

### OPTIMIZATION OF SLANT SCANNING IN THE SYSTEMS OF COMBINED TWO-STEP LOCATION (p. 4-10)

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Two structures of two-step location systems of terrestrial objects were highlighted in the paper. In the first structure, both location system units are terrestrial, the first determines one target coordinate, and the second – another. In the second structure, the second unit is mounted on the flying carrier. Carrier coordinates are determined by the first unit and target coordinates are determined by the scanner surveying of the object location. The scanner unit performs slant terrain scanning that dictates the need to optimize the slant scanning. A comparative analysis of the known energy-information optimization criterion and the proposed information-energy criterion was conducted. It is shown that the proposed criterion in some circumstances has a higher sensitivity than the information indicator. Optimization of the slant scanning of the terrestrial field was carried out according to the proposed criterion. Conditions for the target functional to achieve the minimum in solving the optimization problem by variational optimization at imposing limitations on the relative amount of information were found.

**Keywords:** location, optimization, scanner, system, criterion, slant scanning, information, image, unmanned aerial vehicle, sensing.

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### DEVELOPMENT OF METHODOLOGY FOR DESIGNING AERODYNAMIC SPACECRAFT DE-ORBIT SYSTEMS (p. 11-15)

**Aleksandr Paliy**

A methodology for designing aerodynamic systems that implements an iterative approach for calculating the parameters and evaluating the effectiveness of the system at various stages of its design was proposed. According to the recommendations of the Inter-Agency Space Debris Coordination Committee, the lifetime of the worked-out spacecraft in orbit is necessary to limit to the period of 25 years. One of the effective spacecraft de-orbit systems is the aerodynamic de-orbit system.

When developing this class of systems it is necessary to calculate the parameters and evaluate the effectiveness of the system at various stages of its design. The developed methodology allows to evaluate the efficiency of using the aerodynamic system, depending on the given period of ballistic existence of the spacecraft and determine the possibility of its use taking into account size limitations and the impact of space factors. This methodology lies in implementing the method of successive approximations. Delimitation of applicability and preliminary evaluation of the effectiveness of using aerodynamic spacecraft de-orbit systems is performed in the first approximation. Parameters of the system, taking into account the mass of air pressurization systems and aerodynamic system storage on the spacecraft board are calculated in the second approximation. The active lifetime of the system under the influence of space factors is calculated and its parameters are optimized in the third approximation.

This methodology can be used when developing technical specifications for the design of the aerodynamic spacecraft de-orbit system.

**Keywords:** debris, spacecraft, de-orbit, system design, aerodynamic system.

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## DEVELOPMENT AND RESEARCH OF ADAPTIVE DATA COMPRESSION METHODS BASED ON LINEAR FIBONACCI FORM (p. 16-22)

Vladimir Luzhetsky, Lyudmila Savitskaya

A fundamentally new data compression approach, which is based on the optimizing properties of Fibonacci numbers lies in the fact that the figures are considered as positive whole numbers and presented by a linear Fibonacci form, was investigated. Formation features of the numerical data source model were examined. The effect of the length of data blocks of the compressed file on the compression ratio was studied. Changing the number of bytes in the block provides the formation of different data source models. Ability to change the data source model allows to choose a model that provides the greatest compression ratio for a given encoding rule. Analysis of the results has shown that the effect of the data block length on the compression ratio is different for different file types. For some types, the greatest compression ratio is achieved when the block length is 100 bytes, and the ratio decreases with the increased length. For other file types, the effect of the data block length has a “wave” pattern (the ratio repeatedly

increases and decreases with the increased length), and for certain types of files, the dependence of the transformed data on the data source model used is negligible. Low compression ratios and no compression for certain file types are caused by the fact that the data modeling used does not ensure the formation of numbers that are compactly presented by the linear Fibonacci form. To eliminate this shortcoming, two adaptive data compression methods, based on the linear Fibonacci form, which involve using a set of numerical data source models were proposed and investigated. These models are based on the maximum value of the numerical equivalents of the ASCII codes of bytes that make up the block. Adaptation enhances the compression ratio compared to non-adaptive compression method based on the linear Fibonacci form.

**Keywords:** adaptive compression, numerical model, data source, linear Fibonacci form, compression ratio.

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### BEAMFORMING OF ANTENNA SYSTEMS OF MIMO TECHNOLOGY OF LTE NETWORK (p. 23-26)

Yuriy Khlaponin

An analysis of introducing the fourth-generation (4G) cellular networks, the best of which, according to the International Telecommunications Union, are LTE-Advanced1 (based on cellular LTE (Long Term Evolution) standard) and WirelessMAN-Advanced2 (based on WiMAX 802.16m) technologies, is presented in the paper.

A further increase in throughput and service quality in LTE networks is associated with MIMO. Abbreviation MIMO means “multiple input, multiple output”.

The aim of the research was to develop a method for increasing the throughput in the MIMO system of the LTE network by beamforming with physical separation of antenna elements.

The beamforming method for increasing the throughput in the MIMO system of the LTE network was proposed. A block diagram of beamforming of the multi-user system was presented. To compare throughput, simulation with without beamforming for two types of flow transfer modulation using the Matlab program was conducted. The scientific basis of increasing the throughput in the MIMO system of the LTE network, developed in the paper may be taken into account when designing modern data transmission systems based on intelligent technologies.

**Keywords:** LTE, MIMO, SU-MIMO, MU-MIMO, beam, throughput, adaptive antenna.

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### RESEARCH OF THE NETWORK VIRTUALIZATION EFFECT ON THE OPERATION OF COMPUTING CLUSTERS (p. 27-32)

Vitaliy Nikitchenko

The paper presents the results of the research of the network environment virtualization effect on the interaction time of the computing cluster nodes. Existing simplified model of the parallel algorithm was supplemented by the parameter of duration of data exchange between the cluster nodes. To assess the resource virtualization effect, two approaches are used: formal evaluation of insertion loss by constructing a mathematical model and direct measurement.

