SHOCK WAVE-BOUNDARY LAYER INTERACTIONS AT THE SUPERSONIC FLOW AROUND THREE-DIMENSIONAL CONFIGURATIONS (p. 4-11)

Yevgen Panov, Anton Karvatskii, Serhii Leleka, Taras Lazarev, Anatoliy Pedchenko

The study suggests that the problems of interactions of turbulent flows at the supersonic flow around aircraft elements be solved by numerical analysis methods aided by a mathematical model that is based on the system of the Reynolds-averaged Navier-Stokes equations. The system includes the k-ω SST turbulence model for viscous compressible medium (with two scalar equations of turbulent kinetic energy and relative velocity of its dissipation with the modification that takes into account the transfer of shear stress). The paper presents applied testing and verification of the model along with examples of the problems on supersonic flows around a flat wall and a sphenoid superstructure as well as a perpendicular gas stream. We have identified physical characteristics of interactions between the condensation wave and the boundary turbulent layer, which manifest themselves in the formation of a complex structure of disconnecting and connecting zones of a boundary turbulent layer, which are characterized by respective lines of separation and joining on the wrap surface. The solutions adequately reflect the pattern of the supersonic flow of a compressible medium, condensation waves and vortex zones that are commonly observed during field studies. The comparative analysis of the results of numerical modeling and experimental data confirms the applicability of the mathematical model for complex tasks of the supersonic gas-dynamic state.

Keywords: supersonic flow, boundary layer, shock wave, interference of configurations, numerical analysis.

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LINEAR OPTIMIZATION OF FOREST MANAGEMENT FOR DYNAMIC RECURSIVE MODEL (p. 12-18)

Olga Turkovska, Mykola Gusti, Pekka Lauri, Nicklas Forsell, Petr Havl k, Michael Obersteiner

Our study presents development of a forest management model based on LP which can be easily integrated into a large-scale dynamic recursive model and contain the instruments providing future consideration for harvesting plans under recursive limitations. We introduce a general structure and simulation algorithm of the model. The forest management algorithm was tested applying historical data of Ukrainian forests. Obtained modeling results demonstrate a correct age class transition. They prove as well adequacy of utilizing benefit losses and delay costs as regulative mechanisms for temporal allocation of forest harvesting. As far as statistic data concerning age structure of Ukrainian forests are not publicly available, FesT was validated by comparing projected forest age structure with results of Global Forest Model (G4M).The comparison shows that the projections of both models are fairly close to each other. The divergence between the results can be explained by difference in forest management modelling approach.

Keywords: forest management, linear programming, age structure, forest value, forest management model, dynamic recursive model.

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THE DEVELOPMENT OF THE SYSTEM FOR IDENTIFICATION OF SEISMIC STABILITY AND MONITORING OF ORIGIN OF ANOMALOUS SEISMIC PROCESSES (p. 19-36)

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To minimize damage from earthquakes, intelligent robust noise technology and a system that allows to combine the monitoring of the latent period of violation of seismic stability with the monitoring of origin of anomalous seismic processes (ASP) is proposed. The system includes a network of seismic-acoustic stations for monitoring the beginning of ASP, located in different areas of the region and the local units for noise monitoring of seismic stability, which are installed in the most vulnerable structures of all controlled construction objects. In order to identify the latent period of the ASP origin and violations of seismic stability of construction objects (SSCO), noise is used as a carrier of diagnostic information. Since June 2010, operation of the network of seismic-acoustic stations and stations for monitoring the violations of SSCO showed that they can be used as a tool to identify the focus areas of expected earthquakes, and to control microchanges in SSCO.

Keywords: seismic-acoustic station, seismic stability, identification, matrix, monitoring, noise, robust estimates

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MATHEMATICAL MODELS FOR THE PARAMETERS OF DATA FLOWS IN INFORMATION AND TELECOMMUNICATION NETWORKS (p. 37-44)

Viktor Kosenko, Dmutro Bugas

This paper analyzes and mathematically models the parameters of data flows in the information and telecommunications network. The fluctuation in the data flows, which is inherent in modern multiservice systems, does not allow designing a system based solely on the average bandwidth indices. It is necessary to determine the parameters of the flows of data generated by the tasks performed in the network nodes, which requires devising mathematical models that would reflect both the information and the technical structures of the network.

