

### DESIGN FEATURES OF THE INFORMATION TECHNOLOGY FOR THE LABOR MIGRANTS GROUP STRUCTURE DETERMINATION (p. 4-8)

Oksana Mulesa

The necessity of solving poorly structured and unstructured tasks in dealing with complex scientific and technical problems causes the need for developing relevant models, methods, and software. The task of the labor migrants group structure determination is faced by experts in the field of HIV/AIDS prevention and treatment in the process of investigating behavioral risks of the target group representatives.

In the paper, the verbal and mathematical formulation of the labor migrants group structure determination problem as the fuzzy clustering problem based on the assumption of a simultaneous object belonging to different clusters was performed. To solve the problem, it was proposed to use the adapted fuzzy c-means method based on the representation of non-numeric values by linguistic variables. This has allowed to find the distance between objects, the attribute vectors of which have both numeric and non-numeric components.

The design features of the information-analytical system for solving tasks were determined. The system of tasks that must be implemented in the information-analytical system was defined, grouping of mathematical models and methods that form the basis of an analytical system unit was performed. The structural-functional diagram of the relevant information-analytical system was developed.

Experimental verification of research results on the example of solving the problem of people grouping according to the labor migration direction has confirmed the efficiency of the developed technology and the possibility of its use to improve the decision making efficiency in the field of HIV/AIDS prevention and treatment in the study of behavioral risks of the target group representatives.

**Keywords:** labor migrants group structure determination; fuzzy c-means method; information technology.

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### PERFORMANCE INCREASE OF IN-MEMORY DATA GRIDS BY USING SOFTWARE TRANSACTIONAL MEMORY (p. 9-14)

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The aim of the paper is to study the possibility of performance increase of in-memory data grids (IMDG) by using software transactional memory. In the present study, the problems of determining the IMDG performance under the refusal of the locking mechanism and use of local and distributed transactional memory were solved. Studies were conducted in the absence of redundancy, and in the triple replication of the data stored. The operational features of the software transactional memory under a constantly loaded in-memory data grid were determined. It is shown that using software transactional memory and reducing the size of transactions allows to achieve performance gains of in-memory data grids of 13–48 %. The proposed method is applicable for grids, combining background data recording in the grid and frequent reading operations (such as data grids for business intelligence, TV Guide data grids, etc.).

**Keywords:** data grid, in-memory grid, transactional memory, software transactional memory.

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#### DEVELOPMENT OF THE GENERALIZED CONFIGURATION MANAGEMENT PROCESS MATHEMATICAL MODEL IN PROJECT MANAGEMENT (p. 14-22)

Sergiy Rudnitskyy

The process of configuration management (CM) in the field of project management (PM) solves the problem of consistency support of the project product and the project itself. The problem is caused by the inevitability of the changes during the project implementation. If the CM processes of specific material objects (project products) are studied deeply enough, the CM processes of the project elements, for example management processes, risks, works, commands, procurement, etc., and, in general, the project itself are investigated only at the conceptual level, and require further work in this direction. In the research, the next step in this direction, namely developing the mathematical, formalized description of the generalized CM process without regard to the object of its application was made. In particular, a formal description of the individual action of the CM process at the abstraction level that allows to present an operation or procedure, or a sub-process in the form of such action was obtained. The classification of actions was introduced, and it was found that the whole CM process can be divided into five groups of actions, each being performed as a response to a specific event. The presence of these groups allows to specify the actions that are executed once, after the object mismatch, periodically and randomly, what is necessary to calculate the performance indices of the process under study. It was also found that the CM process is a set of its embodiments, for which the description scheme was proposed. In addition, the classifi-

cation of changes in the controlled object, which may occur during its life cycle was introduced.

**Keywords:** configuration, configuration management, project, project management, process, optimization, change, formalization.

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## INDIVIDUALIZATION OF STUDENTS' INDEPENDENT WORK ON THE BASIS OF INFORMATION TECHNOLOGIES (p. 22-30)

Victoria Shevchenko

The study explores an information technology model of forming individual trajectories, which is conducive to organizing and managing students' independent work. The existing methods of teaching at the university level allow improvement of students' performance with the help of principles of autonomous learning that are implemented during individual work. We have suggested the structure of the devised model and considered several methods that involve the proposed technology as well as the general principle of the information technology functioning. A distinctive feature of the information technology is that it incorporates a method of forming and a method of adjusting individual trajectories of students' independent work. These methods are based on performance prediction and aided by the modified method of cluster analysis of the McKean k-means; they take into account individual performance and motivation of each student with the help of production models of guiding the student.

The suggested model of information technology is aimed at solving the problems of individualization in the higher education process and improving the academic performance of students.

**Keywords:** students' independent work, information technology, individual trajectories, prediction, production-frame models.

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## A LINGUISTIC MODEL FOR ASSESSING INFORMATION SYSTEM RISKS (p. 30-35)

Vladimir Shaporin, Petr Tishin,  
Ruslan Shaporin, Nikolai Kopytchuk

Modern trends in the development of information systems require more appropriate ways of providing information security. The most important step in devising complex information protection is to analyze the risks in the target information system.

The study has revealed that the existing methods have several disadvantages such as absence of facts testifying to uncertain security threats and probabilistic approaches that do not account for the complexity of processes occurring in the system.

Given the difficulties and shortcomings, the authors have suggested that risks should be analyzed through the theory of fuzzy sets and linguistic variables. The approach includes development of fuzzy models allowing to assess risks as probable or emerging and to evaluate whether the information system assets are satisfactory.

