs with given probabilistic properties.

Developed as part of research complex of information technologies can be used at the regional and local levels – for the modeling and analysis of the formation and development of some tourist sites and integrated tourism complexes.

At this paper a complex of information technologies for simulation based on physical analogies of tourism industry objects, information and communication infrastructure and processes of formation and development both the individual tourist facilities, and integrated tourist complexes at the regional and local levels have been developed. The complex consists of three components: a set of information technology simulation and prediction of spatial development of tourism industry infrastructure facilities, recreational attractiveness assessment, methods and tools for modeling the structure and study of changes in parameters of computer networks, software and algorithmic system of the development and operation of tourism field data spaces.

Key words: tourism infrastructure, infocommunication systems, data space, stochastic graph, fuzzy logic, cellular automata, fractal, diffusion.

Бойко Н.І. **Застосування кластерного аналізу для діагностики дієвості господарського механізму торговельних підприємств**

APPLICATION OF CLUSTER ANALYSIS FOR DIAGNOSTIC EFFECTIVENESS OF THE ECONOMIC MECHANISM OF TRADE ENTERPRISES

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In the article theoretical principles are grounded and methodological and practical recommendations are suggested in order to enhance the effectiveness of economic mechanism of commercial enterprise operation. The role and function of the economic mechanism in the management mechanism of the enterprise are considered. The possibility of using the method of cluster analysis for evidence-based segmentation of commercial enterprises is revealed. We give an integrated use of the efficacy of the economic mechanism of commercial enterprise, study recommendations for the implementation of strategic directions to improve the efficiency of the economic mechanism.

The aim of the paper is to study theoretical concepts and develop scientific guidelines and application of cluster analysis to ensure the effectiveness of the economic mechanism of operation of commercial enterprises.

The economic mechanism is the central subsystem of the management mechanism, based on the orientation of management activities on its outcomes, the cost-effectiveness of management. The study of conceptual foundations of the essence of the economic mechanism and its structure allowed forming the author's vision of the economic mechanism of functioning of commercial companies as a specific category of the economy as a set of components, including economic management methods and tools (instruments) to implement them under the influence of market mechanisms for self-regulation and government regulation aimed at achieving the objectives of the enterprise.

The tool selected for the investigation of commercial enterprises in the regions is cluster analysis.

During the study the problem of justification of sampling of the most common commercial enterprises in Lviv region to conduct further analysis of the efficiency and reproduction of fixed assets was solved. Methods and techniques of cluster analysis were applied to address this problem, which resulted in the formation of the required sample.

These results clustering is to justify the theoretical propositions, developing methodological and practical recommendations to enhance the effectiveness of the economic mechanism of operation of commercial enterprises and are useful for other types of analysis related to reproductive, investment and innovation and other related areas of activity.

The proposed integrated approach to improving the economic mechanism of commercial enterprise through the implementation of strategic and tactical measures to improve the effectiveness and implementation of government measures to stimulate it to enhance the effective functioning of the economic mechanism as a whole and enhance the effectiveness of commercial enterprises in particular.

Key words: trade, commercial enterprises, cluster analysis, economic mechanism, hierarchical agglomerative algorithm.

Object of study in this article are methodologies, architectural frameworks, and information technology design of information systems aimed at the identification and analysis of requirements to information systems.

Subject of study in this article are models of patterns of design requirements to information system.

In this article were obtained the following results:

– first developed a generalized category-theoretic model patterns of requirements design to information system, which describes the representations of patterns at the level of data, information and knowledge, and the relationships of these representations;

– first developed a generalized category-theoretic model of information technology generating and analyzing requirements to information system, which describes the processes of formation of patterns of requirements design to information system on the base of requirements, which pushed, and usage patterns to identify and analyze requirements to information system;

– modified the definition of a pattern of requirements design to information system in relation to the identification and analysis of requirements to information system.

The practical value of this article – defines the main features of the application of design patterns in the process of identifying and analyzing requirements to information system.

