

## ABSTRACT AND REFERENCES

## INFORMATION TECHNOLOGY. INDUSTRY CONTROL SYSTEMS

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**DEVELOPMENT OF A MOBILE DECISION SUPPORT SYSTEM BASED ON THE SMART METHOD FOR ANDROID PLATFORM (p. 6-14)****Daniil Horpenko**Odessa National Polytechnic University, Odessa, Ukraine  
ORCID: <http://orcid.org/0000-0002-9052-2595>**Natalya Volkova**Odessa National Polytechnic University, Odessa, Ukraine  
ORCID: <http://orcid.org/0000-0003-3175-2179>**Marina Polyakova**Odessa National Polytechnic University, Odessa, Ukraine  
ORCID: <http://orcid.org/0000-0002-1597-8867>**Victor Krylov**Odessa National Polytechnic University, Odessa, Ukraine  
ORCID: <http://orcid.org/0000-0003-1950-4690>

The work is devoted to the development of a mobile decision support system for solving the multiple criteria decision-making problems. To ensure the autonomous operation of the system, it was proposed to use a three-layer architecture. For reuse and distribution of the code, this model is implemented in three levels: presentation level, application level and data level.

The development of the application level in the developed mobile decision support system involves the creation of three subsystems: a decision-making subsystem, a database interaction subsystem and a message management subsystem. At the core of the decision-making subsystem of the developed mobile decision support system, an improved Smart method was chosen. This method differs from the classical Smart method in that the decision maker uses the elements of the decision matrix as estimates of each alternative for all criteria. Also, the nature of actions on the criteria (maximization or minimization) is taken into account. This, in turn, takes into account the normalization of elements of the decision matrix.

The startup of the database interaction subsystem, which is responsible for transferring and retrieving data to/from the database, occurs via the user interface. To create the database, the SQLite relational database management system was used. SQLite stores the entire database (including definitions, tables, indexes, and data) in one standard file on the device on which the application runs. The message management subsystem allows the decision maker to send the calculation results via the Internet or using the short message service (SMS).

The mobile decision support system has been developed in Java in Android Studio 3.2.1. The task of buying a smartphone was considered, as an application of the developed mobile decision support system.

**Keywords:** mobile decision support system, decision maker, alternative, criteria, Smart method, three-layer architecture.

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**CONSTRUCTION OF A PARAMETRIC MODEL OF COMPETITIVE ACCESS IN RELATIONAL DATABASES BY USING A RANDOM FOREST METHOD (p. 15-24)****Dmitry Gromey**Federal State Government Educational Institution of Higher Education "The Academy of Federal Security Guard Service of the Russian Federation", Orel, Russia  
ORCID: <http://orcid.org/0000-0003-1066-556X>**Eugene Lebedenko**Federal State Government Educational Institution of Higher Education "The Academy of Federal Security Guard Service of the Russian Federation", Orel, Russia  
ORCID: <http://orcid.org/0000-0001-6135-0352>**Dmitry Nikolaev**Federal State Government Educational Institution of Higher Education "The Academy of Federal Security Guard Service of the Russian Federation", Orel, Russia  
ORCID: <http://orcid.org/0000-0001-9334-6948>**Tatyana Rozhkova**Federal State Government Educational Institution of Higher Education "The Academy of Federal Security Guard Service of the Russian Federation", Orel, Russia  
ORCID: <http://orcid.org/0000-0002-7079-4366>

We have considered the task on modeling a request execution time in autonomous relational databases with competitive queries. The shortcomings of existing approaches have been specified, which ignore the cost of the share of successive operations in the cooperative access to data in a memory hierarchy. We have examined the issue of the application of relative cost for the implementation of components in the operations of a plan of the query, instead of calculating the predicted time of computation.

A technique has been proposed for the formal construction of precedents for a training sample, as well as the approach to building a regression model. The developed modification of the machine learning method random forest is used for calculating the request execution time based on their texts and temporary marks of the start, duration of execution.

The constructed parametrical model of competitive access to data is required for obtaining accurate estimates of request execution time when using parallel computations. Models with such characteristics are needed to solve the problems on automated management of a physical data scheme, for building self-identifiable DBMS. The key differences from existing approaches are the application of a request execution time as the target value, accounting the values of predicates and mutual influence of requests that are executed in parallel.

To confirm the results obtained, a simulation model has been used based on the widely known test TPC-C. The used function of loss, taking into consideration the regression nature of the model, was the ratio of the sum of modules of difference between the actual and obtained time to the actual time. The check itself was carried out based on a reference sample, generated for the increasing length of training at postponed data. In the course of this study we have proved a possibility to apply the machine learning method random forest for processing statistical data on the execution of SQL queries. The result obtained is promising for such an approach and makes it possible to derive the parametric models of competitive request processing.

