UDC 004.8:612.82
A.I. Shevchenko, I.S. Salnikov, A.V. Djachenko
**The Content Features of Formation the Scientific Concepts "Artificial Intelligence"
and "Natural Intelligence" by Students-Informants in Creative Experiment**

The problem of formalization creative processes of the person is one of the most difficult, but at the same time one of the topical problems in the field of an artificial intelligence. The researches directed on studying of ways of the decision creative tasks by people, can become a basis in construction the algorithms of machine creativity.

In given article the experiment is presented, which reveals abilities of the person to definition at collision with a new field of knowledge and abilities to formulation the description of new concepts of this area with using knowledge available for him.

The experiment essence consisted in the following: it was offered to informants (first-year students of a technical speciality) to formulate for a small time interval scientific concepts "natural intelligence" and "artificial intelligence", being based exclusively on own knowledge, experience, imaginations of these concepts without use of special sources.

The informants definitions received as a result of conducted experiment have been processed by content-analysis methods. The content of each of concepts "natural intelligence" and "artificial intelligence" has been presented as the set of descriptive features, features-attributes and features-actions; by means of operations over these sets the most essential features for each of concepts, and also the general and distinctive features for both concepts, have been allocated.

On the results based on the made analysis it was artificially designed the generalized definition of concept "intelligence", which has been compared to existing dictionary definitions of the given scientific term. Comparison has shown that the designed definition does not concede dictionary ones neither in completeness, nor in accuracy.

Following conclusions have been made:

– The creative problem of formation the scientific concepts definitions can be successfully solved by the person even at insufficiency of knowledge in the field.

– The experiment described in article in its simplicity and presentation allows to track features of formation the new scientific concepts by unprepared experts, and also to reveal possibilities of formalization the process of scientific concepts formation.

– Processing of experimental data has shown possibility of machine formation the scientific concepts definitions: on the basis of the content-analysis of corresponding scientific texts, detection of feature sets of concepts and execution of operations over these sets the algorithm for synthesis of the definition of the given scientific term can be made, which can approach to the real creative algorithm.

UDC 62.505
Volodymyr Harbarchuk
The Metodological aspects of Control of State as Intelligent Cybernetic System

In article it is offered new cybernetic approach to the problematic of construction of effective structure of a control system by the state. To tell the truth, cybernetics as a science about control state considered Herodot, and in 18-th century – the Ampere. But a control state is such specific sphere of activity of the person in which on scientific methods base in last turn. In result arose and there is a set of absurd methods and the ways of government based on heuristic and egoistical reasons of those who comes to control of state.

In article it is shown, that the essence of the state can be classified precisely enough depending on that as well as who puts the system purpose – the nation-wide purpose of management. If such purpose for one state is put by other state we already have a pathology because one state is the colonizer for the second. Conditions at which the level of democratic character depends on statement of the purpose in the state are determined. The main problem will be, that the state as system most complex of cybernetic systems of accessible to the person that in her both the object of management, and a managing subsystem are intellectual. Such systems refer to as intellectual cybernetic systems.

Resume

And the essence of a problem of management that each citizen of the country has the own, local purpose and this purpose not always, or not completely coincides with the nation-wide purpose of system. It at once generates a problem of the conflict both in object of management, and in a managing subsystem. Methods of management of such systems demand the decision very difficult in mathematical understanding of problems of search of the best compromises between the nation-wide purpose and the local purposes of citizens and constructions on the basis of these compromises of very difficult algorithms of management.

Other problem will be, that such systems have hierarchical structure, and the quantity of levels of hierarchy is defined by scales of the country and scales her political and economic activities. Proceeding from principles of construction of hierarchical structures of control systems it is shown, that irrespective of a level of centralization, or decentralization of management in a control system "state" the unique supreme control center should be unequivocally determined. It is shown, that "twohead" control systems of the state are simply unable to carry out effectively functions. Examples of a real life with such structures of management are Ukraine and some other young states.

Article has methodological and theoretical value for so actual problematic as efficient control the state and can be useful to those statesmen who would like to apply even in the elementary variant scientific approaches to government.

UDC 519.865.7
A.V. Matviychuk
On the Issue of Principal Possibility of Creation of Artificial Intelligence

There is placed emphasis in this article on necessity of using at creation of artificial intelligence systems such mathematical tools, which based on principles of information processing by living organisms. It's pointed to two generally accepted approaches to artificial intelligence systems building – semiotic (which reconstitutes higher mental processes at human mind and may be realized with use of fuzzy logic methods) and biological (which simulates an intelligent behavior on the basis of tiny non-intelligent elements by the way of creation of brain-like structures and may be realized with usage of neural networks tools).

At analyzing both mentioned approaches it was revealed that human's mentation don't go over sentence or other syntactic constructions – the human usually recalls any situation instantly (activating the large group of brain neurons simultaneously). Accordingly, it might be supposed that the human's mentation occurs through the images saved in the mind. But the human perceives it by means of his native language. In this case the language is just projection for human of his thoughts but these thoughts may go across the mind even without transforming of theirs into linguistic form.

It's shown that for creation of artificial intelligence it's necessary to be able to operate by images which realized the semantic. But the representation of these images is not obligatory must be syntactic or even linguistic. Let's note this conclusion contradicts generally accepted Newell – Simon's hypothesis about possibility of realization of strong artificial intelligence just on the basis of physical symbol systems. However the stated in the article argumentation illustrates the decision-making process in wildlife without symbolic language holding.

Taking into consideration the stated reasoning it may be induced such conclusion: if it would be make an attempt to realize the artificial intelligence based on wildlife principles it's reasonable to construct the system operating just by images. From our point of view as most adequate tools for reproduction of mental processes of various animate beings may be used the classic artificial neural networks, particularly networks of associative memory, which set in motion the big groups of neurons like a biological neural systems. As appropriate, further to these neural networks may be added unit of linguistic interpretation of obtained results.

UDC 681.3(03)
V.A Nastasenko, E.V. Nastasenko
Definition of the Greatest Possible Memory for Systems of Artificial Intelligence

The possibilities of creation of modern intelligence systems in a great deal depend on the fast-acting implementation of operations in computers used for them, in particular – on the volumes of their storage memory and the treatment of information. It is important at this to know their maximum possibilities, and whether they exist in general. Basic principles of increasing of volumes of computer memory are considered in this work, it is shown that the limits of these possibilities in theory can be limited by the sizes of working layers and the amount of cells, forming the memory devices. On the basis of the developed conception the basic ways of increasing parameters are considered, including a transition from crystalline layers to the layers of electronic clouds of atoms, and further – to the structures of elementary particles, and the maximum possible layer, related to the Plank's parameters of length, time and mass is selected. However the transition to the new levels requires qualitatively new technical decisions and technologies. Within the framework of the grounded reality of these parameters their connection with the parameters of gravity and electromagnetic fields is proved which are single common at Plank's level, that provides the possibility to operate them. As a maximum possible memory cell there can be graviton, the sizes of which are equal to the quantum of space of the Universe, having the Plank's sizes. The determination of maximal volume of memory is possible in this case, as the whole volume of the Universe, filled these quanta of space the size of which will make a size to 10^{183} byte. The quantitative estimation of these possibilities is grounded by the reliable laws of physics and executed calculations.

UDC 658.325
D.S. Knysh, V.M. Kyreichik
The Distributed Genetic Algorithm with Fuzzy Migration Operator

This article is about a new model of distributed genetic algorithm (GA) with a fuzzy migration operator. The authors suggest new model of distributed genetic algorithm. This model is based on migration buffer which works with all population. So this model has two additional parameters: the buffer size and method of buffer size manage. This model has "sea of islands" structure with difference number of "islands" (in experiments were used 8 and 16 islands). Because migration operator has a big influence to GA's work, the authors developed new operator based on fuzzy sets theory. The migration operator has two main parameters. The first is frequency of using and the second show how many chromosomes will be exchange. To develop fuzzy migration operator we have to choose factors of migration work and create rules base. In the current research were used two factors that are level of diversity population and level of development population. In experiments were used three multicriterion functions: Rastring's, Sphere's and Grivank's functions. The fuzzy migration's work results were compared with migration operator which is used after each 5, 10, 15, 20 and 25 iterations. The results have showed that fuzzy migration operator is better than other for Grivanks's and Sphere's functions. The authors held that dynamic connections between populations are further development of distributed GA.

UDC 681.78
Y.F. Kutaev, L.I. Tumchenko, V.A. Gubernatorov
Application of the Method of Sections to Control the Surface Form
of the Stain of Radiation in Real Time

Now in polygraphy, laser processing of materials, a location, optical communication and other areas of engineering necessity of wider implantation of optical-electronic systems with automatic adjustment of distortions of formed light radiation is felt. Destabilising effect of mechanical or climatic factors, instability of characteristics of a source of radiation, indignation in an optical path can be the reasons of these distortions, un preliminary adjustment optical units, etc. Support of com-

prehensible quality of correction demands continuous runtime check of characteristics of light radiation, for example space allocation of its intensity, including an estimation of deviation of the specified allocation from initial or standard allocation.

Theoretical basic on solution of the given problem are considered.

UDC 04.93'1
T.B. Martynyuk, A.G. Buda, V.V. Khomyuk, A.V. Kozhemiako, L.M. Kupershtein
Classifier of Biomedical Signals

The features of the classification of biomedical signals in terms of bioelectric signals (BES) are considered. The choice of classification method with the discriminant functions (DF) computation for the definition of "rough" regularity of the experimental data is proved. The features of matrix data arrays processing on the difference cuts (DC) are presented, which allows combining the implementation of the classifier basic operations. The using of the vector linear metric of similarity in the processing on the DC is proved, which allows abandoning of forming (accumulation) DS quantities. The analysis of characteristics neural-network implementation of a digital filter (BF) in the consisting of the classifier is executed, the realization of basic blocks in the form of multilayer neural network – two concatenated maps: two-dimensional computing map and one-dimensional features map is proved.

UDC 519.161
A.V. Morozov, A.V. Panishev, V.O. Skachkov
Modification of Little's Method for Solving the Circular Rural Postman Problem

For the first time the limited version of the known Rural Postman Problem (RPP) − the Circular Rural Postman Problem (CRPP) is formulated in this article. It consists in a finding on the transport network presented by connected weighed graph $H = (V, U)$ the closed simple cyclic route with minimum cost which contains the fixed set of edges $R \subseteq U$. CRPP is generalization of the Hamiltonian Rural Postman Problem as the set of its feasible solutions includes the Hamiltonian cycles which are passing on all edges of the set R.

CRPP is NP-difficult and it is not always solvable. It's one more singularity, complicating searching of an optimum, consists in unknown in advance a subset of vertices of the graph on which there will pass a required cycle.

It is shown that CRPP is reduced to the problem of finding of a simple cycle with the minimum cost in the graph received as a result of vertex-edge conversion of the initial graph.

The method of solution the CRPP based on classical algorithm of branches and bounds for solving the Travelling Salesman Problem (Little's algorithm) is offered.

In the offered method at each vertex of branching of the solution tree matrices of lengths of the shortest paths and the matrix of routing including all vertex and edges of the graph which can contain in the optimal path are calculated to avoid loss of solutions.

For the first time three rules of branching are applied the partitioning of the set of all solutions on not intersected subsets and lower estimations of cost of optimal solution implying from them are received.

UDC 04.272.26
I.A. Nazarova
Extrapolation Block One-step Numerical Methods for Solving Stiff Cauchy's Problem

The decision of initial value problem for ordinary differential equations (ODE) is an inherently sequential process. However, extrapolation methods for solving Cauchy's problem for ordinary differential equations possess a high degree of potential parallelism. This article is dedicated to the design and analysis of the efficiency of parallel algorithms for local extrapolation based on implicit block methods. The use of implicit multipoint one-step scheme as a based method for the technology of the local extrapolation allows us to solve stiff problems. The developed algorithms are implemented on parallel systems with distributed memory and the topology of the hypercube. The theoretical estimations of the runtime and exchanges, total overhead of parallelism, speedup and efficiency of parallel solutions are defined. The numerical experiment on a system of tests for ODE is performed.

UDC 004.272:004.042
O.N. Paulin
On Parallel Dataflow Processing Adapted to Range of Bit-arbitrary Configuration

In this article the parallel processing (compressing) of dataflow is considered. It is represented as arithmetic multi-row binary codes (AMC). The efficiency of treatment is evaluated by criterion of minimal delay.

The generalized model of the operation of AMC compressing is constructed. A feature of the model is an arbitrary configuration of an area of treated bits, in this case bits of each digit possess the symmetry regarding compressing operation of AMC. This situation just is described by means of the author's applied theory of symmetrical functions (SF). This theory allows to design the logical schemes of devices based on compressing operation of AMC.

The model involves mathematical description and structure compressing operation of AMC, procedures, methods and facilities of AMC compressing based on SF taking into consideration obvious or latent internal carries, methods of AMC decomposition on the regular fragments: rectangles, triangles, rhombuses and trapezes.

The fragments of bit area are processed by appropriated multi-operand adders. Decomposition of bit area on the regular fragments allows to simplify process of design devices and variation of parameters of the fragments allows to obtain optimum complication of the device by equivalent delay one.

Classification of known, improved and new methods and facilities of AMC compressing is made.

UDC 004.89
T. Usova
The Expert System Application in the Information Technology for Parallel Solving of Nonlinear Equations

Article is devoted to a problem of automatic system for parallel solving of nonlinear equations performance optimization for the purpose of further implementation on the computing cluster. Nonlinear equations, especially mixed type, very often haven't any analytical decision. Thus iterative methods are applied for their solving which doesn't give required rate of intermediate value convergence each time. Therefore, such methods development is issue of the day.