All scientific and practical results obtained by the author in person.

The use of information technology development and analysis of requirements for information system, which is based on the proposed model pattern of requirements design to information system can solve the problem of reusing requirements to information system by forming and continuous updating of the knowledge base of objects and processes that are automated and learn about new approaches to formulating requirements and means of representation. So instead of reusing certain requirements to information systems, which makes the desired effect, it is proposed to carry out the re-use of knowledge identified during the formulation and analysis requirements that have been put forward to the information system, set up IT service providers before.

Key words: information system, requirement, pattern, theoretic-categorical model.

Кунанець Н.Е., Камінський Р.М. **Кластерний аналіз як методологічний інструментарій дослідження бібліотек**

CLUSTER ANALYSIS AS METHODOLOGICAL TOOL
OF RESEARCH OF LIBRARIES

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The simple technology of hierarchical agglomerative cluster analysis of twenty different libraries is presented, and described with the samples of classified features of the same size. The proximity matrix is built for conducting the cluster analysis, using the table "Library and classification criteria" and selecting the appropriate metric for calculating the distance of closeness between each library. This technology is implemented in an environment of Microsoft Excel-2003. It includes the creating the table "object-property", the building the proximity matrix, and the defining the structure of the dendrogram and the interpretation of clusters.

As a final procedure of the agglomerative hierarchical cluster analysis, the authors determined the dendrogram parameters, its construction and interpretation concerning the choice of clusters and their number. The building such a tree gives the hierarchical order of object clusters: the higher level is (greater distance between clusters is the vertical axis), the more objects are in clusters.

The application of cluster method contributes to the creating the algorithms of efficient information retrieval, and the building of evidence-based classification systems oriented to the librarianship. The method of hierarchical agglomerative cluster analysis can be used in typological or semantic distribution of the library stocks and studying the thematic and specific structure. This method can be considered as universal, which gives possibility to formalize the typological division of any objects in the field of librarianship and social communications.

Key words: the cluster analysis , the object-property table, the proximity matrix, dendrogram, clusters.

Катренко А.В., Магац А.С. **Аналіз математичних моделей планування в мульти-проектному середовищі**

ANALYSIS OF MATHEMATICAL MODELS OF PLANNING IN MULTI-PROJECT ENVIRONMENT

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The main purpose of this paper is a critical analysis of management and planning models in multi-project environment, identifying key characteristics of the environment, the criteria that should be satisfied with the models. It is important to both quantitative and qualitative aspects.

Mathematical models provide efficient use of existing resources, assist in planning of project organizations. They cover various components and provide guidance in making decisions. This is an important stage in the multi-project environment. It is expected that there will be no further dispersion of forces on projects for which resources are not enough.

Effective planning in multi-project environment and application of the models is very relevant today: many organizations operate in the form of projects. Today there is clearly a problem when doing projects: a large part of them is unfulfilled in terms and amounts that were allocated for implementation. The problem is that many organizations do not know what resources they actually possess. It is necessary to isolate key resources. It often happens that the number of projects is very large and useful to discard some of them.

This problem is urgent and requires immediate solution. Existing models do not meet modern requirements in this area, do not meet modern needs. Important is the development of new algorithms.

Investigation into the current state of multi-project environment is conducted. Particular attention is paid to the practical disadvantages of current project management. Prospective measures aimed at improving the situation are analyzed.

The article has theoretical and practical value. The mathematical models of optimization: buying, storing, and distribution of resources are considered. The current status of the project management is considered. System analysis was applied, as the model is consistent with the objectives and tools present in such an environment. The results can be applied when developing new models.

Projects must be balanced. There should be a balance between projects that develop the market and the industrial components, between the risks and possible benefits of implementing risk projects, between research and development.

There should be efficient use of valuable, strategic resource of the organization that will ensure getting the most significant results.

Key words: multiproject, optimization, project management office planning.