**Keywords:** autonomous systems of database management, self-identifiable databases, random forest, competitive access, parallel computing in relational database management systems.

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## IMPROVEMENT OF THE METHOD OF SCENARIO ANALYSIS OF FUNCTIONAL REQUIREMENTS TO AN INFORMATION SYSTEM (p. 25-35)

**Mohammed Q. Mohammed**

University of Information Technology and Communications,  
Baghdad, Iraq

ORCID: <http://orcid.org/0000-0002-2962-316X>

**Saif Q. Muhamed**

University of Information Technology and Communications,  
Baghdad, Iraq

ORCID: <http://orcid.org/0000-0003-2565-8346>

**Maksym Ievlanov**

Kharkiv National University of Radio Electronics,  
Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0002-6703-5166>

**Zarina Gazetdinova**

Kharkiv National University of Radio Electronics,  
Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0002-9627-2443>

We have considered a task on improving the base method for scenario analysis of the functional requirements to an information system (IS). The results from studies of the methods for scenario analysis of the functional requirements to IS have been analyzed. Their main drawback in our opinion is the need for the implementation of these methods by analysts manually only. To overcome this shortcoming, it has been proposed to improve the base method for scenario analysis by using the models and methods based on a formal knowledge representation.

For a formal description of the representation of a scenario for implementing a functional requirement at the level of knowledge, it has been proposed to use a model of structural patterns in the design of functional requirements. It has been shown that the formal description of knowledge derived from the Use Case diagrams is a special case of a given model. We have proposed a model of the subclass of structural patterns for designing scenarios for the implementation of functional requirements.

An improved method of scenario analysis of functional requirements to IS has been constructed. The essence of improvement is the selection from the publications of scenarios for meeting the requirements of knowledge and a subsequent analysis of knowledge-oriented descriptions of these scenarios in order to identify overlapping scenarios for the implementation of various functional requirements to IS. To identify and address the cases of such duplication, it has been proposed to use the improved method of synthesis of architecture descriptions variants for a created IS.

An example is provided of testing the improved method of scenario analysis of functional requirements in the course of analysis of functional requirements to a project of the functional module of labor safety. The verification results confirm reliability of the proposed method.

The proposed improved method for scenario analysis of functional requirements to IS makes it possible to obtain a description of the architecture of a created IS based on a much smaller amount of information on the functional requirements to IS.

**Keywords:** functional requirements, method of scenario analysis, Use Case diagram, knowledge-oriented model, architecture description.

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**INFLUENCE OF THE DIRECT MESSAGE SEARCH MECHANISM BASED ON THE TCP PROTOCOLS ON THE EXCHANGE PROCESS (p. 36-42)**

**Vasyl Melnyk**

Luts'k National Technical University, Luts'k, Ukraine  
**ORCID:** <http://orcid.org/0000-0001-8282-6639>

**Kateryna Melnyk**

Luts'k National Technical University, Luts'k, Ukraine  
**ORCID:** <http://orcid.org/0000-0002-9991-582X>

**Svitlana Lavrenchuk**

Luts'k National Technical University, Luts'k, Ukraine  
**ORCID:** <http://orcid.org/0000-0002-5453-3924>

**Ihor Burchak**

Luts'k National Technical University, Luts'k, Ukraine  
**ORCID:** <http://orcid.org/0000-0003-2662-6442>

**Oleksii Kaganiuk**

Luts'k National Technical University, Luts'k, Ukraine  
**ORCID:** <http://orcid.org/0000-0003-4616-8768>

The direct search mechanism is implemented with the expansion of the traditional socket TCP interface for receiving messages while bypassing the traditional order of the established queue. This mechanism can be used for high-performance and clustered computer systems in order to intensify data exchange and continuous support of a maximum load on computing machines. The interface for direct message search is implemented on the base of the Linux kernel. The experimental test results are obtained by using a set of simple micro-benchmarks. During the test, the sender sends the required number of fixed-size messages via an established connection, and the receiver skips unexpected messages and reads the expected one into the user's space. The approach to finding the expected messages is realized with multiple searches for a case where the socket application treats the TCP socket as a list of messages with the ability to receive and delete the data not only from the buffer top but from any place in it. All expected messages are recognized and processed by the developed `seek_recv()` call. Each test contains ~80 repetitions, which include such operations as socket opening, sending 800–1000 messages according to the acceptance politics, and socket closure. The system only uses one active socket at the same time.

The received results confirm a noticeable decrease in message processing CPU time by 36–40 % and overall productivity growth. However, when the volume of messages is approaching 1000 bytes, i.e. close to the typical size of the TCP packet useful load, there is a productivity decrease in the message exchange process.