Offered in the article automation method for parallel solving of nonlinear equations is based on application of the information technology, which includes algorithm of nonlinear equations solving representation in the form of the structurally-procedural program. Further this program can be paralleling between computing node of the cluster with MPI technology use.

The information graph of nonlinear equation construction methods based on elementary base units with expert system application is represented. Role of the expert in the information graph construction process is described in detail.

The developed methods for automation of nonlinear equation information graph construction with use of expert system allows to paralleling various types of problems from a nonlinear class at the expense of solving model invariance relative to the equations type and gives the chance to unite the algorithm of nonlinear equation structural analysis with the structurally-procedural implementation on multiprocessing system with programmable architecture.

UDC 519.6
A.N. Khimich, A.V. Popov, V.V. Polyanko
Technologies of High-performance Computations for the Investigating and Solving of Problems on the Strength Analysis of Constructions

An objective of this paper is introduction of high-performance computations (on multi-processor computers) into software available for computers with one one-core processor. An example of this is the creation of the program complex based both on the domestic program complex LIRA and on the intelligent parallel programs from INPARLIB library which implements technologies of high-performance computations for investigating and solving of problems (static linear and non-li-

near, dynamical linear) on the strength analysis of constructions on computers with parallel arrangement of computations, in particular, on intelligent parallel computers INPARCOM.

Original statements of problems and statements of resolving problems arising during the finite-element discretization of the original problems are dealt with in the paper. Parallel algorithms for the forming, investigating and solving of these discrete problems are described, as well. A description of implementation of the technologies proposed in the LIRA-cluster complex for the solving of problems on the strength calculation of constructions as well as some components of its interface are given.

Investigations and approbation of the LIRA-cluster program complex on the workstations INPARCOM carried out by authors have demonstrated the prospects of the creation of program tools intended for the solving of application problems on parallel cluster-type computers by means of embedding of parallel programs for the solving of the separately taken sub-problems into program complexes available in various branches of science and technology. Programs from the INPARLIB library and their analogs for other computers with parallel processing of information may serve as such parallel programs.

UDC 004.8/.93'1:519.254
A.E. Yankovskaya, S.V. Kitler
Decision-making on the Basis of Parallel Algorithms of Test Pattern Recognition

Despite of existence of rather larger number of approaches and methods of decision-making on the basis of test pattern recognition (Zhuravlev J.I., Zagorujko N.G., Zakrevskij A.D., Yankovskaya A.E.), setting of the problem under consideration has not lost its urgency.

Since decision-making is carried out in realtime, and the problem itself is NP-complex, it is expedient to use parallel algorithms of test pattern recognition and acceptance of total solutions on their basis for reduction of time expenses at decision-making.

Solution of the given problem is quite important in ill-structured areas, such as medicine, geology, psychology.

In the given research the decision-making is carried out on the basis of matrix model of data and knowledge and with usage of logic-combinatorial algorithms.

The matrix data model consists of a description integer matrix in space of characteristic features and matrices of distinguishing in space of classification features.

The matrices of description and distinguishing are used to construct, using parallel algorithms, the matrix of implications, which defines distinguishability of objects from different patterns (classes at fixed classification feature) and is used to search the irredundant column coverings of the matrix of implications, which are required to construct the unconditional irredundant diagnostic tests (UIDT).

These UIDTs are used for construction of decision rules, on the basis of which is made decision on membership of object under investigation to pattern (class at fixed classification feature). When the number of UIDTs is considerably big, time expenses for construction of decision rules is large, hence the algorithm of their parallel construction is proposed.

The final conclusion on membership of object to pattern is based upon voting procedure by results of recognition using all ways of recognition corresponding to all possible k-valued UIDT.

UDC 681.03
V.A. Shekhovtsov, N.A. Bazhenov
Using NLP to Define the Scope for Stakeholder Assessment of Simulated Service Qualities

The paper is devoted to the problem of involving business stakeholders in a software process in a form of assessing the perceived quality of the service-oriented system in its usage context. To organize such assessment it is necessary to start with defining its scope. Such scope is comprised from the set of services and qualities of interest together with possible usage contexts, these quality characteristics are later supposed to be simulated interactively in a way accessible to business stakeholders. The authors restrict themselves with the case when the initial specification of the system is available in natural language form.

To solve the problem, the authors propose to use Natural Language Processing (NLP) techniques to extract the scope information from the natural language specification and to represent it in the format of specific predesign models compatible with the rest of the simulation solution. These models extend the KCPM model developed as a result of the NIBA project in the University of Klagenfurt, Austria to deal with the quality attributes and requirements for the service-oriented systems.

To obtain structural representation of the simulation scope it is necessary to bridge the gap between natural language knowledge data generated by stakeholders and structured modeling data used by designers and developers. The proposed approach combines probabilistic part-of-speech tagging with sophisticated rule-based chunking and produces from free requirements text structured ontology-oriented tree-based output, available in XML format. It is proposed to use various interpretation rules, mainly based on predicate argument structure of verbs and its agentivity, the obtaining output is supposed to be mapped into different modeling concepts and parameters.

As a result of applying the proposed technique, predesign model representation of the set of services and qualities of interest (and, optionally, some of their usage contexts) could be obtained. This representation serves as a scope for subsequent quality simulation and assessment activities. Automating the task of defining the simulation scope reduces the up-front costs for applying the simulation framework. Reducing these costs can be considered an important step in the direction of increasing the feasibility of its deployment.

UDC 004.89
A.V Anisimov, C.S. Lyman, A.A. Marchenko
The Computational Methods for the Semantic Proximity Measures
of Natural Language Words

The main purpose of this article is to give comparative evaluation of different measures of semantic similarity and relatedness. Also, there were proposed and estimated some modifications of existing measures. For these goals the application software was developed.

First part of this paper describes main features of a lexical database for English language called WordNet. It is used as a knowledge-source in this paper. According to WordNet, a synset or synonym set is defined as a set of one or more synonyms that are interchangeable in some context without changing the truth value of the proposition in which they are embedded. It is a structural element. All synsets are related to each other. Hyponyms (IS-A relation) are important relations, thanks to them the taxonomy is formed.

The main part of the paper reviews several measures and their improvements. Considered measures are divided into next classes: path-based and gloss-based. First class is based on finding length of paths between concepts in the Knowledge Base; second one is based on using dictionary descriptions (glosses) of concepts

Path-based measures were developed mainly for IS-A relationship such as hypo- and hypernymy (concretization and abstraction). Thereby these measures are defined on taxonomy.

The gloss-based measures constitute the next class. The essence of this approach is quite simple: a semantic relatedness of two concepts is direct proportional to a number of words (or tokens), that both the description of the first and the second concept include. Also, there is suggested a modification: descriptions of immediate neighbors of the concepts take into account, as well as the descriptions of those concepts.

Finally, correlation rates between results of the measures computation of word pairs and human judgments about relatedness of the words are presented as the experimental data.

UDC 004.522:004.934
I.Yu. Bondarenko, O.I. Fedyaev, K.K. Titarenko
Classifiers Construction Based on Separate Hyper Surfaces

The paper is devoted to the usage of the modern graphics card sw/hw tools with the parallel architecture for construction of the Russian speech neural network phoneme recognizer. In particular, localization and recognition of phonemes is carried out by means of the neuronet approximators

which work in a parallel way and realize models of appropriate phonemes. The phoneme approximators are constructed on the basis of multilayered perceptrons owing to its universal approximating properties and existence of good training algorithms. As consecutive implementation of operation of the neuronet appoximators group does not allow to recognize speech signals in real time represents scientific and practical interest the problem of neuronet appoximator paralleling both in a recognition mode, and in a training mode.

Authors offer decomposition of neuronet algorithms into fragments for its mapping on the multiprocessor system. As commercially accessible variant of such computing system the modern graphics card with the parallel architecture is considered. To organize parallel computing on the graphics card, authors apply modern technology nVidia CUDA. By means of CUDA the neuroalgorithm fragments are displayed as parallel computing threads on the processor nodes of the graphics card.

Results of the carried out experiments have shown that the parallel implementation of neuro-computing on the graphics card allows to accelerate the neuronet phonemes approximator operation several times both in a training mode, and in a recognition mode.

UDC 004.421
P. Goncharenko, T. Zabolotnia, A. Mykhailyuk, V. Tarassenko
Organization of Software Spelling Corrector for Text-oriented
Information-Analytical System

In a society based on knowledge, an important factor of a successful career in practically any field is the availability of prompt receipt of necessary information, mostly in textual form. Considering this information-analytical systems (IAS), in particular text-oriented systems, acquire the character of increased demand information technology. In this regard, the problem of developing a theoretical basis and corresponding software tools for the effective implementation of all forms of natural-language textual information objects intellectual processing, including spelling correction, is actualized.

One of the means that provides high competitiveness of IAS is it's realization in the form of an open software product, adapted to the scaling. Often the basis of such software realization is agent approach according to which spelling corrector that is to be included in the IAS, ought to be built as a software agent, whilst the open system performs the role of it's environment.

Analysis of the spelling corrector tasks range, as well as selection of the accuracy and speed of error correction as criteria of effectiveness for this software determine the appropriateness of corrector implementation in form of reactive agent in relation to external IAS. Productive corrector's work is ensured based on input data processing using linguistic resources as well as accumulated in its internal database statistics of the joint use of words. Whenever an agent receives the command to correct the distorted word, it is necessary to update the contents of the database taking into account received information. Thus, with each further correction agent can increase the accuracy of its work through the use of statistical information taken from a larger number of texts.

Based on the above-mentioned, the process of corrector's work can be divided into two stages – the training stage, which is performed one-time before the agent starts to work, and the working stage.

The algorithm of software agent-corrector functioning, as well as its structural and logical organization are developed. Two ways for the agent architecture organization are proposed and analyzed: as a single entity and as a set of highly specialized software agents.

UDC 004.912
G.V. Dorokhina, V.A. Akchurin
A Morphological Analysis Module «RDMA_IAI» Vocabulary Database Correcting

The morphological analysis is one of the text processing stages. The IAI developed the Russian words declarative morphological analysis module (RDMA_IAI) and the Russian words morphological analysis without a dictionary (RwdMA_IAI).

It was discovered, that the RDMA_IAI database contains some errors – an incorrect values of morphological information (MI) – the set of grammemes for wordform. A possible source of these

errors was stage-by-stage expansion of grammemes set that are used at database and numerous processes of dictionary base addition and correction.

The RDMA_IAI vocabulary database is a source for filling of the RwdMA_IAI database. So the RDMA_IAI errors entail the improper morphological analysis results and errors at RwdMA_IAI database.

The article is devoted to discovery and correcting the errors at the dictionary base of the morphological analysis module RDMA_IAI. In order to achieve this purpose the rules for the incorrect morphological information values search were generated; founded errors were classified; the recommendations to correct a dictionary base were made.

RDMA_IAI database contained about 1360 different values of MI. Using theory there was generated the set of 96 rules that made it possible to find 211 incorrect values of MI (about 44 500 word-forms).

RDMA_IAI specifications require human check for all database modifications are planned. This requirement was realized using proposed technology.

The practical significance of introduced at the article set of rules and technology lies in the fact of their applicability for Russian morphological vocabulary database checking and correcting.

T.V. Yermolenko, M.A. Panfilova
**Influence of GSM-compression on Identification Acoustic Features
that Characterize a Speech Flow as a Whole**

An analysis of speech signal on durational speech segments is important part of expert criminalistics identification research of digital phonograms. This analysis is realized by means of integral features that characterize a speech flow as a whole and identify the group belonging of speaker.

The features, which describe statistical characteristics of pitch and amplitude-frequency spectral density of speech signal, are the most robust integral acoustic features. A bandpass filters grid is used for the calculation of spectral features.

GSM had became the global standard of cellular networks and had occupied leading positions in the world. Therefore in increasing frequency the digital phonograms in this format are used in a sphere of criminal and civil justice as a proof. Thus, there is a necessity of research of compression algorithms influence on the identification speech signal features, that defines actuality and substance of this work.

Methodology of integral features sets computing, that is used by the modern speaker identification systems, is described in the article. Spectral features are calculated on the basis of filtration by digital filters grid. Authors suggest to use a bark-scale and tempered musical scale for definition of filters' pass bands. Such choice is conditioned by psychoacoustical perception principles.

Computational investigation of influence of GSM compression on the values of integral identification features is conducted. The identification analysis of compressed signals by means of GSM-algorithm showed stability of pitch distribution histogram characteristics and also perspective of usage of tempered musical scale for definition of filters' pass bands.

A. Zhuk, S. Panfilov
Development of Extended Computer System Architecture for Sound Processing

A lot of projects related to digital sound processing, speech recognition, speaker identification and music recognition is developed nowadays. A set of libraries exists which encapsulate such a processing. These libraries realize some kind of inner program environment for intermediate data storage and data exchange. As for researcher, such libraries can be used by him only as a comparison objects for quality estimation of his own method. The researcher creates his own library or his own software complex in which he uses his own data structures, mechanisms for data exchange and messaging and so on. Thus the generalized architecture of sound-processing system is needed to bring some standards and make cooperation process easier for organizations and particular researches.

Resume

The requirements to this architecture are shown in the article and the structure of such sound-processing system is discussed.

Authors offer object-oriented models for data storage and sound data processors. These models while not being made with shared usage in mind cover two most sufficient parts of discussed sound-processing system architecture. The offered set of classes and the types of links between them used in models is explained. Also short description of class members is given.