Малиновський О.Б. **Електронні бібліотеки: мультимедійна складова**

DIGITAL LIBRARIES: MULTIMEDIA COMPONENT

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The aim of the article is to determine the feasibility of the use and importance of multimedia technologies to improve efficiency of digital libraries as a basis for the use of the technologies of an information age and qualitative changes in all spheres of life.

The task of the article is to describe the main features of a multimedia technology in the e-libraries to meet user needs relevant and accessible information.

The object of the article is a multimedia and information service for the users in a digital library.

The subject of the article is the digital libraries and their use to satisfy the information needs of the users.

A scientific novelty lies in a complex defining and formulating of the ways of the processes and methods improvement for users service in an electronic library with a multimedia technology and the role of a multimedia component, which is oriented for use in these libraries.

The scientific results of this research allow forming the practical methods to improve an efficiency of the digital libraries in the users information service.

The contribution of the author consists in a complex system analysis of a multimedia component in the users information service system of an electronic library and an efficiency of the use a multimedia in the major work processes of such libraries.

Multimedia technology was considered as a factor of qualitative changes of informational environment in a digital library. It has been observed the increasing tendency of the use of digital libraries, as well as the use of information technologies in the conventional and automated libraries. It was emphasized that the key processes in the digital libraries have a significant role in the information era and in the society of the 21st century. The basic tasks of combining the digital libraries in general media space were formulated. It was proved that multimedia technologies greatly improve the library and information services and provide an improvement of the environment organization in a digital library.

Key words: multimedia, digital library, information technology

Назарук М.В., Пасічник В.В. **Інформаційна технологія аналізу діяльності середніх шкіл**

INFORMATION TECHNOLOGY OF ANALYSIS
THE ACTIVITY OF SECONDARY SCHOOLS

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Using information technology to model and automate decision support in the management of the educational process generates the need for solving problems related to the analysis of large amounts of data (big data).

Modern methods of collection, storage and data processing are based on the technology of data warehousing and complex multi-dimensional data analysis. The use of this technology makes it possible to carry out a detailed analysis of the educational institutions, the current state of educational resources, the quality of educational services, and so on. And it allows identifying trends in their development.

The aim of the article is to analyze the activity of institutions of secondary education on the basis of methodologies of data hypercube construction and processing in order to create systemic transformation of the national education sector and the introduction of complex intellectual information technologies and their support in accordance with international educational standards.

The object of research are technological processes of data processing in information educational technologies.

Subject of research are methods and tools for creation, representation and processing of data in information technologies of analysis the activity of secondary schools

Multidimensional data model of secondary schools was worked out. It allows to carry evaluation of activity of secondary schools by profiles:

compliance with state standards of education by the educational establishment;

the quality of training pupils;

the efficiency of using of educational, scientific and methodological potential;

providing of development and efficiency of using material and technical basis (level and the dynamics maintenance of educational process by computers, connecting secondary schools to the Internet, and so on.).

Systematic analysis of the activity of secondary schools was performed using the methodology of constructing hypercube data. Detailed description of dimensions hypercube data of secondary schools were identified and presented.

Key words: multidimensional data analysis, data hypercube, dimension, attribute.

Рішняк І.В. **Моделювання процесу управління ризиками у мультипроектному середовищі**

THE RISK MANAGEMENT MODELLING IN MULTI-PROJECT ENVIRONMENT

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The paper proposes a method for modeling risk management in multi-project environment. Simulation was conducted and the example was provided in the article.

The goal is to identify a risk modeling algorithm for optimal decision making suitable for a specific situation. This aspect can be seen as static and dynamic models, which in turn describe deterministic or stochastic informational

situation accordingly. However, in the course of project activity, when the decision affects a large number of factors, it is advisable to pay attention to dynamic models only.