Possible options for interaction between the computing cluster nodes were consistently considered. The main components of the time of delay of interaction between computing nodes were determined. Further, the obtained formulas are detailed using the static-dynamic program analysis provisions.

An instrumental component, which is determined by direct measurement of the packet passage time parameters is a part of the obtained mathematical expressions. It uses a trace tracing framework, which has allowed to measure the time of the packet passage between applications inside virtual machines of different physical computing nodes, and between applications that are inside the virtual machines, located on the same physical server.

The above results allow to determine the time limits for performing a set of parallel processes in the virtualized environment. This in turn allows to estimate the appropriateness of transferring some computational problem in a cluster of virtual machines.

**Keywords:** virtual machine, computing cluster, networking, process tracer.

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### METHOD OF INVESTIGATING STRUCTURAL PROPERTIES OF NON-STATIONARY SIGNALS IN INFORMATION-MEASURING SYSTEMS (p. 32-39)

Diana Shantyr

The problem of investigating structural properties of non-stationary broadband signals to obtain measurement data on the technical condition of the surveillance object was considered.



The analysis of the main approaches to solving this problem was performed. The principle of structural analysis of the measuring signal was formulated. The generalized statistical model of the broadband measurement signal structure was developed. A method of investigating structural properties of nonstationary signals was proposed. A generalized algorithm for this method was given. An analysis of the effectiveness of the research method was carried out.

Applying the proposed method allows to reduce the loss of information about changes and trends in the technical condition of the surveillance object by analyzing the structural components of the measuring signal. The research results allow to reduce measurement errors (by about 1.5–2 times, depending on the problem to be solved); exclude gross and systematic measurement errors and eliminate the influence of operator (subjective) errors; minimize environmental effects; build a flexible structure of the IMS; ensure the stability of the algorithm and implement real-time measurement of nonstationary physical process parameters; significantly increase the technological (reduce the measuring instrument production cycle by approximately 2 times) and economic (reduce the measuring instrument cost by at least 3 times) performance.

**Keywords:** structural analysis, spectral analysis, wavelet transform, information-measuring systems.

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## SIMULATION MODEL OF THE TECHNOLOGICAL COMPLEX OF CHARGE PREPARATION FOR SINTER PRODUCTION (p. 40-45)

**Boris Zobnin, Oleg Gorbenko, Igor Azhipa, Roman Yakovlev**

A simulation model of the technological complex of charge preparation for sinter production was developed. This approach stems from the fact that the dimension of tasks and non-formalizability of objects do not allow to use rigorous mathematical meth-

## EVALUATION OF PERTINENCE OF LINGUISTIC DESCRIPTORS IN INFORMATION RETRIEVAL SYSTEMS (p. 46-53)

Larisa Chala, Yulia Kharytonova

The possibility of using acronyms as linguistic descriptors for the classification of the analyzed electronic texts is considered in the paper. The proposed approach is implemented using a two-step procedure.

In the first stage, acronyms are extracted from several text documents of the field under consideration, followed by preparation of specialized acronyms dictionaries. Search results are sorted to remove impertinent pairs "acronyms/definitions", and then the alignment of the letters, contained in acronyms, with the definition words is carried out.

In the second stage, the modified metric DeMT, which allows to determine the pertinence definition of the acronym in the document under analysis is applied. Herewith, the adapted dictionary, created in the first stage of the process under consideration is used. The modified metric DeMT, which takes into account contexts can be successfully adapted to the problem of evaluating the pertinence of linguistic descriptors.

**Keywords:** descriptor, acronym, mining, electronic text, classification, semantic information.

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## IMPROVED ROBUST RIDGE REGRESSION ESTIMATES (p. 53-57)

Vera Gritsyuk

In multiple linear regression when the predictors are strongly correlated, the least-squares estimates (LSE) usually provide inaccurate predictions. Ridge regression, based on the minimization of a quadratic loss function, is sensitive to outliers. Two smoothly redescending  $\psi$ -functions based on the Winsor's principle, which lead to asymptotically efficient estimates were considered. The method of iteratively reweighted least squares (IRLS) based on the proposed  $\psi$ -functions can be used to produce the resulting robust ridge estimates for identifying outliers and ignoring zero-weight outliers. Examples, selected from the relevant literature, are used for illustrative purposes. It is possible to obtain convergence to the final estimates of the coefficients with fewer iterations than without using ridge regression. The combined robust and ridge estimates result in stable coefficients and balances that help in determining the true coefficients and outliers.

**Keywords:** M-estimates, Winsor's principle, robust ridge estimates.

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## INFLUENCE OF TANK'S WALL DISPLACEMENTS MEASUREMENT ERROR ON ITS INTERNAL STRESSED STATE DETERMINATION (p. 58-62)

Khrystyna Pankiv

In the article the tank's wall surface coordinates measurement error was calculated and its influence on the accuracy of the tank's wall material stress-strain state determination was shown.

Possible approaches to reduce error are also shown, such as increasing precision of angular positioner's encoder wheel and using a camera with higher resolution.

The measurement error dependence on the tank's base radius and the number of the measurement points are shown and a conclusion was drawn, that more measurement points should be chosen to achieve required accuracy for bigger tank's base radius.

Reducing of tank's wall surface coordinates measurement error influence on tank's stress-strain state accuracy calculation is provided with using smoothing splines.

The principles for measuring tank's wall surface coordinates, developed by author provides high accuracy levels and are

good enough for using them to estimate the tank's wall stress-strain state.

**Keywords:** vertical cylindrical steel tank, measurement error, stress-strain state, coordinates.

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