The next steps in development of discussed sound-processing system as they are seen by authors lie within message and module interface specification development, storage model enhancement, run-time type identification functionality addition for complex data types being used.

A.A. Kargin, T.V. Shariy
Applying the Fuzzy Logic in the Systems of Phonological Classification of Speech Sounds

The article is devoted to the task of automatic speech recognition. The problem of phonological classification of the speech sounds by features as an alternative to the Hidden Markov Models widely used today is studied. The two most important binary classification schemes are investigated – the scheme by Jacobson and the scheme by Wiren & Stubbs. The last one is chosen for further experiments.

The novel fuzzy approach to the classification is offered, according to which the output values of the classification blocks in the scheme by Wiren & Stubbs are fuzzy values. Given approach allows avoiding the categoricity problem at the stage of making the decision to which concrete feature class should be the current sound assigned.

For the fuzzification procedures the special acoustic characteristics are offered. These characteristics (acoustic measures) are being calculated on the basis of spectrums of the phonetic segments. While formulating the measures the results of previous phonological research were encountered. For example, the acoustic measure "Vocality Measure" encounters the degree of evidence of the fundamental frequency in the spectrum, and the measure "Acuteness" encounters the relative energy of the high-frequency areas of the spectrum.

In order to estimate the quality of the class discrimination of speech sounds in the article the scores of dispersion of the output fuzzy values of the classification blocks in the scheme by Wiren & Stubbs are entered. The results of experiments of the class discrimination of phonemes are given. It is shown that for most of the blocks the results can be considered as good – the mean values of the score of dispersion lie in range [0.49, 0.59] while the variations values are relatively small.

Further investigations are connected with the research and development of fuzzy models that would allow determining the degree of accordance of current speech segment to the concrete phoneme on the basis of fuzzy information at the "feature" level as well as at the "cepstral" level.

Yu.G. Kryvonos, Yu.V. Krak, O.S. Zagvazdin
A Method to Detect Speaker Change in Continuous Speech Signal

In many tasks related to digital speech processing and speech recognition it is required to know when the speaker change occurs in the signal. For example, in automated transcription systems speaker change points could be used for more intelligent signal segmentation, in speaker-independent speech recognition systems such knowledge could be used to adapt and train the system for a new speaker.

Speaker change detection task is finding a point in a continuous speech signal where speaker change occurs without any prior knowledge of speakers and without any prior knowledge of the number of speakers. Absence of a priori knowledge about the speakers makes speaker change detection significantly different from more traditional tasks of speaker verification and speaker identification.

The proposed method is based on the assumption that the speaker change occurs somewhere around a breathing point – a pause in a speech signal. Thus to determine if there is a speaker change

at a given pause point two sets of characteristic vectors are built – one for the signal before the pause and one for the signal after it. Characteristic vectors consist of 12 mel-frequency cepstral coefficients. Once the sets of vectors are built they are compared based on the following dissimilarity measure:

$$d(X_1, X_2) = \mu_{1/2}(d(x_{1i}, x_{2j})), \quad \forall x_{1i} \in X_1, x_{2j} \in X_2,$$

where $\mu_{1/2}$ is a statistical median and $d(x_1, x_2)$ is the Euclidean distance between the vectors x_1 and x_2. The decision on whether speaker change exists at a given point is based on whether the measure exceeds a given threshold. The threshold is found experimentally.

The practical implementation of the proposed method with the automated transcription system has demonstrated method's acceptable quality and good performance with relatively small computational complexity which allows it to be implemented in real-time systems.

Igor P. Kuznetsov, Elena B. Kozerenko and Andrew G. Matskevich
The Organization Principles of the Object-Oriented Systems
for the Unstructured Text Information Processing

A semantic linguistic processor which extracts the objects and their links from natural language texts is considered. The conceptual model underlying the algorithmic developments is the extended semantic networks (ESN). The paper describes the use of the processor for the Russian and English text formalization. Peculiarities of the texts are taken into account by linguistic knowledge of the processor. We describe the use of this processor for text formalization in different subject areas, such as criminology (summary of incidents, accusatory conclusions, etc.), mass media documents about terrorist activities, personnel management (autobiographies, resume). Special features of each problem area are examined: the collections of extracted objects, the means for their identification, their connections, occurring contractions, punctuation and special signs, specific character of language constructions, etc. All these special features were taken into account in the linguistic knowledge development.

A tremendous increase of documents flow, obtained by the users through different information channels (including the Internet), requires new solutions. The majority of such documents (about 80 %) exists in the form of natural language (NL) texts. It is impossible to read and comprehend even the smallest portion of the factual information available. The existing information systems can render assistance, but for this a preliminary formalization is required. At the same time a great number of end users are people interested in specific subject things. For example, a criminal inspector seeks to extract information on important figurants, their places of residence, telephones, criminal events, dates and other such facts; a personnel manager is interested in the organizations, when and where a person worked and in what position. Other people try to extract from the media the information about countries, cities, places of interest, monuments, important persons, catastrophes, etc. We call these particular objects of user interest together with their features and links *information objects.*

We construct a new type of information system which considers the interests of the end user and is oriented at extracting information objects from texts. Due to the use of the reverse linguistic processors the formation of reports, filling the required table forms and relational databases is carried out. The expert component ensures the updating of the information by the analytical results, obtained via processing the knowledge structures. Different types of search are provided: the search for concrete entities, the search for similar entities, the search for connections, etc. The results are achieved not at the level of words or word forms, but at the level of the knowledge structures from the knowledge base.

Resume

UDC 004.934
V.V. Pylypenko, O.N. Ladoshko
Annotation and Accounting Disfluencies in the Problem
of Automatic Recognition of Ukrainian Speech

The paper deals with the problem of regular occurrence of disfluencies in spontaneous Ukrainian speech that has not been solved before. It reveals disfluencies which disrupt the normal course of the sentences.

The title of the text is "Annotation and accounting disfluencies in the problem of automatic recognition of Ukrainian speech".

The subject of it is to annotate, to classify and to investigate the effect of disfluencies on automatic spontaneous speech recognition system.

The main aspects are annotation and accounting disfluencies which on applied side present a challenge for automatic speech processing. When, for instance, word interruptions are concerned they also give rise to word-like speech elements which have no representation in the lexicon of the recognizer.

The challenge is considered by example of a computerized stenographer. It makes the text from sound records based on the speech recognition system aided by human. Large vocabulary (more than 10K words) continuous speech recognition system for a number of speakers is used to process recorded files.

The research is devoted to investigate the problems are caused by three main types of disfluencies in Ukrainian spontaneous speech, namely filled pauses, all variations of self-repairing (repeated words, repairing with insertion, repeated words with insertion, false starts of the words and breaks of words) and confusional words.

We analyze corpora of spontaneous Ukrainian speech. An advantage of using spontaneous speech from such corpora is the large amount of transcribed data available, making possible to study even infrequent disfluency types in their natural environment.

The data analyzed for distributional analyses comprises 73775 words, 46 different speakers which have told 500 words at least, and 1803 disfluencies. Rate of disfluencies per word in spontaneous Ukrainian speech is equal 2,44 % for natural reported speech. The investigation reveals that articulated repeated words have little or no effects on overall recognition rates.

It was conducted a research to analyze appropriate disfluencies for individual speaker. The experiment shows that amount of speaker's disfluencies are varying against the speaker (account for 4,24 % to 6,94 % of total amount of speaker's words). Individuals also differ in the relative promotion of types of disfluencies they produce. Some occurrence of speaker's disfluencies comes from an acoustic measure: speaking rate. The faster speaker has more frequent occurrence of disfluencies, in terms of words per second.

On the basis of disfluencies annotation and transcript correction the cleaning of the speech data was provided. The cleared speech data have been applied to speech recognition system, and have significantly improved the automatic speech recognition results by 6,5%.

Such results have implication for further studying and modeling disfluencies in automatic speech processing. Also practical application of the results would be useful to present speakers or speaker's type in automatic disfluency processing, not only to allow for overall rate differences, but also to model differences in type distributions.

UDC 681.3
L.A. Sviatogor, V.P. Gladun
Machine Understanding of Natural Language Texts: an Ontological Paradigm

In the work essentially new approach to problem of the semantic analysis natural-language (NL) texts is presented. Many texts and discources are characterized by the high semantic complexity defined by a variety of associative communications; they can be understood only in an extensive context of human knowledge. The linguistic paradigm of the semantic analysis, as well as a formal logic text-processing methods, cannot provide extraction from the text of its deep maintenance – communicative sence.

Therefore, it is necessary to work out a new sight (new representations) on "text knowledge extraction problem" and proceed from this to elaborate a new conception of the semantic analysis, new methods and means, which adequate to this aim.

The ultimate aim of all new procedures should be "machine understanding" of NL texts. It means, firstly, full formalization of knowledge representation system, from which the text interacts, and, secondly, localisation in this knowledge environment such semantic structure, which is reflecting the sense substance the text is presented.

As a knowledge representation system it is developed the object-oriented hierarchical three-level ontology – HiO*3, which be of conceptual graph (by R. Shank). As an elementary result of the semantic text analysis the local structure of ontological graph – a subgraph named as " a semantic trajectory" – is declared. The way on subgraph begins with concept, coinciding with the text keyword and comes to the end on the top of ontological graph. The final result of the full semantic text analysis is the "ontological sence", defined formally and constructively as an set of semantic trajectories (subgraphs set) for all text keywords.

The ontological sense is formally certain, monosemantic (exactly to ontology) and completely calculated. Process of its finding through machine knowledge ontology can be interpreted as machine understanding the NL text.

In the final research the new conception of the complex texts ontological analysis is proposed: the ontological sense is formally determined and the new information technology of the semantic analysis which leads us to machine understanding a natural language texts is indicated.

UDC 004.934.1'1
V. Shelepov, A. Nitsenko, A. Zhuk
Computer Voice Control System Development on Example
of Mathematical Formula Voice Input Task

One of the tasks of intelligent sound data processing via computer is speech recognition (SR). This task means methods and algorithms development, which make possible to achieve correct computer reactions on a speech contained in a sound signal. Solving SR task leads, besides of other interesting possibilities, to creation of computer voice control systems. The goal of this article is a description of modular computer voice control system which is based on separately pronounced command recognition.

The system, which is described in the article, was initially projected as application for mathematical formula voice input but with modular structure in mind. It means that program consists of several parts: one main application – speech recognizer and unlimited quantity so-called controlling modules which are consolidated around main application. The purpose of controlling modules is cooperation organization between main application and any arbitrary application, which such a module was created for. The advantages of such an approach are clear: because of dynamically-linked nature of controlling modules and because of fixed structure of them the vendor of controlled application is able to add voice control functionality into his product without any additional money spendings on SR researches. Moreover, all controlling functions for different applications are united inside one controlling center.

The data flow diagram of modular computer voice control system is shown in the article. Also, the file format for dictionary of commands is described and exported functions of controlling module are listed. This information is enough for uninvolved developer to create his own controlling modules.

The speech recognizer in the system uses hybrid recognition technique. For the first, the generalized transcription of spoken word is build using original phoneme-based recognition technique. This allows to shrink list of potential results significantly. The second recognition phase involves full-word recognition techniques for final result selection. The basics of phoneme-based methods and algorithms, which are used in the system, are also described in the article. This methods require calibration for successful usage with particular speaker. Authors of the article offer a teach-during-usage approach to such a calibration. This approach completely hides from the end-user almost all aspects of the recognizer tune, while allowing acquisition of all necessary for calibration data from corrections made by the user.

UDC 004.89:004.93
V.G. Abakumov, E.Yu. Lomakina
Automatic Gesture Recognition in Intelligent Systems

The concept of hand gesture application in intelligent systems to control the robotic devices is considered. The basic procedure of hand motion recognition was analyzed in detail, and the main points in each recognition stage were emphasized. An approach to reduce the space dimensionality in which hand is located and to avoid the limitations associated with the use of special markings has been proposed.

A fixed set of gestures is used in recognition, with the help of which certain commands to control the robot in real time is defined. Therefore, the speed and simplicity of the algorithm are very important. This approach includes hand segmentation on the basis of skin color features and dimensionality restriction. Dimensionality restriction is essential, because high dimensionality means huge computational cost. All hand motions are described by basis vectors. Principal component analysis (PCA) is recommended for reducing the dimension of the observed vectors without significant loss of information and independent component analysis (ICA) is used to display the characteristics.

Learning process must be applied for the system to react accordingly to certain set of external influences. It means adapting of the system to the specific movements of the user hands (a specific set of gestures). Visual hand images are used as learning objects.

So, on the basis of these preliminary processing procedures the signal that carries information about gesture in image is generated. Then gesture is compared with a set of gestures from the database and if classification is successful, a certain command is given to corresponding gesture. Output control signal of the system is generated, and automatic device performs a certain action accordingly to the command which signal carries.

The algorithm can be modified by including additional stages of preprocessing, such as camera calibration, filtering and so on. Segmentation stage is quite simple and needs to be improved when it is used in complex working conditions. Reliable performance of hand gesture recognition algorithm takes into consideration the ambiguous nature of static and dynamic gestures, problems of hand localization in image, lighting conditions and noise.