In the majority of cases, in order to set the probability of the set of elements of events an analytical method is used, that is giving the law of the distribution of the random variable. Among its advantages is the absolute probability of formalization and ordering of certain values of a random variable depending on the two main factors that are taken into account when modeling uncertainty: dispersion of possible values of a random variable from its expected value and the deviation of a random variable values from the expected value. When dealing with probabilities analytically, the choice of the distribution of the random variable is crucial.

The risk is a difficult objective-subjective category, influenced by both external circumstances and internal parameters of the project and the subjective perception of the risk of a person who makes a decision.

Depending on the specific conditions, the availability of information and the goals of the project risk can vary significantly. Therefore, the risk estimates are useful methods, sensitivity analysis, alternative methods of decision making. Using the results obtained we can achieve a corresponding prediction, compare it with the intended purpose of and shape administering information and the necessary action.

Key words: multi-project environment, project, risk, simulation, risk management.

Савчук Т.О., Козачук А.В. **Прогнозування стану техногенної ситуації за допомогою імітаційної моделі, що базується на багатовимірному рівнянні дифузії**

FORECASTING OF THE STATE OF TECHNOGENIC SITUATION USING A SIMULATION MODEL THAT IS BASED ON A MULTIDIMENTIONAL DIFFUSION EQUATION

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In the modern world the speed of technological processes is growing rapidly. To be able to quickly and accurately assess their current and potential future state and, if necessary, change the occurrence of man-made process, it is necessary to provide effective technological systems. Application of simulation modeling allows to make such assessment of a technological system.

Consider the problem of forecasting of technogenic situation that is presented by set of characteristics, most of which can be described by stationary processes using a multidimensional data structure that describes the possible states of the technogenic situation and their change over time. The goal of the research is to improve the accuracy of determining the state of the technogenic situation through the usage of multidimentional models of technogenic situation. The object of the research is the process of forecasting of the technogenic situation. Purpose of the research is a simulation model of forecasting of the technogenic situation.

The approach of the forecasting of technogenic situation that is described in the article is based on the simulation of development of the technogenic situation using a discrete form of multi-dimensional diffusion equation. Simulation of the state of a technogenic situation is based on consistent calculation of possible states of technological situations that are stored in multidimensional data structures – hypercube of characteristics of the technogenic situation with a limitation that only the forecasted characteristic of technogenic situation is unsteady, and the remaining features are considered as those that can be described by a stationary process. This allows to perform preliminary calculations of possible states of technogenic situation that greatly reduce the complexity of predicting its status by running the main part of the intensive calculations before to main forecasting request. Additional optimizations were made to decrease calculations in case when the technogenic situation can be describe by amount of characteristics that is less or equal to four.

Key words: simulation, multidimensional presentation of data

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Чарковська Н.В., Стрямець О.С., Бунь Р.А. **Моделювання та просторовий аналіз емісійних процесів від целюлозно-паперової та харчової промисловостей Польщі**

MODELLING AND SPATIAL ANALYSIS OF GHG EMISSION PROCESSES: PULP AND PAPER INDUSTRY, FOOD INDUSTRY OF POLAND

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The purpose of this article is the development of mathematical models of greenhouse gas (GHG) emission processes from the production of pulp, paper, food and drink in Polish regions to carry out the GHG spatial distributed inventory, and the spatial analysis of obtained results. The main tasks in the achieving of this goal were: to create a database of major industrial enterprises with their geographical location and the production technology; to construct the digital map of GHG point-type sources (enterprises) using their geographical coordinates; to gather the information on the industrial production volume, and split the statistical data from the country level to the level of an enterprise or elementary area using the specific disaggregation indicator for each category of activity – the production capacity of an enterprise or urban population, respectively; to create the specialized geographic information system (GIS) for spatial analysis of GHG emissions using statistical data on the results of industrial activity, the digital map of voivodeships of Poland, the population density map, the digital map of towns; to carry out computational experiments for the estimation of GHG emissions and make their spatial analysis. The objects of the investigation are the GHG emission processes. The subjects of the investigation are the mathematical models of GHG emission processes during the production of industrial goods (paper, pulp, food and drink) in Poland. The GHG spatial inventory in the industrial sector of Poland hasn't been done yet. The novelty of the article consists in the development of mathematical models of GHG emissions in the industrial sector of Poland that take into account the allocation of emission sources (enterprises), the possibility to use the specific emission factor for the enterprise, and the providing an opportunity to build GHG spatial inventories. The mathematical models of GHG emissions in the industrial sector have a practical value for the government agencies of Poland in solving the complex environmental and economic problems to reduce GHG emissions in their respective territories. In the result of numerical experiments the estimates of GHG emissions for each category of pulp-paper industry and food industry at elementary areas 2×2 km of Poland, and on the level of enterprises have been obtained.