The suggested approach can help analyze the risks of an information system, using natural language that is understood by any owner of the assets; it adds experience in security design.

**Keywords:** Coras methodology, asset, risk, fuzzy knowledge bases, linguistic variables.

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### SPACE PERCEPTION ANALYSIS IN THE PANINI PROJECTION AND ITS USING IN COMPUTER GRAPHICS (p. 36-43)

**Petr Kachanov, Andrey Zuev, Konstantin Yatsenko**

The main parameter in the study of virtual reality for the human-computer interaction is the information received by the person. However, the transformation from three-dimensional space to two-dimensional is accompanied by a distortion in the resulting images. The paper describes the Panini projection model in terms of the information content and engineering psychology.

The analysis of the data describing the features of human visual perception of the virtual space is performed. It is shown that the mathematical model of the Panini projection is based on geometric transformations, which correspond to the system of human visual perception and produces biologically correct three-dimensional images. A description of non-planar perspective projections is given.

Finally, it is concluded that the simple geometric transformations, which are available to the observer can improve the information content of the synthesized images. The results of using the described projection models in computer graphics were obtained. A comparison of images in the perspective projection and Panini projection was carried out. The reasons of using the described projection type were explained.

**Keywords:** Panini projection, veduta, space perception, spherical projection, cylindrical projection, space compression.

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### DEVELOPMENT OF AN ANALYTICAL ESTIMATION METHOD OF THE FAULT RISK IN THE POWER SYSTEM (p. 44-50)

**Mykola Kosterev, Volodymyr Litvinov**

Modern risk-oriented management of electric power system requires the definition of risk as an integral operation index that allows to reliably characterize the power system state. Assessment of the power system state is performed under a significant number of technical and operational uncertainties.

The approach to the analytical determination of the fault risk in the electric power system without regular probabilistic and statistical modeling using the Monte Carlo method was proposed. The developed risk assessment method lies in determining, based on a one-time probabilistic-statistical modeling, analytical expression, which allows to reliably perform a rapid assessment of the fault risk in the power system based only on the equipment state characteristics and power system pre-fault parameters.

Based on the developed method, the algorithm of the rapid risk assessment of dynamic instability in the power system was determined. The proposed algorithm allows to obtain an analytical expression for the fault risk in the power system as a polynomial dependence. In this interpretation, the risk is a function of the technical state of the power system elements and pre-fault conditions. Using the developed algorithm, risk assessment of dynamic instability in the test circuit of the power system was carried out.

**Keywords:** risk, failure probability, rapid assessment, dynamic stability, power system, power line.

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## NEURAL-NETWORK APPROACH TO STRUCTURAL TUNING OF CLASSIFICATION RULES BASED ON FUZZY RELATIONAL EQUATIONS (p. 51-57)

Hanna Rakityanska

An adaptive approach to structural tuning of classification rules based on solving fuzzy relational equations, allowing to avoid the fuzzy knowledge base redundancy is proposed. The approach lies in building and training the neural-fuzzy backward chaining network, the isomorphic system of fuzzy relational equations, which allows to adjust the structure of fuzzy rules as new experimental data appear.

Because of the lack of effective selection methods, there is no single methodological standard for structural tuning of fuzzy rules. Modern neural-fuzzy systems use heuristic selection methods to reduce the number of rules without losing the distinctive ability of the network.

It was found that using the neural-fuzzy backward chaining network allows to avoid the knowledge base redundancy while preserving the inference precision. The number of rules in the class is equal to the number of solutions, and the form of membership functions of fuzzy terms is defined by intervals of values of input variables in each solution. This approach is an alternative to the classical approach, based on selection of rules from a set of rules-candidates that prevents obtaining compact fuzzy knowledge bases.

**Keywords:** fuzzy relations, neural-fuzzy backward chaining network, solving systems of fuzzy relational equations.

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## AN UPGRADE OF PREDICTORFUNCTIONS BASED ON THE ANALYSIS OF TIME SERIES FOR MASHING BEER WORT (p. 57-62)

Nick Chernetski, Vasil Kishenko, Anatoly Ladanyuk

The paper presents research findings concerning the complex system of the mashing and brewing section of the brewery by methods of nonlinear dynamics. We have analysed the time series of the variable technological processes of making beer wort. The prior information and analysis on the dimensions of the reconstituted phase trajectories of the object determined our selection of the structures and functions of the basic models of the dynamics in the process of mashing wort; the structures and functions had the form of nonlinear algebraic polynomials and fractional rational functions of the 3–6 order, respectively. As a result, the calculated and established coefficients of the dynamic models have provided adequacy of the experimental data model that is sufficient for practical purposes: the prediction error does not exceed 6%. Simulation in the VectorODE package made it possible to upgrade predictor functions for predicting the progress of mashing beer wort in chaotic regimes of the process. We have determined the optimal structure and parameters of differential equations as predictors for the criteria of time and prediction accuracy. Besides, we have

proved effectiveness of the obtained models for predicting the behaviour of the object in a wide range, including chaotic regimes. The derived models were checked through time test series that showed the effectiveness of these predictor functions: the depth of the prediction was 8–17 minutes with an accuracy of 3 % to 7 %. Using predictor functions ensures the implementation of effective management strategies in the technological complex of beer production in conditions of intermittency.

**Keywords:** prediction, mathematical model, predictor function, mashing wort.

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