UDC 004.932
A.V. Agarkov
Image Segmentation Based on Using Graph-descriptor

Paper is devoted to the problem of image segmentation. The description in a kind of the graph is used for this purpose. To vertex of the given graph there correspond structural elements which are allocated by using of a multiscale representation. The multiscale representation is under construction on the basis of convolution with a kernel which represents a difference of Gauss functions with various scale of the smoothing, known as operator DoG:

$$D(x,y,\sigma_i) = \left(G(x,y,\sigma_i) - G(x,y,\sigma_{i-1})\right) * I(x,y) = L(x,y,\sigma_i) - L(x,y,\sigma_{i-1}).$$

Basis for the image description make set of image local features which are allocated from an achievement condition of function $D(x,y,\sigma)$ extremum. For the additional structural elements formation, areas of the image which correspond to extrema in a direction in planes of multiscale representation $D(x,y,\sigma_i)$ are used. Each structural element is characterised by brightness and scale, a range of scales, in which it keeps a stable arrangement.

Image segmentation is based on splitting of the graph-descriptor into subgraphs which corresponds to areas with homogeneous brightness in relation to arounded background. For this purpose it is deleted vertexes and edges, not satisfying to the set conditions. The procedure result is graph spliting into coherent subgraphs.

As parameter for vertexes selection their range of the scale has been used. As parametres for edges selection– type of the neighbourhood and how range of scale and characteristic scale of neighbours with each other concern.

Vertex with definite range of scales are considered only. In consider there are only the edges which connect vertexes corresponded to the structural elements which centers are located in the ne-

ighbor pixels. Characteristic scales of the given structural elements should belong to a range of neighbor scales. I.e. will be satisfied a condition

$$(\sigma_{min}^1 \le \sigma_{ext}^2 \le \sigma_{max}^1) \wedge (\sigma_{min}^2 \le \sigma_{ext}^1 \le \sigma_{max}^2) \tag{1}$$

where $[\sigma_{min}^1, \sigma_{max}^1], [\sigma_{min}^2, \sigma_{max}^2]$ – ranges of neighbour scales the structural elements, $\sigma_{ext}^1, \sigma_{ext}^2$ – their characteristic scales. Results of segmentation are considered at use of a condition (1) and without it. Set $D^1 = \{d_i^1\}$ – result of segmentation without use (1), set $D^2 = \{d_i^2\}$ – result of segmentation with use (1), where $d_i^{1,2}$ – a splitting subgraph.

As, reception ways of sets D^1 and D^2 also differ only of the additional condition it is obvious that elements d_i^2 are subgraphs of d_i^1. In particular, it means that each segment corresponding to subgraphs from D^1 can be broken on subsegments, corresponding to subgraphs from D^2. Thus, set elements D^2 define internal structure of the segments. Thus, between elements of sets D^1 and D^2 are established hierarchical relation, defining internal structure of segments from D^1.

Between set of elements D^1 the hierarchical connection has been established which reflect images segmentation at various levels of detailed elaboration.

This segmentation quite adequately displays image structure despite simple enough rules applied to it. It allows to assume that more difficult ways of the segmentation using will allow to allocate more precisely the segments of images corresponding to separate objects and their components. I.e. use of the count-description for images segmentation is represented perspective enough.

UDC 04.93'11
O.V. Barmak, Iu.V. Krak, Iu.G. Kryvonos
About One Approach of Human Identification by the Nose Contour Profile

The paper suggest an approach for person identification technique based on nose profile. Image processing algorithms allow to obtain the nose's shape as a set of points $Z = \{z_i = (x_i, y_i), i = 0 \cdots \widetilde{M} - 1, x_i, y_i \in R\}$. The further work with the set is made possible using the proper conversion of normalization $Z \to D$, where $D = \{d_i = (x_i, y_i), i = 0 \cdots \widetilde{M} - 1, x_i, y_i \in [0,1]\}$.

Recognition procedures for point-based shapes which describe the contours of noses of various people gain variable amount of points $\widetilde{M}$. Further transformations are possible if the number of points in the contour-descriptive shapes (M) remains constant. This is achievable using means of piecewise linear interpolation.

The objective is to find the transformation from the set of points D into the set of characteristics P: $D \to P$, where $P = \{p_i = (x_i, y_i), i = 1 \cdots N\}$, $N \ll M$. Elements of the set of characteristics uniquely describe the contour of a nose. The science of physiognomics, art and criminal expertise studies give knowledge that there are few feature-rich zones of a nose, the combination of which allows to describe well-known types of noses, such as Greek, Roman, Hawk etc. These zones are: the baseline of a nose, the tip, the dorsum, and the bridge as well. The latter is used to widen the set of noses that can be expressed using this technique. The topology of the descriptive curve has 4 explicit feature zones.

The set of characteristics P is obtained using B-spline approximation. It is suggested to use 4 base points. This doesn't not allow to approximate the shape in its exact form, but does allow to obtain the characteristic values for the four zones.

As the result, the four sets of characteristics $P^j = \{(y_i^j, Ind)\}$ for the feature zones of a custom profile are obtained, where $j = 1,...,4$ specify the amount of zones, i.e. 4, L is the amount of nose profiles; Ind is the human's identifier. The problem of identification is then equivalent to the search of $Ind \in \widetilde{P}^k, k = 1,...,4$, where $\widetilde{P}^k = \{(\widetilde{y}_i^k, Ind) : |y_j^k - \mathcal{C}^k| \le R_k, j = 1 \cdots L, y_j^k \in P^k\}$, where $\mathcal{C} = \{\mathcal{C}^k, k = 1,...,4\}$ is the set of characteristics for the input curve.

The suggested approach proved its compatibility in practice. The further research will be aimed on the improvement of the approach, further testing on larger sets of input data obtained within specific living region, comparison of curves for relatives etc.

UDC 004.415.24 (004.932)
S.L. Bedratiuk
Watermark Algorithm Robust to Active Attacks

The rapid development of modern information technology has led to situation when most products of people intellectual work are stored on digital media. They are not only preserved, but also distributed and sold over the Internet. So copy right protection of digital media appears as very important direction of steganography. One of the most effective way to address copy right protection is to use digital watermarking.

The article contains the basics of digital watermarking, examples of their usage, the problems faced by developers of watermark algorithms. Also it has been proposed robust watermark algorithm for the picture containers, which is based on geometric distortion compensation approach and uses image's point features founded using SIFT. Algorithm detects geometric transformation of container based on result position of image feature points. Feature points are detected by scale-invariant feature transform. Watermark information is embedded to frequency domain of container.

UDC 004.93'1; 004.932; 528.85/.87(15)
L.A. Belozerskiy, N.I. Murashko, D.S. Suschenia
Features of Polynomial Geometric Correction Concerning to the Tasks
of the Images Analysis Captured at Different Time Space Survey

Using of differences between the space survey images, captured at different times, is a quite common approach for solving the problems of analysis of changes in the ground objects. In the procedures, implementing this approach, it is usually assumed that the parts of these images, having the same coordinates and corrected geometrically, or their pre-defined fragments are considered.

Usually, widely applied visual comparison of before-mentioned parts or fragments does not meet any overwhelming difficulties, although this method requires a consistent approach to the problem of revealing the changes that took place in the area or at the object during the time interval between space surveys.

The attempts to solve similar problems automatically require another consideration of images corrected geometrically and, in particular, polynomially. In the publications, where the appropriate specific features are considered, the presence of distortions is only briefly mentioned, relying on the fact that the polynomial correction requires interpolation to be applied.

As a result, the scope of researcher's attention does not include the unequal number of pre-arranged reference points (resulting from mutual offset of the strips in the area of interest on the ground surface, covered by the satellite survey during the satellite's revolutions) and varying accuracy of their topographic location, affecting the before-mentioned difference between the fragments.

Appropriately, this article is intended to consider how the number of reference points, errors in their topographic location, and brightness interpolation used during geometric correction, affect the characteristics of difference images.

These problems cannot be solved experimentally, both because of natural and economic reasons (limited number of days of satellite survey in a year, high cost of survey, weather and climate variations etc.). Therefore, modeling is necessary.

Article generalizes the data of the modelling during its preparation. It was carried out in a wide range of interchanges of number reference points of fragments at imitation of mistakes of their binding in a combination to really functioning algorithms of geometrical correction of real images. As a result on the difference image a constant existence of changes in the form common variable in its limits brightness background in conditions when any real changes on a surface of shooting did not occur is detected. For guaranteed support of changes absence the role of the images captured at different times during modeling was executed with the same initial image geometric corrected under distinguished conditions.

Relying on the results of the examples investigated and dependences obtained, the mechanisms were revealed, resulting in generation of the difference background between the fragments of the images captured at different times. The causes of the background brightness level variations and ways to diminish this background were evaluated, and the opportunities were demonstrated for application of considered modeling principles for selection of reference points, their number, accuracies of topographic location, and for obtaining the estimations in real situations.

UDC 681.322
D.A. Viattchenin, V.V. Starovoitov
Objects Identification through Fuzzy Inference System

The paper proposes a methodology to identify the objects on aerospace images in-time, close to the real, through the mechanism of fuzzy inference for the example of Mamdani's type fuzzy inference system. The method of rapid prototyping of a fuzzy inference system based on the result of the training data set processing by the heuristic D-AFC(c)-algorithm of possibilistic clustering if described briefly. A process of forming of the training data set for the fuzzy inference system constructing is considered. A general plan of the application of the fuzzy inference system for objects identification on aerospace images is proposed. The method of uplearning of the fuzzy inference system is included in the proposed plan and the method is based on the D-AFC-TC-algorithm of possibilistic clustering. Results of numerical experiments are presented and preliminary conclusions are formulated.

UDC 004.932.751
Yu.V. Krak, D.V. Shkilnyuk
Analysis of Elements of Finger-sing Language

At present a special attention should be drawn at the issue of communication system supply among physically challenged people and other members of society.

The object of the research is elaboration and realization of recognition algorithm of dactyl language which is used by physically challenged people.

A special emphasis is laid at separate ways of quality improvement of dactyl language elements recognition. In particular a method of edge detection with the help of luminancy function which is used for improvement of the level of gesture recognition quality and a method of application of Sobel operator. The present scientific research represents the results of preliminary conducted researches. The conclusions of such experiments are the illustrative evidences of the usage of above mentioned methods which increase the quality of correct text recognition which is presented by the individuals of various hand size in different focal distances. Verification of such research is the effectiveness of recognition that has improved from 64 % to 75 % of presented gestures. Hereby implementation of present methods assists in more effective recognition of dactyl language elements.

The article also dwells on extended classification of dactyl language elements.

UDC 528.9:681.3.06
A.N. Kryuchkov, S.V. Ablameyko, G.P. Aparin, L.N. Sobol
Methods of Operative Analysis of Terrain State Based on Models of Digital Terrain Maps and Aero- and Space Photographs

Remote sensing data in the form digital aero- or space photographs (DP) and digital terrain maps (DM) are widely used for solving many practical tasks. But the DP first should be transformed in a map projection and scale, i.e. matching of DP with DM should be performed. In spite of quite many papers published on this topic, there are still many problems with accuracy of matching and convenient user-friendly tools for object extraction from the DP and the DM updating, etc. The matched DP images are used to update digital maps to solve applied tasks.

In this paper, methods of operative analysis of terrain state based on models of DM and DP images are presented and described. Several methods are considered and proposed in the paper. The general procedure includes matching of DP and DM images at the first stage. Then, digital maps are updated by using DP images. And then, remote sensing data and DM are used to solve various applied tasks that are shown in the paper.

Resume

We have long-term practical experience in creation of systems for joint interpretation of remote sensing data and map images. The following applied tasks have been solved with the help of the developed methods:

– discovery of fires on the satellite images with calculation their coordinates on maps;

– evaluation of forest state to produce forest maps from satellite image (forest status monitoring);

– classification of forest by wood species and age;

– pollution spreading forecasting on digital map taking into account atmospheric conditions (wind propagation and others);

– control of territory flooding and modeling of its dynamics;

– hazard (extreme) situation modeling.

The practical systems solved these and other tasks have been developed and used in organizations of Belarus and many other countries.

UDC 621.396

N.P. Lavlinskiy, N.I. Gallini
The Synthesis on Generalized Matrix of Autocorrelation Function of Barker Signals'
for Modern Communication and Location Systems

The theory of presentation of ACF binary phase-manipulated signals based on "generalized" matrix ACF which is adequate both to Barker's signals and to the signals with nonquantized in duration elements has been developed earlier by one of the authors allowed to use "engineering" approach to the synthesis of "barker's" signals ($|(R_i(\tau))| \leq 1+\delta$, where $\delta \ll 1$).

The signals with given (not necessary integer) length code of small side peaks ACF is obtained, not solving the focused problem of their minimization. The method of compensation of surges of derived ACF signals at the expense of leveling of shifts, which are located in pairs or groups in different on even lines of matrix. The sign of surges of ACF ($\Delta R'(\tau)$) – $(-1)^m$, where m – number of line. As a result, having available shifts, equal on quantity in even and old lines of matrix, the resulting surge $\Delta R'$ appears to be small.

The "barker's" signals for code length N$\in$[8;14] have been found. The same signals for $\in$[4,5; 7] had been found before for some values code length on minimax or (and) square ($\sum_i |R_i(\tau_i)|^2 = \min$) criterion, the found before signals excel the Barker's signals.