Key words: geoinformation technology, mathematical modeling, greenhouse gas emission, food industry, spatial inventory, Poland.

Федонюк А.А. **Деякі аспекти моделювання соціальних мереж**

SOME ASPECTS OF DESIGN OF SOCIAL NETWORKS

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The Modern informatively saturated world generates the necessity of deep analysis of the phenomenon of social networks, as, society aims to set conformities to law of distribution of streams of information in society for the use of such networks with the forecast behavior in interests of society. Application of known mathematical approaches i and corresponding programmatic-algorithmic tool appeared the most widespread method of design of social networks.

This work is an attempt to analyze and systematize scientific research that touches on the description of social networks and the creation of their models.

Scientific sources dedicated to the construction of diverse models of the processes of formation, development and functioning of social networks of different nature and profiling are analyzed. The wide spectrum of directions of research into social networks is revealed, in particular sociological, statistical, economic and others, with a tendency towards the application of mathematical formalities for the construction and functioning of social networks models, which were almost never used in the aforesaid industry before.

The models of description of modern social networks are rightly predisposed to the application of the powerful mathematical vehicle worked out for physical phenomena and processes of the material world. It is related to that clear analogies observed between the physical phenomena in the "lifeless" wild and processes of functioning of social

networks from one side, and on the other hand – the slender, mathematically forecast structure of behavior of social network is created. This predictability allows planning the development of this network and influencing on it in the interests of society, which is a very important aspect of modern society development.

Key words: social network model, the physical analogy.

Яремчук Ю.Є., Шиян А.А., Заячковський В.М. **Модель процесу передавання управлінської інформації в соціально-економічних мережах**

MODEL OF SPREADING MANAGEMENT INFORMATION
IN SOCIAL AND ECONOMIC NETWORKS

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Social and economic network models are used in many domains such as economics (innovation, management and marketing), politics, revolutionary action, crime, terrorism, disasters and emergencies, wars, epidemics etc. The paper aims to develop a model for spreading management information in socio-economic networks, taking into account information properties of active agents. The subject is a socio-economic network in which nodes are people. The object is the process of spreading information in social and economic networks. In the framework of this research a case is considered when information is entered into the network by a single agent (model generalization for the case of many agents will be made separately). It has been proved that within the model of information spreading in a network, when the perception by the agents is only taken into account, the model of socio-economic network can be reduced to the problem of finding a particular value of some function (or the product of certain functions), which is given to a number of natural numbers. We proved that the model of social and economic networks can be described as the one-dimensional chain, in which the agents are at the equal distance (strongly connected network), or a set of the one-dimensional chains (weakly connected network). The criterion for the ability of local agents to restore the adequate management information is obtained. The developed apparatus is based only on the characteristics both of the network and agents, which can be measured in experiments. Such experiments can be carried out in some domains, and used for prediction in other domains. Thus, in the model the function is used, which describes the effects of the loss of information in the communication process. This function does not depend on the type of information, which is passed from communicant to communicant. For example, it depends on the type of network: Skype, the Internet (e-mail, social media, electronic media, etc.), phone, communication in a crowd, etc.

Key words: social-economic network, management, information, management efficiency criterion.

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