We have determined the structure of the mathematical apparatus for analyzing the network structure in the form of a complex mathematical model that describes the information structure, the data flows between the nodes and the technical structure of the network. The study describes basic parameters of the model of the network information structure, which lays the basis for modeling the data flows. The model parameters characterize the intensity of the data flows between the network nodes in performing the applied tasks and the queries of the user.

The devised mathematical model describes the parameters of the data flows between the network nodes in the fixed information structure and takes into account both the exchange of data between the nodes, which results from the interaction of applications in separate nodes, and the user queries to the data stores. We have devised a mathematical model of the data flows in a stratified multi-tier information structure of the network that is typical of the most common modern technologies of the network construction. The model allows determining the loading capacity of the network channels and the network equipment while designing the technical structure of the network.

The suggested models can be applied in devising the methods and detailed algorithms for managing the data flows in a specialized network.

Keywords: information and telecommunication network, information structure, technical structure, data flows, mathematical modeling.

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INTERPRETATION OF THE MEASURE OF DEPENDENCE FOR MULTIVARIATE STABLE RANDOM VARIABLES USING FACTOR MODEL (p. 44-49)

Vadim Shergin

The problem of interpretation the measures of dependence of multivariate stable random variables in the space of these variables was considered. It is noted that both the examined distribution laws and the existing measures of dependence are parameterized using characteristic functions, i. e. in the frequency domain, not in the space of random variables. This is what causes the relevance of the studied problem.

The paper presents a model of symmetric mixing of hidden factors that allows to consider the dependence between random variables within the factor model. Under this approach, a set of identically distributed observed random variables is seen as the result of a linear transformation of the same number of independent random variables (hidden factors). It is shown that for the multivariate normal distribution, the correlation coefficient can be interpreted as a measure of the differences between the linear transformation of factors and identical transformation.

The analysis of parameterization forms of multivariate stable distribution laws was performed. The subclass of such distributions, for which it is possible to represent the observed random variables by a linear combination of the independent variables was singled out. It is important to note that this subclass is parameterized unambiguously, in contrast to the general case of multivariate stable laws.

It is shown that within the selected subclass of multivariate stable distributions, the measure of dependence has the same meaning as the correlation coefficient for the multivariate normal law.

Keywords: multivariate stable distributions, measure of dependence, factor model, symmetric mixing of hidden factors.

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DIFFERENTIAL AND LINEAR PROPERTIES ANALYSIS OF THE CIPHERS RIJNDAEL, SERPENT, THREEFISH WITH 16-BIT INPUTS AND OUTPUTS (p. 50-54)

Irina Lisitskaya, Tatiana Grinenko, Stanislav Bezsonov

The results of the differential and linear properties analysis of the ciphers Rijndael, Serpent, Threefish with 16-bit input and output data blocks, indicating that all the ciphers repeat the properties of random permutations in the considered application mode are presented. The main provisions of a new methodology for accelerated cryptanalysis of block symmetric ciphers to the linear and differential cryptanalysis attacks consisting in the fact that all modern block ciphers after a certain number of cycles under the laws of transition distribution of XOR difference tables (total differentials) and the laws of bias of XOR difference tables (total differentials) repeat the corresponding indexes of random permutations are confirmed. The testing of randomness indexes of large ciphers can be accomplished through the development and subsequent analysis of randomness indexes of reduced models that allow carrying out real-time computational experiments.

The results are further evidence that the full-scale ciphers and their small versions asymptotically repeat properties of random permutations of the corresponding degree.

Keywords: random permutation, maximum linear probability, maximum differential probability.