Two signals $\overline{L_s}$ and $\overline{G_s}$ for code length N=15 with integer duration of elements, have been found, which are equal to "barker's" signals with proper processing, which means the exceeding of the "damned" code length N=13 (when N>13 "Barker's" signals don't exist).
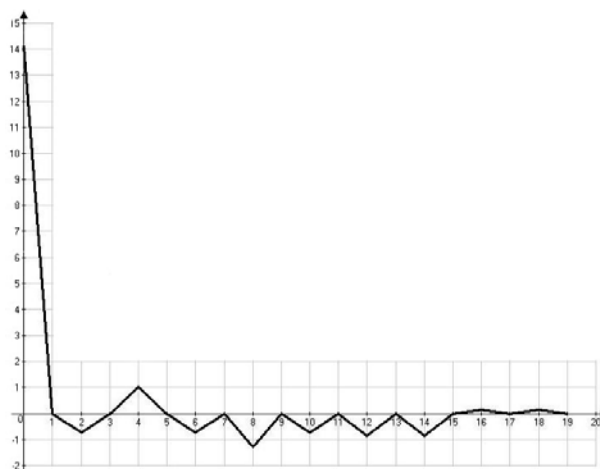
Compensated ACF for N=15

It has been proved that ACF of binary FMn signals is piece-linear function, defined by the sum of K – 1 modules $|\tau - \tau_s|$, balanced by whole number coefficient g(s.k). Shifts τ_s and coeffi-

cient g(s.k) are elements of combined ACF matrix K – is a quantity of elements of this matrix k – is a quantity of elements of the signals. The task is non-linear, multiextreme.

Theorem

For odd k $R\left(\tau,\overrightarrow{\tau_i}\right) = N - k\tau + \frac{1}{2}\sum_{S=1}^{K-1} g(s,k)|\tau - \tau_S|, \tau \in [0,N]$.

UDC 04.89:004.94
P.V. Lukashevich, B.A. Zalesky, A.M. Nedzved
Reconstruction of 3D Object Surface by Outlines of its Cross Sections

Methods for medical object surface reconstruction and volume computation by several outlines of its 3D cross sections are proposed. Also methods of reconstruction of branching objects surfaces are described.

Proposed approaches use simple models to restore body shape and estimate its volume.

In order to restore the three-dimensional surface, usually 3 – 6 contours of object cross sections, which can be performed manually or obtained automatically, are used.

In general, cross sections can be not flat and not parallel, but they should be not overlapped.

Three-dimensional object vector surface is formed by triangles with vertices lying on adjacent contours of cross sections. To restore branching parts of the object surface, a special procedure is developed. This procedure builds additional points between adjacent contours, which are used to construct branching surface parts. Resulting surfaces allow fast hardware rendering via OpenGL or Direct3D libraries.

The criterion of minimal area is applied for object surface restoration. Use of the criterion gave good practical results. The task of area minimization was carried out with help of stochastic methods.

To simplify implementation and reduce running time the surface was reconstructed by parts instead of global reconstruction of entire object surface.

The offered results facilitate initial diagnosing and make it more convenient for medical specialists.

Program realizations of the methods have been used in Belarusian Research Center for Pediatric Oncology and Hematology (BRCPOH) under the Ministry of Healthcare of Republic of Belarus in the framework of the project ISTC B-1489.
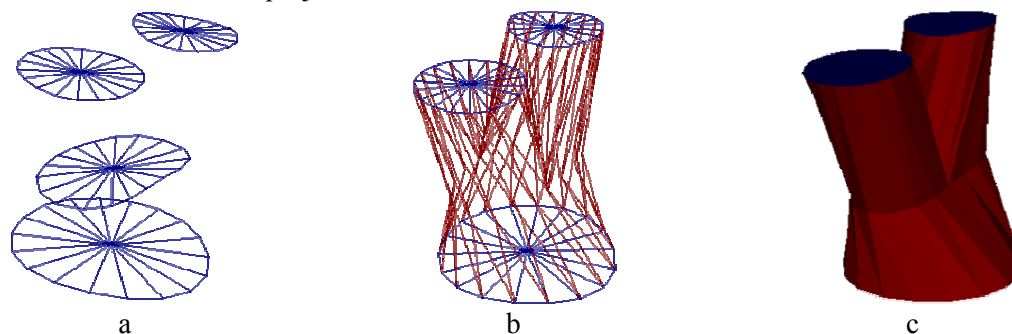
Example of branching object reconstruction: a) initial cross-sections in space; b) wireframe object surface reconstruction; c) object surface reconstruction

UDC 004.89:4.93
K.V. Murygin
Normalization of the Image of a Car Plate and Segmentation of Symbols
for the Subsequent Recognition

The automation of auto transport traffic control is now actual and important problem in which frameworks systems of automatic recognition of license plates actively are developed. There are many the similar systems focused on national standards of license plates which can essentially differ under many characteristics: the size, the form, color of symbols and a background, quantity and structure (letters and figures) symbols, the alphabet of symbols. Therefore the problem of recognition of car license plates accepted in Ukraine is actual and important in practice.

Resume

In the article results of the decision of a problem of normalization of a car plates and detection of symbols on the image of plate for carrying out of their further recognition are presented. Normalization here is understood as rotation of the image of plate in an image plane so that the line of symbols settled down horizontally. For the decision of this problem the global analysis of the image by means of Hough transformation is used. Segmentation of symbols is based on use of models of an arrangement of symbols on plate. During comparison of various models to the real image the model having the best conformity which parameters are used for detection of symbols location is defined. Such approach has allowed to define also type of car plate and a symbol accessory to letters or figures that facilitates their further recognition. The offered algorithm of normalization and segmentation of symbols allows to use successfully it in systems of recognition of car plates. Rate of processing of images in the size of 640*480 pixels on computer Pentium Core2Duo with frequency of the processor 2.33GHz was 12-15 frames per second. The further researches in a direction of development of automatic car plate recognition system can be bound up with recognition of the symbols presented on the images of license plate.

UDC 04.93'1;004.932
A.M. Nedzved, P.V. Lukashevich, D.A. Hancharou
Reconstruction of Medical Object Shape by Distance Maps of its Cross Sections

In this paper we propose a reconstruction method of medical and other three-dimensional objects by building distance maps of cross sections. The major advantage of the method is the ability to generate an arbitrary number of intermediate layers. In addition, proposed an original approach to solving the branching problem.

To resolve problem of the same number of contours in neighboring layers used convex hull algorithm. Combining objects is realized through the calculation of the coordinates of the center of mass and a line through them. The division of objects on the middle layer is a separate task. The number of contours in the middle layer is equal the number of contours in the final layer. The contours of the intermediate layer are separated by watershed lines, which are constructed by using distance maps. For all separated objects analyzed the distance between the centers of mass. Based on this information formed a pair of objects. Combining the corrected convex contour and objects allow to define the area to determine the contours.

Using the binding of all objects on the layer ensure the stability of the algorithm for objects of any shape, and bitmap representation of the data excluded the curling surface elements. This algorithm is the most effective for use in problems of object measurements.

The results will contribute to the development of diagnostic software radiological techniques for proper calculation of the data on the dynamics of the regression of tumor formation, optimization of the decision on treatment.

Program realizations of the methods have been used in Belarusian Research Center for Pediatric Oncology and Hematology (BRCPOH) under the Ministry of Healthcare of Republic of Belarus in the framework of the project ISTC B-1489.

UDC 004.93
I.O. Paliy, A.O. Sachenko, S.G. Antoshchuk, T.O. Burak
Neural Networks Approach to Computer Face Recognition

Computer face recognition systems are actively developing and take approximately 12 % of modern biometric technologies. As a rule they involve two main procedures – face detection and recognition. High validity and speed are the main requirements for such systems.

It is developed the generalized information face detection model which uses the multilevel combined cascade of classifiers. There are also developed the face detection methods based on the abovementioned model for grayscale and color images' processing. They use the combined cascade of neural network classifiers (CCNNC) which consists of the cascade of weak classifiers for the face candidates' detection and the convolutional neural network (CNN) for candidates' verification. The face candidates' verification method is improved by using the CNN's property to handle a whole

input image at once. The method of CNN training set formation is also improved by the parametric adaptation of the active training set structure. The CCNNC allowed reaching one of the best validity values on the CMU test set with 0,88 true positive rate at 10^{-8} false positive rate, while processing images in near real-time mode.

Frontal faces are the most suitable for recognition. Therefore the face view recognition algorithm was developed based on the principal component analysis. During the experimental research on UMIST dataset this algorithm showed the recognition rate of 0,85.

Face identification and classification algorithm was developed based on the convolutional neural network. The algorithm was tested on well known test sets (Weber, Yale, AT&T) and showed the recognition rate of $0,85 – 0,93$ at $0 – 0,03$ false positive rate and $0,07 – 0,12$ false negative rate.

UDC 621.397
I.I. Salnikov
Information Technical Systems of Remote Objects Image Analysis,
Working in Em-waves

It is shown in the paper that the concept of information as new knowledge was a generalizing factor combining such systems as message transfer systems, remote objects spatial parameters extraction systems, target destination and navigation systems, management and investigation in information technical systems (ITS). The paper considers the ITS of remote objects image shaping. It is stated that it is possible to shape a remote object image in the waves of any physical nature, but the most widely spread ones are electromagnetic (EM) waves of various frequency ranges, spreading in all possible media with different spreading characteristics. Remote objects image shaping is necessary for solving the following problems: detecting new objects in the observed zone, measuring the objects' spatio-temporal parameters (dimensions, coordinates, velocity) and recognizing the objects with the view of their identification.

In the problem of receiving an object image in EM-waves two directions have been clearly defined, both being connected with the ratio of the radiation wavelength used and the sizes of the receiving antenna aperture:

– wavelength cutting causes resolving power increasing, but it results in greater influence of weather conditions on ITS performance;

– by the specific wavelength, defined by the conditions of passing through atmosphere, increasing the aperture sizes is performed through synthesizing by the receiver's movement in space.

For shaping remote objects images various physical phenomena are used: absorption, refraction, reflection, scattering, diffraction, interference, which are observed by EM-waves interacting with objects and which are based on electromagnetic field's interacting with the charges being in the medium. The above-mentioned physical phenomena change EM-wave spatial characteristics, its temporal characteristics also being changed in case of the object moving.

There exists a great variety of ITSs, solving the most diverse problems of providing information for a person, but one can find out some common features of the interaction of an information carrier as an EM-wave with remote objects and a technical system of extracting these objects' spatio-temporal parameters values from the EM-wave parameters. The generalized structure of the remote objects image analysis ITS in electromagnetic waves is given.

The author has carried out the systematization of methods for remote objects spatio-temporal parameters analysis for the most information capacious ITSs, forming images. They are television systems of detection and target destination, television systems of monitoring the earth surface, radar side-looking systems, radar technical protection systems.

UDC 004.272
L.I. Tymchenko, I.D. Ivasyuk, R.V. Makarenko
Fundamental Computing Structures and Algorithms
on the Base of Parallel-hierarchical Transformation

The article deals with the possibility of construction of essentially new computing structures and algorithms. A theory of parallel-hierarchical transformation PH is put forward to solve this problem.

Resume

Principles of construction of architectures were investigated and methods of synthesis of information structures were developed as well as possibility of simultaneous figurative multistage perception.

Parallelism analysis which is realized in computing devices singled out several levels.

Forms of parallelism on the last three levels will be carried out with Flinn's terminology use.

On PH basis transformation is possible with the help of different structures of computing environment.

Transformation of arrays of information on the basis of PH method transformation can be done with varying degrees of parallelization of computing process.

Formation of a result while coding of arrays of information in several ways.

1 Only initial single elements go to result.

2 All single elements on every level go to result.

All these methods were put forward because with good convergence of arrays the result of coding by volume of transformed data is minimal.

Next method of transformation consists in parallel processing of a single array which are processed consequently on each level. Final method of transformation of package of arrays by parallelization of computing process consists in consequent transformation of each array by element.

Developed forms of parallelism for parallel-hierarchical structures of four classes-SISD, SIMD, MISD, MIMD allow to use them for solving different applied problems, for work of which different time scale is needed.

L.I. Tymchenko, V.V. Melnikov, N.I. Kokryatskaya, V.V. Shpakovich
**Parallel-hierarchical Network Learning Methods Creation
for High-eddicient Images Recognition**

Parallell-hierarchical networks are one of modern directions in the area of recognition pattern, having good calculable productivity due to homogeneous organization of the up-diffused structure and also having a capacity for learning and generalization. These information-computer properties are allowed by PH to decide intricate problems networks, for what they must be integrated in more difficult systems.

Major technical advantages of the offered combined method learning of PI networks, which are realized in a new programm product as compared to previous programm facilities and methods stopped up in him are next: exactness of measuring after the correction of power centers of fragments of routes of determination was 0,01 element of decomposition (as compared to 1,2 element of decomposition). Thus a percent of «good» images was 38,4 % (as compared to 50 %), that promotes the general percent of correct recognition to 92,5 % (84,8 %). However, index – «mean recognition time» at initial level for learning of PI network makes: 60 sec (30 sec).

During statical patterns recognition the middle percent of correct recognition rose at zero level of PI network: 93,75 % (80 %). Also we mark considerable growth of middle percent of correct statical patterns recognition at the construction of level cross-correlation curves: 84 % (as compared to 5 %). Index «mean recognition time» at initial level at learning of PI network makes: 10,73 sec (12 sec).

I.M. Udovik, L.G. Akhmetshyna, A.M. Akhmetshyn
Self-Organising Interferometric Method of Low Contrast Image Segmentation

The article is devoted to statement and solution a problem of low contrast images processing under conditions of a priori uncertainty system characteristic of their forming and also spectral and statistical properties of useful signal (region of interest) and a noise. Using local-adaptive transformations of brightness images gives possibility for transition to a new information basis. It opens a practical possibility for solution the task increasing quality, sensitivity and resolving power visual analysis of low contrast images, and also validity of segmentation procedure on base using virtual

analogies with most high-accuracy and sensitive method of radiophysical and optical measurements as interferometry and corresponding mathematical apparatus.