**Keywords:** TCP sockets, message search, interface expansion, performance.

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**CONSTRUCTION OF THE EXPERT SYSTEM OF GEOSPATIAL ANALYSIS THAT EMPLOYS SCENARIOS FOR THE AUTOMATED DATA GENERATION FOR A DIGITAL MAP (p. 43-50)**

**Gregory Drobaha**

Ivan Kozhedub Kharkiv National Air Force University,  
Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0001-7644-8838>

**Vladimir Lisitsin**

National Academy of the National Guard of Ukraine,  
Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0003-0177-4254>

**Lyudmila Safoshkina**

National Academy of the National Guard of Ukraine,  
Kharkiv, Ukraine  
ORCID: <https://orcid.org/0000-0001-6336-8919>

**Ihor Morozov**

National Academy of the National Guard of Ukraine,  
Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0002-9643-481X>

**Andrey Poberezhnyi**

National Academy of the National Guard of Ukraine,  
Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0002-8984-6912>

This paper reports a study into the formalization of algorithms for solving problems, the generation of data for digital maps, as well as their implementation, through a set of simple operations that would be intuitively clear to a user who is not a specialist in the field of geoinformation technologies.

The approach that has been proposed is based on the construction of typical scenarios for model execution. Such scenarios are edited and adapted to the use of alternative electronic terrain maps.

The result of scenario operation is a set of data – layers of a digital map based on the input parameters for the model and the problem-solving algorithms, compiled by an expert. That makes it possible to construct libraries of typical scenarios, to store them centralized, as well as provide a common access to the scenarios, and to exchange data among applications. The result of running a scenario is that the user is provided with a possibility, without writing a programming code, to perform complex operations on processing geographical data and to simulate various processes at an electronic terrain map.

A geospatial analysis expert system has been developed, containing both the basic functions for geographical data processing and the high-level specialized models. A tree of decisions is built under a mode of visual construction of a problem-solving algorithm. We have implemented a conveyor of operations at which the data sources in an expert system derived when performing any operation are sent to the input of the next operation.

The results of this research could be used in simulation models of military activities, the tasks on photogrammetry in designing the optimal routes to fly over a territory, and as an additional tool for analysis of terrain in geoinformation systems. There is a possibility to expand the functionality of an expert system and to add new types of operations.

Thus, there is reason to assert that the process of automatic construction of data for digital maps requires specialized software and highly skilled users of geoinformation systems.

**Keywords:** geoinformation system, geospatial analysis, digital map, overlay analysis, simulation model.

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**DEVELOPMENT OF NEURALNETWORK AND FUZZY MODELS OF MULTIMASS ELECTROMECHANICAL SYSTEMS (p. 51-63)**

**Gennady Kaniuk**

Ukrainian Engineering Pedagogics Academy, Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0003-1399-9039>

**Tetiana Vasylets**

Ukrainian Engineering Pedagogics Academy, Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0002-2148-8645>

**Oleksiy Varfolomiyev**

DeVry University, New York, USA  
ORCID: <http://orcid.org/0000-0001-7110-0760>

**Andrey Mezeria**

Ukrainian Engineering Pedagogics Academy, Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0003-2946-9593>

**Nataliia Antonenko**

Ukrainian Engineering Pedagogics Academy, Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0001-8319-2826>

The study objective was to construct models of multimass electromechanical systems using neural nets, fuzzy inference systems and hybrid networks by means of MATLAB tools. A model of a system in a form of a neural net or a neuro-fuzzy inference system was constructed on the basis of known input signals and signals measured at the system output. Methods of the theory of artificial neural nets and methods of the fuzzy modeling technology were used in the study.

A neural net for solving the problem of identification of the electromechanical systems with complex kinematic connections was synthesized using the Neural Network Toolbox application package of the MATLAB system. A possibility of solving the identification problem using an approximating fuzzy system using the Fuzzy Logic Toolbox package was considered. A hybrid network was synthesized and implemented in a form of an adaptive neuro-fuzzy inference system using the ANFIS editor. Recommendations for choosing parameters that have the most significant effect on identification accuracy when applying the methods under consideration were given. It was shown that the use of neural nets and adaptive neuro-fuzzy inference systems makes it possible to identify systems with accuracy of 2 to 4%.

As a result of the conducted studies, efficiency of application of neural nets, fuzzy inference systems and hybrid nets to identification of systems with complex kinematic connections in the presence of "input-output" information was shown. The neural-network, fuzzy and neuro-fuzzy models of two-mass electromechanical systems were synthesized with the use of modern software tools.

The considered approach to using artificial intelligence technologies, that is neural nets and fuzzy logic is a promising line of construction of appropriate neural-network and neuro-fuzzy models of technical objects and systems. The study results can be used in synthesis of regulators for the systems with complex kinematic connections to ensure their high performance.

**Keywords:** identification of multimass systems, neural-network models, fuzzy approximating systems, hybrid networks.

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