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METHOD FOR AUTOMATIC ASSESSING OF THE GRADIENT FILTER THRESHOLD FOR FAST PROCESSING OF DYNAMIC SCENES OBJECTS (p. 55-58)

Leonid Timchenko, Oleksandr Poplavskyi, Natalia Kokriatska, Anna Poplavska

In this paper, we present a new method based on the use of information provided by the gradient methods for determining the geometric parameters of objects with high accuracy. The algorithm is based on the use of data obtained after image processing by gradient filters. Also, it reacts to the slightest change in the contours of objects of the dynamic image scenes. Repeated experiments using more than 5000 real images were processed to improve the theory. Given a high refresh rate of modern systems, a position of the Center Of Gravity (COG) in the dynamic images is changing gradually even for rapid motion. Using this feature, COG for each frame of a training sample is defined under various threshold values by means of an algorithm. A number of elements (frames) in the training sample are selected depending on the type of the dynamic object, a task set and on the initial conditions. The suggested method is recommended for further use by the expert system, in parallel with its own operation, with a goal to maintain a threshold value on the optimal level in case of dynamic perturbing factors. After the research, we found that the prediction accuracy increased that essentially improved results. A number of experiments demonstrated increasing the accuracy of determination of the center of blurred objects. Also, we have eliminated the human factor. All of the calculations are done automatically. These data are very useful and important for all areas of science where high accuracy of the results is necessary.

Keywords: center of segmentation, threshold gradient filter, threshold, expert system.

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INVESTIGATION OF THE MUTUAL INFLUENCE OF PORES IN THE WELD UNDER THERMO-MECHANICAL LOAD (p. 59-63)

Elena Strelnikova, Oleg Kovch

The mutual influence of pores in the weld under asymmetric thermo-mechanical load was investigated. The dependence of the geometric characteristics of the chain on the crack opening in the weld was explored. The technique based on the final element method for determining the stress-strain state in the weld around the pores was developed. The technique allows to evaluate the mutual influence of pores on the origin and opening of cracks in space. The technique will allow to increase the life of welds.

The feature of the research consists in setting the loads, different in time, depth of plates, length of plates and welds. The analysis of the stress-strain state of the weld at all stages of loading until complete cooling of the design was considered. The research of various load application methods was performed. The reliability of the results was determined using engineering methods.

In a pore with a diameter of 3.5 mm, subject to a maximum temperature, stresses are above the allowable $\sigma_{max}=$ =3600 kgs/sm^2. In the sites around the pore, the crack opening process will occur.

The calculation results show that the pore with a diameter of 3.5 mm in the weld causes cracking, it contradicts the allowable diameter of 4.0mm for such a weld. The importance of the research results lies in investigating the layered asymmetric thermo-mechanical loading. Asymmetric thermo-mechanical loading has led to cracking within the acceptable limits of the geometric parameters of pores.

Keywords: pore, crack, strain, stress, thermo-mechanical load, finite element, weld.

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DEVELOPMENT OF TECHNOLOGY FOR AUTOMATED CREATION OF MATERIALIZED VIEWS (p. 64-73)

Kateryna Novokhatskaya, Oleksii Kungurtsev

One of the urgent tasks in the DBMS optimization by the materialized views (MV) – the saved query evaluation results - is selecting queries, the result of which can be materialized. The problem is characterized by high computational complexity since it requires an analysis of the DBMS transaction log over a long period of time. The choice of the MV should be based on the cost of their future support, as well as the execution frequency and cost of queries, optimized by the MV data. It is effective to create the MP not for individual queries, but to form groups of similar queries and create views for them. When searching for the same type of queries, the SQL syntax should be taken into account. The paper considers the technology for automated creation of MV. Query evaluation was proposed, which takes into account the statistical and time indicators of query execution, as well as update frequency of the base tables. The query tokenization algorithm, which takes into account various syntactic structures of SQL was developed. The model of presenting queries in the form of numeric vectors was described. The pre-clustering stage was introduced to reduce the volume of the data processed. The improved clustering algorithm has allowed to form groups around the most resource-intensive and often executed queries. An algorithm for grouping and forming the central query, specifying the results of the preliminary clustering was developed. The described technology allows to automate the full creation cycle of MV. Experimental data showed that technology improvement has allowed to increase performance and reduce the resource intensity of the MV generation process, as well as enhance the quality of the developed MV compared to previous solutions.

Keywords: materialized view, query evaluation, query grouping, central query, clustering.

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