The results of experimental testing of devised method on digital models and real images are presented. A domain of ones applicability is identified and made comparison with known methods of image processing.

The method gives possibility for forming a new "composite" image on base of multidimensional synthesized ensembles with various characteristics of analyzed images. It gives possibility for facilitating multiparameter data analyzing and interpretation.

L.G. Akhmetshina, T.S. Iamnych
Interpolation of Spatial Data by the Method
of Two-dimensional Projection of Unclear Clusters

This article is devoted to setting up and decision of interpolation task of spatial data, set at an uneven net. Informative possibilities of new method, essence of which is based on the unclear clustering of incomplete experimental data, consideration of their belonging functions projections on a co-ordinate plane and use of them for the receipt of prognosis values in additional points with the interactive increase of unclear model exactness on the basis of analysis and neutralization of minimax errors in base point, are considered.

Actuality of the work is conditioned by the presence of great number of practical tasks with incomplete basic data for which measuring is possible only in some points, that especially justly in the large systems (geology, ecology, mining industry, economy) and by the features of processing of spatial data.

In a theoretical aspect the worked out method behaves to the type of self-organized unclear models. The results of verification of method are presented on a model – known geophysical fields, real data, being reconnaissance mining holes, comparing is conducted to the known methods of interpolation.

The got results except the best high-quality accordance of model demonstrate the good result of extrapolation is expansion of model surface on external areas which the results of measuring absent for.

A.P. Ben
Use of Game Theory Model for Representation and Analysis of Navigating Situations
in System of Support Decision-Making of the Navigator

A growth of intensity of sea transportation for the last decade had led to a significant increase in the number of sea accidents including human victims and complex technogeneous consequences that is why the increase of safety of navigation becomes one of the most important problems of modern shipping. A decrease of human factor influence upon the level of accident rate at sea presents a current scientific and practical problem that should be solved in the light of optimization of navigator's interaction with up-to-date technical means of navigation. One of the most perspective ways is the development of systems of support in decision making (DSS) of navigator. A significant feature of such DSS is the operation in the mode of real time that imposes strict time limitations on the processes of working out and making decisions and requires to plot scenarios of ships' divergence for the whole period of interaction. So, it needs to take into account the principle of commonality of interests of interacting ships consisting of preventing collision and normative coordination of their behavior in accordance with International regulations for preventing collisions at sea (COLREG-72). The above circumstances dictate the need to develop mathematic models adequate to the requirements of COLREG-72, suitable, at the same time, for description of situations of ships' interaction while their divergence and decision making as to the ship's control in real time under conditions of dynamically changing navigational situation. The aim of this work is to develop mathematic model to represent navigational situations in the decision support systems on the basis of game theory approach. The use of the proposed model will permit to increase adequacy of presentation and assessment of navigational situations, to shorten the time necessary for decision making as to the ship's control in DSS of navigator.

Resume

UDC 519.816
G.V. Gorelova, A.I. Khlebnikova
The Cognitive Modeling for Intellectual Decision-Making Support System
for Transit Trade Management

The article is devoted to the questions of cognitive modeling of transit trade company managerial processes and working out on the basis of the cognitive module the intellectual managerial decision-making support system in this sphere.

Transit trade was chosen as the object of the research, since nowadays small wholesale commercial firms are the most simple in the organization form of the small-scale trade business of various types of industrial, household goods, materials for construction and hundred thousand people are involved in such trade activity. These companies play essentially big macroeconomic role, than it can seem at first sight, thus this role is not always positive. Frequently, excepting a case with sale of goods by small wholesale amounts by large commercial firms which, as a rule, purchase the goods directly at home producers, or on foreign markets, the goods on a way to the retail dealer or the end user pass through a chain of several intermediaries. This circumstance not only creates a significant added value on a way to the retail dealer or the end user, but also creates significant additional risks. Besides, owing to low qualification and low level of knowledge of the market, absence of skills and the weak economic relations with transport and logistical companies, such companies become a source of inefficient decisions in the field of logistics of goods movement, on the one hand giving an additional job to the transport and logistics enterprises, and on the other hand reducing economic efficiency of the consumers and doing, for example, small retail dealers noncompetitive under the prices in comparison with large commercial networks.

Therefore there is a problem to increase efficiency of managerial decisions in transit trade activity, both for commercial firms, and for consumers. One of the ways of this problem solving is development of intellectual managerial decisions-making support system in the given subject domain and their implementation in management practice of trading companies. In spite the fact that there is a considerable quantity of the various types of DSS ensuring logistical activity, they, basically, are intended for the large companies.

In the given work it is offered to design decision-making support systems for small and medium size companies which would allow to react effectively to fast changing environment, expecting possible development of market situations under the influence of diverse factors. For these purposes it is offered to use cognitive modeling methodology which can be a basis of models base and knowledge base development of intellectual managerial decisions-making support system.

In the article a number of results of cognitive modeling of a transit trade management system, representing to possibility of the offered toolkit are shown. It is illustration of a working out of cognitive map of the transit trade reflecting internal and external environment of system, possible scenarios of the system development received by impulse modeling on cognitive map at any entering of operating and revolting effects on tops of a map. The short analysis of results of computing experiment is given.

It is offered to use developed models and methods as a basis for designing cognitive module in intellectual managerial decisions-making support system.

UDC 004.89
O.M. Zemlyanskiy, N.P. Kaverina, V.E. Snytyuk
Designing of Fire Monitoring Systems in Uncertainty Conditions

Annually on the Earth arises about seven millions fires. The basic directions of fire safety maintenance are a fire occurrence conditions elimination and minimisation of its consequences. Installation of automatic warning facilities about fire occurrence is one of such problems decision ways. The quantity growth existing tendency of heavy fires, failures and their negative consequences is not in the last instance caused by low efficiency of fire automatics systems and, in particular, systems of fires revealing – fire alarm system.

It is shown that alarm system placing, a lining of communication lines, installation of intakes demands an accurate, correct choice of fire monitoring system for objects, and default of their requirements conducts to increase in false operations, to increase in time of fire revealing.

Carrying out optimisation of fire monitoring system structure it is necessary being based on two positions:

1. Considering considerable cost of element base and installation of fire monitoring systems, at a choice of gauges, structures of their placing and installation to start with necessity of construction and use of a compromise area semblance between system cost and volume of a possible damage in case of a fire and its untimely revealing.

2. At a choice of gauges placing structure to be guided by their time and operational parametres, and also the expert judgements containing integrated "experience" of similar systems operation with possibility of the environment features account.

Considering features and lacks of fire alarm system gauges placing, the elements which are components of structure optimisation technology for fire monitoring system are offered. Problems which are necessary for optimum structure definition solving of fire alarm system gauges placing are formulated. Corresponding technologies of gauges fire extinguishing structure optimisation are necessary for basing on technologies of Soft Computing as rigidly set rules of their placing appear often enough inefficient.

It is noticed that at the resulted problems there is a significant amount of fuzzy production rules containing fitness-functions, offered by experts. It is obvious that such rules quite often have inconsistent character. Their objectivisation consists in definition of fitness-function parametres, proceeding from the values containing in training samples, and the decision of a total error minimisation problem at the conclusions equal in rights, or minimisation of weighed error, otherwise.

For the such problem decision probably use of neural-fuzzy networks or evolutionary modelling. The last for a number of reasons is represented preferable though experiments remain still ahead.

UDC 514.116
L.P. Mironenko
Trigohyperbolic Functions and their Algebraic Properties (I)

In the paper it is considered a transformation from a set of well-known elementary functions $\sin x$, $\cos x$, shx, chx to a set of new linearly independent functions which designated as *six*, *cox*, *inx*, *osx* and named trigohyperbolic functions. Series expansions of elementary functions have served as basis for such transformation. Four new functions were defined during putting out of common terms in the series:

$$\sin x = six - inx, \ \cos x = cox - osx, \ shx = six + inx, \ chx = cox + osx.$$

According to these definitions the exponent function can be represented in the next form: $e^x = six + inx + cox + osx$. Inverse formulas are found:

$$six = \frac{1}{2}(\sin x + shx), inx = \frac{1}{2}(-\sin x + shx), \ cox = \frac{1}{2}(\cos x + chx), \ osx = \frac{1}{2}(-\cos x + chx).$$

Asymptotic behavior of all trigohyperbolic functions is $\approx \frac{1}{4}e^x$ at $x \to \infty$.

If apply well-known correlations between functions $\sin x$ & $\cos x$ and shx & chx (for example, $\sin^2 x + \cos^2 x = 1$, $ch^2x - sh^2x = 1$) corresponding correlations between new functions six, cox, inx, osx can be easilyfound:

$$co^2x + os^2x = 1 + 2six \cdot inx, \qquad si2x = 2(six \cdot cox + inx \cdot osx)$$

$$si^2x + in^2x = 2cox \cdot osx. \qquad in2x = 2(six \cdot osx + inx \cdot cox)$$

$$co2x = 1 + 4six \cdot inx \qquad \sin^2 x = 2(cox \cdot osx - six \cdot inx)$$

$$os2x = 4cox \cdot osx \qquad \cos^2 x = 1 + 2(six \cdot inx - cox \cdot osx)$$

Algebra for trigohyperbolic functions is formed according to the well-known trigonometric equations. More than 70 equations are presented in the paper.

Trigohyperbolic functions of imaginary argument are obtained if in the new functions six, inx, cox, osx instead of argument x is substituted argument ix:

$$si(ix) = i \cdot six, \ in(ix) = -i \cdot inx, \ co(ix) = cox, \ os(ix) = -osx.$$

Euler's formula is easily checked also:

$$e^{ix} = si(ix) + in(ix) + co(ix) + os(ix) = i(six - inx) + cox + osx = \cos x + i \sin x.$$

Representation of trigonometric and hyperbolic functions through the new trigohyperbolic functions is a foundation for practice with usual trigonometric, hyperbolic and exponential functions. One can easily work both with the new set of functions and traditional set of functions. Unusual correlations between these sets of functions make the theory very interesting and promising. It can be generalized and developed into differential and integral calculus, differential equations.

Practically the new theory can be applied in the phase transitions theory, junction processes in electric chains, optics. The new functions have specific properties:

a) functions six, inx, cox, osx are monotone;

b) their differences ($(six - inx), (cox - osx)$ are finite and periodic functions.

UDC 004.89:004.031.43
Yu. Nechayev, O.N. Petrov
Research of Non-stationary Dynamic Sea Objects Behaviour
in the Side Intelligence Systems of New Generation

The approach to synthesis of neural network models of non-stationary systems is developed in the paper. A control of characteristics of dynamic sea object is an application of this approach.

Ingress of water to the compartments of dynamic object and water filtration to adjacent compartments because of the breach are typical pictures of origin and developing of non-stationary processes in complex dynamic systems. The main task of intelligence system is practical guidelines elaboration of forecast of emergency situation development under the conditions of uncertainty and incompleteness of initial information.

An interpretation of emergency situations is given on the basis of time curves and phase-plane portraits. An analysis of behavior of emergency dynamic object in heavy seas allows picking out three typical situations describing development and stabilization non-stationary processes of rolling:

− rolling development and stabilization;

− the transition from one stable condition to another;

− continuous increase of dynamic rolling under the conditions of catastrophic flood.

The third situation is the most difficult case of realization of emergency object dynamics in heavy seas. The dynamic object loses stability and capsizes because of ingress of heavy load of water under the conditions of asymmetric flood. Consequently the examined system stabilizes in case of flood decrease or the dynamic object loses stability of oscillating movement.

Another approach to nonlinear non-stationary dynamic system modeling includes the use of methods of catastrophe theory and representation system behavior with the help of cusp catastrophe.

In the case of emergency flood the system continuously changes its state and moves towards the new catastrophe, capsizing under the influence of external disturbance under the conditions of sharp lowering virtually all elements that define the cusp catastrophe.

Carried out computing experiments indicate functionality and effectiveness of neural network models in complex tasks of analysis and interpretation of emergency situations under the conditions of continuous change of dynamics of object and environment.

UDC 005.311.6
M.V. Novikov
Transversal Filter in Systems of Decision Making in Securities Market

In order to solve the task of information selection which is necessary for decision making it is considered the information filter which is synthesezed on the basis of Freedman − Sawidge' model, model of nominal optimum and transversal filter, that allow to optimize the securities choice from the available alternatives of the condition of Securities market.

UDC 62-50:15
N.B. Paklin, S.V. Ulanov, S.V. Tsarkov
Classifiers Construction on Imbalanced Datasets on Example of Credit Scoring

The article discusses the problem of building binary classifiers on imbalanced datasets. This problem is actual in such application as credit scoring, where the part of good clients as a rule is more than 90 %. Such classifiers have a tendency to take new samples to the majority class. The problem is complicated by essential differences of classification costs.

The existing approaches were reviewed: different types of sampling (oversampling, undersampling, one-side sampling, focused oversampling, SMOTE technique) and cost-sensitive machine learning algorithms.

The experiments were made on two datasets of bank clients credit histories. The aim was to analyze the efficiency of different approaches to building binary credit scoring models in terms of imbalanced datasets. Oversampling, undersampling and several various algorithms of machine learning: logistic regression multilayer perceptron, SVM, Naïve Bayes were used for this purpose. The experiments showed that logistic regression (both kinds of rebalancing sampling) and also algorithm of decision tree C5.0 (undersampling) provide the best results. SVM method demonstrates the worse results with increasing costs ratio.

UDC 004.82
O.O. Saveliev
On the Concept of an Information Data Intelligent System for Telecommunication Companies in the Development of Intellectual Decision Support Systems

The paper is devoted to the problem of construction of information data intelligent system for telecommunication companies. The author made the investigation and analysis of modern methods, tools, technologies and ideas of construction of data intelligent systems to identify their characteristics. In addition, the concept of its own information data intelligent system for telecommunication companies was proposed in the development of intellectual decision support systems.

The main purpose of the paper is development of concept of an information data intelligent system for telecommunication companies. The author considered the following questions in order to achieve it:

1. Analysis of corporate management systems for telecommunication enterprises.
2. Problems of data intelligent in the field of telecommunication and usage their solutions.
3. Concept of information data intelligent system for telecommunication companies.

The questions considered in this article are relevant, because until now the issue of creating a single, integrated data intelligent tool that supports many platforms, is not resolved, and such systems could find practical application in telecommunication companies managing, as well as for specialized tasks.

UDC 004.82+07.52
R.A. Sandu
Mivar Technology Using to Create a Multidimensional Evolutionary Application of Automated Information System to Support Decision Making for the Management of Innovation Resources, Chemical and Petrochemical Industry in Russia

The article examines the application of Mivar technology of Prof. O.O. Varlamov for the complex scientific problems in the management of innovation resources. To solve the problems of innovation management of chemical and petrochemical industry in Russia it is requires the constant computer monitoring and analysis of the development of chemical complex, as well as assessment of their level of innovative resources. Currently, such tasks in an automated mode are successfully solved by expert systems. The paper analyzed the characteristics of the subject area and explained that as an expert system for innovation management of chemical and petrochemical industry in Russia has to be established "multidimensional evolutionary applied automated information system supporting decision-making" on the basis of Mivar technologies.

Resume

UDC 004.272
L. Feldman, T. Mikhaylova
Probabilistic Model of Block Memory

The probabilistic model of block memory with one and several input streams is suggested. The main parameters such as the average number of used banks and factor of loading, which characterizes average capacity of block operative memory are determined on the base of Markov's model. The speed of memory under the same number of banks increases with the rise of independent flow of requests. However increasing of operative memory capacity, which is got because of division of the general flow of the applications on certain number of independent flows, requires the essential complication of management multiprocessor computing systems. The developed model can be used as base for model defined the optimum correlation of amount banks and modules in each of them, which can be used for memory optimization with block-round-robin scheme of stratification.

UDC 004.82:004.62:314.1
Oleg Chertov
Metadata Modeling of Statistical Information Description

The process of developing a general structure for a statistical metadata system was initiated in 2004 during the joint meeting of the United Nations Statistical Commission and Economic Commission (UNECE), the European Commission Statistical Office of the European Communities (EUROSTAT), and the Organization for Economic Cooperation and Development (OECD) dedicated to the problems of a statistical metadata information system (METIS). For now, there have been worked out standards and recommendations concerning statistical metadata which are used in practice by national and international statistical offices.

But, all the documents mentioned above address either the description of architecture and general statistical business processes or the description of the metadata from the point of their interaction with the other (non-statistical) information systems. At the same time, to practically implement an metadata driven integrated statistical system, we also need the detailed study of the metadata model which will be used to describe the statistical information and the specific way of its processing. Moreover, we need to explicitly mark out the problems of providing information confidentiality, since they are most important for the systems of publishing or disseminating the statistical information.

For that matter, the aim of the current work is to develop a statistical information description metadata model which would take into account the special features of the data processing in the statistical domain, and also would explicitly support providing confidentiality of the information being stored.

In the paper, we discuss the problems which arise during the modeling of the metadata used for describing various pieces of statistical information. We concretize the well-known model of statistical business processes, and propose a novel semeiotic metadata model. Both models take into account aspects of providing statistical information depersonalization and confidentiality, and also its protection against the disclosure by means of data mining methods.

To demonstrate the capabilities of a practical implementing of the proposed metadata model, we provide a shortcut description of a model for a "statistical survey" notion. The developed model will be used during the construction of an Integrated Statistical Data Processing System for Ukraine. Its implementing is scheduled for 2012 (according to the "Development of State Statistics System for Monitoring the Social and Economic Transformations" project with the support of the International Bank for Reconstruction and Development).

UDC 004.896.006.1(204.1)
T. Akinfiev, A. Apalkov, M. Armada
Autonomous Robot for Water Sampling

The article discusses a new autonomous underwater robot. The aim of this work is to develop an autonomous underwater robot that can take water samples from depth readout from the surface of the reservoir in the pre-defined points, while providing high vertical positioning accuracy as well

as low-cost water samples. Robot's body consists of two parts, top and bottom, which are connected with toothed belt drive. The upper part of the robot has positive buoyancy, the lower part of the robot has negative buoyancy, and the robot as a whole has a positive buoyancy. The toothed belt drive is equipped with an optical angle sensor and allows for lowering the bottom part of the robot to a given depth with high accuracy. An additional feature of the robot is the ability to take water samples without changing the weight of the robot. This is to ensure that the process of taking samples of water robot would not change its vertical coordinate. This is achieved by special design of sample containers and by applying the corresponding control algorithm. The robot works in two different modes. The first is the regime of horizontal displacement on the surface of the water to the point with the predetermined coordinates, and the second is the regime of vertical movement of the lower part of the robot and water sampling. In laboratory tests of the robot it is shown that the robot can provide a depth positioning accuracy about one millimeter. Note that this accuracy refers to the situation when the process of changing of the effective length of the toothed belt is quasi static, with the robot being in unperturbed water, and when the effective length of the toothed belt varies in the range of about 1 m. Some special experiments were made to study the effect of water surface waves on the accuracy of positioning of the robot. It is shown that the smaller is the cross sectional area of the robot upper part, the lesser the waves affect the vertical positioning accuracy. For example, when the upper part of the robot is made in the form of a tube with a cross section of 3 cm^2, the vertical oscillations of the robot under the action of waves with amplitude of up to 10 cm were only a few millimeters. In real working conditions of the robot in the sea, the depth positioning accuracy can be deteriorated considerably due to the influence of the factors such as water temperature dependence on the immersion depth or ocean currents, which may have different velocities near the surface and at depth. Nevertheless, the use of special sensors and appropriate control system can compensate such errors.

M.A. Gabidulin
Potential Accuracy of Photo-electric Digitizers of Movings on the Basis
of Sine-cosine Raster Interpolators at Technological Restrictions

In the article the maximum attainable potential accuracy of photo-electric digitizers of movings on the basis of sine-cosine raster interpolators at constructive-technological restrictions is discussed. The models of transmission functions of raster matching with the axial located source of radiation and sine-cosine transformer with the four-phase and the circular read system are offered allowing to consider joint action of principal causes of errors and to provide accuracy achievement at expanded constructive-technological tolerances. The technique of synthesis is offered to provide the sinusoidal form of transmission function and minimization of influence of a clearance variation between rasters upon amplitude of the basic harmonic of transmission function allowing to consider the elementary obturation matching of rasters at the analysis of errors.

Victor M. Kureichik, Asker A. Kazharov
Use of Bee Algorithms for Combinatorial Problems Solution

The combinatorial problems solution approach by means of bee colony algorithms, which belongs to the biologically inspired algorithm class, has been considered in this paper. This algorithm class was developed for the scientific direction, which can be called as "natural computing". The main idea of these algorithms is the modeling of biological processes and swarm intelligence. Algorithms of graph partitioning into parts according to the number of connections between parts criterion have been considered in this work.

The following algorithms have been implemented and investigated in the course of this work:
1. microevolution;
2. evolution;
3. genetic;

4. ant colony;

5. bee colony.

The experimental research and the comparison of the proposed algorithms on the graph partition problem example have been made. The algorithm could be applied to other combinatorial problems, including the Traveling Salesman Problem. To apply this algorithm we have to modify the problem statement and to construct a new goal function.

A computer program was created during this work. This program realizes the described model of biologically inspired algorithms. Experimental research has been made for graph partitioning problem solution on different benchmarks.

For graphs with dimension of up to 100 vertices a "good" solution is found in less than 10 seconds time. The bee colony algorithm has demonstrated the ability to go from local optimum through the random search use more than other algorithms. The advantage of bee algorithm in terms of quality solutions increases with the number of vertices increase. The algorithms proposed by the authors can be applied for the effective solution of similar problems on graphs.

UDC 004.382

S.A. Polivtsev

Intellectual Radio Networks with Fuzzy Configuration

In the article the possibilities of application peer-to-peer radio networks of standard IEEE 802.15.4 (ZigBee) a range of 2,4 GHz for work of the system consisting of small-sized mobile robots group and one command point are discussed. The primary goal of group of robots – is carrying out of investigation during rescue operations after technogenic and natural accidents and failures. For controllability preservation by separate robots and system as a whole, it is offered to raise "intelligence" of a communication system at the expense of flexible routeing of channels between command point and the concrete mobile robot to have system with automatic, intellectual restoration of the channel of data exchange.

Minor alterations in a package of the data and addition of new reports of communication allow to construct in standard ZigBee an intellectual radio network with an indistinct configuration. Properties of a network allow to apply it as moving devices (group of mobile robots) and stationary devices.

UDC 519:682.5

R.A. Varbanets, V.G. Ivanovsky, A.P. Ben

Use of Principles of Fuzzy Logic in the Expert system of Technical Diagnostics of Ship Internal Combustion Engines

Analysis of performance of some elements of ship power plants shows that the greatest operating losses are connected with failures of main and auxiliary ship diesel engines (SDE). In connection with this, diagnostics of SDE according to parameters of working process is timely and, in significant extent, allows technical personnel to carry out their effective and failure-free operation. At present, the authors have developed and successfully put into operation a programmed hardware-controlled complex of vibration diagnostics of the main working parameters of SDE – DEPAS D4.0H.

The experience of practical use of this complex showed that solving the problem of malfunction diagnosis in SDE requires some widening of DEPAS D4.0H functional possibilities by means of creating a specialized expert system (ES) for classification of failures depending on the change of SDE basic parameters. The aim of this work is the development of expert system using principles fuzzy logic for determination of malfunctions in SDE on the basis of key indicator parameters of working process obtained as a result of vibration diagnosis of SDE by means of programmed software-controlled complex DEPAS D4.0H. Experience of practical operation of D4.0H system allowed to detect some interrelations between observed changes of indicator parameters of the working process, fuel feed parameters and standard sorts of SICE malfunctions. On the basis of revealed interrelations we have formed a diagnostic matrix of malfunctions that is the basic element of the developed ES, providing a formation of production rules. Presented matrix permits to simplify

the process of transition from expert estimation to production rules of ES. While filling ES knowledge base the expert has a possibility of visual control of correspondence of introduced changes of diagnostic symptoms and diagnosed defects in SDE. A joint use of suggested expert system with programmed software-controlled complex of vibration diagnosis of operating parameters of SDE DEPAS D4.0H ensures the increase of economical efficiency and service life characteristics and extension of overhaul period of SDE operation.

UDC 004.89:004.4
A.S. Voronoy
Virtual Organization of Agents for the Development
of Ontological Knowledge Base for Computer Learning System

Current models of representation and integration of information resources are actively developed and put into practice in e-learning. To work with such resources it's necessary to describe the characteristics and semantics of resources and subject area, as well as the possibility of processing this information software agents. The most important element of modern information technologies are ontologies, which allow for automated processing of information semantics.

In this article organization of multiagent system for constructing ontologies for computer learning is proposed. The contents of virtual organization of agents for automatic search of infomational resources, text analysis with the goal of detecting concepts and their relations, development and adding ontologies, adding creating ontologies in knowledge repositories are proposed.

The structure of virtual organization agent system creation ontology includes the following working groups of agents: search for documents by subject area in unstructured sources and semantic Web; extracting knowledge from the documents and presenting them in a formalized manner suitable for inclusion in the ontology; integration of ontologies and combining fragments; the storage and access to the ontology and its fragments.

The proposed multi-agent system for automating the development of ontologies implemented in the project of intellectual learning environment for the development of students in Computer Science in State University of Informatics and Artificial Intelligence.

UDC 004.89:004.4
S.M. Voronoy, A.A. Yegoshina
Search Method of a Tree Root of a Word-creating Tree for an Expert Learning System

The paper is devoted to the problem of processing large volume of derivatives of words in derivative synthesis in natural language systems which leads to complications and slow down the search for a word. It is proposed an heuristic method of derivation on a given semantics.

The base of algorithm is a method of searching the depths. To reduce the amount of sorting ordering of the vertices in the list depends on the heuristic information. Then the first will be resolved a vertex, that is considered the best.

Lexical value of new word is completely with all semantic components in lexical value of a base word. That's why measure of "promising" of a vertex is a measure of semantic closure of a candidate vertex to current semantics.

The heuristic method which is proposed provide to reduce time spent on the construction of the original words by reducing the number of vertices derivational trees that are analyzed.

An expert system of teaching the Russian language word building has been developed to study the proposed algorithms of morphologic analysis and word-building synthesis. The results of the study confirm correctness and efficiency of the algorithms which have been proposed. Accuracy of solving problems through application of the system exceeds correctness of word-building models used by a person, speaking Russian 10 – 15 % in average.

UDC 519.816

G.M. Gnatienko, V.E. Snytiuk

Mathematical and Software for Tasks of Expert Information Processing during Exams

In this paper mathematics and software for the automated carrying out of examinations is described. It is shown that estimation process is one of decision-making process elements. Aspects of active and passive estimation are defined. It is developed the procedure for student estimation process optimization in conditions of full uncertainty by subject domain structurization and unbiasness axiom application. Principles of knowledge effective control are offered: a necessary condition of expert system effective functioning is working out of the problems logic scheme; the uniform methodology of carrying out of the expert control and an estimation of its results for various problems is a sufficient condition; an effective use of the automated systems probably only under condition of synergetic procedures presence directed on reduction of control time and questions quantity. It is offered to consider as attributes of estimation completeness and knowledge monitoring procedure speed, and also statements and conclusions objectivization. It is shown the feature of realisation of a subject domain structurization on the ontology basis.

The preconditions of expert estimation are described and the analysis of estimation process efficiency is made. The analysis of the basic aspects of a subject domain structurization is carried out. Types of questions which can be used at carrying out of examinations are considered. The possibilities of automated systems of carrying out of examinations are resulted. The architecture of the automated system for questions forming support is described. The system passes test in the several organizations and in the near future the working version of system will be ready for operation.

In this paper the campaign to methodology construction of expert systems creation for any carrying out of examinations and estimation of competence, definition of qualification, control of knowledge, etc is offered. It is based on preliminary structurization of the subject domain, the developed analysis algorithm of polytypic answers of experts and the logic scheme of carrying out of estimation process. And if the algorithm directly can be used, subject domain structurization should be carried out by experts, and the logic scheme of estimation develops the expert person. Last two procedures are not simple and more detailed methodology of their development remains actual scientific problem.

UDC 004.9.1.2

M.A. Kurilov, S.V. Tereshchenko

Classification of Web-resources Content Management Systems and their Use for the Development of Distance Learning Website

In this work, has been systematized knowledge in the field of content management systems web-resources: a classification of these systems, identified their main advantages and disadvanages are identified, and possibilities of these systems to automate the development of a site of distance education are explored.

The need for users in automating tools for web-resources is constantly growing. Automation of web-resources can be achieved through the use of so-called Content Management Systems – Content management system (CMS) – a system that supports the creation, management, distribution, placement and development of a common information. They cover the entire life cycle of pages on the site, from providing simple tools to create content and its distribution to archiving. Also they provide the ability to manage the site structure, design pages and navigation.

Currently, it is promising to interact with students through information and communication networks from which the Internet users environment is allocated greatly. Distance learning play an increasingly important role in the modernization of education. Traditional methods for developing online learning materials, as a rule are expensive, time-consuming and require specialized skills that are often difficult to acquire. To develop the site distance learning would be appropriate to use content management system training – Learning Content Management System (LCMS), which provide the ability to quickly create, deploy and manage the content of online courses.

Use of information technology in education, can significantly improve the effectiveness of teaching and reduce the cost of it. Currently, LCMS are the most promising in terms of distance learning because they allow to build content quickly and to trace learning outcomes. Therefore the development of distance learning site systems on the basis of learning content management is the most appropriate and relevant for today.

UDC 51(071)
L.P. Mironenko, I.V. Petrenko, I.A. Novikova
Some Remarks to the Question on Reducing the Obtaining
of the Canonical Equations of Second Order Curves

The purpose of the paper is reducing the obtaining of the canonical equations of the ellipse and the hyperbole.

Let's use the standart definitions of second order curves. An ellipse is the geometrical place of points on a plane for which sum of focal radiuses for any point of the curve has the constant value: $r_1 + r_2 = const$. Let's the ellipse focuses $F_1(-c,0)$ and $F_2(c,0)$ are arranged on the axis x symmetrically with respect to Cartesian coordinate system origin. Then the ellipse definition $r_1 + r_2 = 2a$ in the given Cartesian system will be $\sqrt{(x+c)^2 + y^2} + \sqrt{(x-c)^2 + y^2} = 2a$. Accordig to the traditional approach the both parts of the last equation should be squared. After rearrangement the given expression should be squared again. After applying the equality $c^2 = a^2 - b^2$ the ellipse canonical equation $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ has been got. This procedure is very cumbersome. Let's consider the another way. Let's write down the ellipse equation $\sqrt{(x+c)^2 + y^2} + \sqrt{(x-c)^2 + y^2} = 2a$ as $\sqrt{A} + \sqrt{B} = 2a$ and multiply the both parts of it on the conjugate expression $\sqrt{A} - \sqrt{B} \neq 0$. We'll get $A - B = 2a(\sqrt{A} - \sqrt{B})$. Taking into account $\sqrt{A} = r_1, \sqrt{B} = r_2$, we'll obtain: $A - B = 4cx$. So we'll get the system of equations $\begin{cases} r_1 + r_2 = 2a \\ r_1 - r_2 = 2xc/a \end{cases}$, which has the solution $\begin{cases} r_1 = a + ex \\ r_2 = a - ex \end{cases}$, where $e = \frac{c}{a}$ is the ellipse eccentrisity. Then the expression $r_1 = \sqrt{(x+c)^2 + y^2} = a + \frac{c}{a}x$ has been squared: $\sqrt{(x+c)^2 + y^2} =$

$$= a + \frac{c}{a}x \Rightarrow \left(1 - \frac{c^2}{a^2}\right)x^2 + y^2 = a^2 - c^2.$$

After applying $b^2 = a^2 - c^2$ we'll get the ellipse canonical equation $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.

The hyperbolic case is considered similarly. The hyperbole is defined by the equation $|r_1 - r_2| = const$. It can be written in the form $\left|\sqrt{A} - \sqrt{B}\right| = 2a$. By the same way we'll get the system of equations $\begin{cases} |r_1 - r_2| = 2a \\ r_1 + r_2 = 2|cx|/a \end{cases}$. After applying $c^2 = a^2 + b^2$ we'll get the hyperbole equation:

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1.$$

The alternative method of obtaining the canonical equations of second order curves has been offered. This method is based on expressions for focal radiuses. This way is shorter with respect to the traditional way. The offered method is simple and comfortable in aplying.

Resume

UDC 004.416.3:004.85
P.I. Fedoruk, M.V. Pikulyak, M.S. Dutchak
Intellectual Mechanism of Individual Learning Trajectory Construction in Adaptive Systems of Distance Learning

At distance learning solving the problem of training adaptive trajectory construction allows not only to plan the educational process, but also to improve the quality of its educational effects by using modern information technologies and innovative teaching programs and methods.

The article reveals the intellectual mechanism of individual learning trajectory construction in adaptive systems of distance learning and knowledge control which is based on the model, the basis of which consists of graph theories and knowledge quantification.

The developed mechanism makes it possible to organize the process of learning in accordance with the knowledge level, speed of task fulfilling, quality of learning material mastering and other individual parameters of learners. This training system provides the structured selection of educational material (delivery of portions of theoretical knowledge, doing exercises to consolidate the theory, giving help at fulfilling exercises), according to preset parameters of a student model. On the basis of comparison of data obtained during the learning process with forecasting results there appears the correction of students parameters. So the next portion of information (quantum) is given by using the renewed model.

Learning algorithm, that corresponds to the given mechanism, aimed to realize by programming method the individual approach to training, allowing to solve the differentiation problems that exist in modern distance education.

UDC 004.89:004.946
O. Fedyaev, T. Zhabskaya
University Virtual Department Design Under Agent-oriented Multi-model Approach

The educational process at the university department is distributed in time and space. The department as an object of modeling is a distributed system, whose subjects carry out a certain intellectual activity. To give the participants of the educational process possibility of autonomous and distant fulfillment of their educational-methodological duties has been set a goal to create a virtual department in which all necessary relationships for study are preserved and such tough space time limitations as time table are removed. To achieve a set goal the agent-oriented approach was selected.

Development process of multi-agent system is hierarchical and has to tie together models of different design level. However, because of using different methodologies and toolkits, operating different concepts, a lot of problems arise during this process implementation, concerning the transition from conceptual to physical models for multi-agent system implementation.

The task of this research is to develop the transformation method of Gaia abstract models to JACK environment physical concepts for creation of agent-oriented system of university virtual department.

In order to pass from abstract agents models to their view at the level of JACK environment visual models in a proper way, the semantics specifications of visual models of this environment has been developed and on its base the transformation method of Gaia abstract models to JACK environment physical concepts has been developed. The developed transformation method provides qualitative passing via all stages of multi-agent system design.

UDC 681.3
Volodymyr Harbarchuk, Grzegorz Koziel
Properties of a New Fourier Transform-based Steganographic Method

Article is final at a stage of end of the thesis for a doctor's degree one of co-authors – Grzegorz Koziel. It concerns to one of the most actual modern directions of protection of the information – computer steganography. Particularly, a researched problem is the problem of use in computer steganography sound containers. For this purpose the theoretical and practical analysis of quality of sound containers and the analysis of methods of concealment of the different information in such containers are carried out. A base for this analysis was chosen a corresponding part theoretical electrical engineers.

In particular, methods of transformation sound signals with use of transformations Fourier are analyzed and appreciated, etc. It is shown, that for the purposes steganography such transformations are not reliable for allow to find out effectively enough changes in structure of a spectrum of a signal so, the nonempty containers keeping the valuable information allow to find out. However use of such property in a spectrum of signals as masking in a combination to transformations Fourier has enabled to construct very much effective algorithms of concealment of the diverse valuable information, needs a protection, in sound files and the further secret transfer to the lawful addresses.

The set of machine experiments for various variants of the suggested algorithms is carried out and convincing concealments of the information given about efficiency in sound files are received on the basis of the offered method of masking.

In connection with completeness of the executed researches the offered methods and algorithms can be used for practical purposes protection of the information and its transfer by methods computer steganography.

Due to the complexity of grid computing, many new security problems have appeared here. As a result, the study of security problems in grid is important, complicated and difficult.

Access to grid resources, which are spread across geographical and political boundaries, is based on a trust relationship between the resource providers and the users. All members of grid community have to stick to the security policies agreed upon by both parties. The grid security architecture today does not prevent certain unauthorized access to the programs and data files are transferred to a remote machine. Theoretically, anyone with administrator privileges can access this information.

A grid user needs assurance that the machine is not compromised and his data and programs will not be stolen when accessing any grid resource. However, the providers may not be aware of the system being compromised or having internal breaches based on attacker having administrator privileges.

Thus, there is a need for a security system that protects the grid user's data from all other users, even the super user.

We have explored the problem of unauthorized access to grid user's programs and data. Based on our analysis, we have concluded that the security system in grid should be expanded for the purpose of additional defense of user's private data.

In this paper we recommend encryption of data when it is in storage, so that all backups will also be more secure. Our security subsystem is positioned as an addition to the security framework of Open Grid Service Architecture (OGSA), not an alternative.

We propose to use FPGA-based Reconfigurable Unificated Accelerators (RUA) combining advantages of software and hardware solutions. The application of RUA allows lowering essentially the cost of the technical solution due to their unification and mass production. Up-to-date FPGAs allow producing any digital scheme inside by loading correspondent configuration for milliseconds. Such flexibility allows grid users to create own crypto processors for data conversion. The hardware implementation of the file content encryption process complicates significantly unauthorized access to user's data and programs from malicious person.

Grid users are usually not specialists of cryptography. So our grid security subsystem provides several modes of functioning, in particular:

– "transparent" mode – maximum standard grid security system utilization;

– "extended transparent" mode – supporting possibility of loading into FPGA the non-standard cipher realization configurations;

– "semi-transparent" mode – user controls the encryption process itself, the grid security system is used for auxiliary purposes (key delivery etc.) only.

Thus, an actual task of the grid security system enhancement is raised in this paper, a solution based on PC-compatible reconfigurable unificated accelerators is proposed.

Resume

UDC 681.3;004.056.53
V.K. Fisenko, E.P. Maksimovich, O.V. Melekh
The System of Linguistic Indicators and Decision Making Criteria
for Certification of Information Security Systems (ISS)

The purpose of the certification is to verify the compliance of the information security systems with the requirements to the existing legislation in the field of information security, as well as the laws and regulations in the field of information protection, including technical regulations, and issue of the conformation certificate on the basis of this documents.

The certification procedure provides the solution of a number of tasks, ranging from the certification request to conformation certificate issue. The most difficult and important tasks are those which require the use of specific indicators and criteria for decision-making. At this stage, the solution of such problems is performed with the use of linguistic indicators and criteria for decision-making.

At the stage of preliminary acquaintance with the information system the following decision-making rules are used:

– the current state of the system is satisfactory if its purpose and architecture meet the necessary requirements, and the processed information is accurate, reliable and efficient;

– the system monitoring is satisfactory, if system surveillance and the registration of events in real time are being conducted continuously.

At examination of information security systems the following indicators and criteria for decision-making are used:

– ISS documentation has a complete description, if the number and the name of its characteristics (attributes, properties, functions, parameters, etc.) fully correspond to the number and the name of the characteristics (attributes, properties, parameters, procedures, etc.) of the ISS described in the source documentation submitted by the owner;

– the organizational structure of the ISS meets the requirements, if the real structure, the list and the description of the functions of subsystems of the operating system corresponds to the described organizational structure of ISS according with the criteria of description completeness, the adequacy of representation, a sufficient level of specification, etc.

At the analysis of initial data on compliance with regulatory documents, the following decision making criteria are used:

– the coverage of all the quality indicators is achieved if the information provided in the documents reflects the implementation of all safety requirements related to confidentiality, integrity and availability;

– Nonredundancy of the initial information is provided, if the source data, presented for verification do not contain the information which is out of the security and complicates the process of certification, etc.