

ABSTRACT AND REFERENCES

INFORMATION TECHNOLOGY: INDUSTRY CONTROL SYSTEMS

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AN ALGEBRAIC METHOD FOR CALCULATING PAGERANK (p. 6-12)

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An algebraic method is proposed for finding PageRank estimates for pages of websites. The amount of calculation in the proposed method does not depend on the value of the damping coefficient, which allows obtaining more accurate estimates of the rankings of PageRank in comparison with analogues. A distinctive feature of the proposed method is a step-by-step performance of calculations simultaneously with the work of the graph traversal algorithm. The comparative analysis of algorithms for traversing graphs has shown that, in contrast to the depth search algorithm, the breadth search algorithm gives a more orderly arranged matrix of transitions, which has the blockwise Hessenberg form. The use of this circumstance makes it possible to reduce significantly the amount of calculations by the proposed method. The resulting equations describing the proposed method have a block structure that allows efficient distribution of the entire volume of operations to parallel computational threads. Proceeding from the fact that the bulk of the calculations can be performed while the graph traversal algorithm is running, the study has determined the conditions under which the proposed method makes it possible to obtain PageRank values faster than the known iterative algorithms. The applicability area of the developed method is, first of all, its use in direct verification of the reliability of posting advertising materials on a relevant web resource; therefore, it is limited to specific Internet sites or segments with no more than 10^4 or 10^5 pages.

Keywords: site graph, page ranks, transition matrix, damping coefficient, teleportation matrix.

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WEBORIENTED DECISION SUPPORT SYSTEM FOR PLANNING AGREEMENTS EXECUTION (p. 13-24)

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The problem of construction of the web-based decision support system when planning the execution of agreements at service-rendering enterprises is considered. Characteristics of operations of such enterprises are explored. The improved mathematical model for the problem of agreements execution planning was constructed and the criteria for evaluation of effectiveness of the resulting variant of the solution were determined. The use of the additive convolution of a particular criterion with setting priorities of meeting each of them was applied as estimation of effectiveness of execution variant. The combined algorithm for solving the problem on planning was developed, aimed at taking into account the features of the subject area. In order to use the combined algorithm, it is proposed to represent the input data in the form of a multi-layer graph, each layer of which corresponds to the working time of one executor, and nodes determine the synchronization points between the layers. During designing a combined algorithm, the elements of the ACO algorithm and of the genetic algorithm were used. The DSS structure for agreement execution planning was proposed, and the technologies, used for its implementation, were considered. The users' interface of the system

was presented. The developed decision support system provides support for the management functions during planning and enables the in-depth analysis of situations, their evaluation and selection of the optimal variant of the plan, performing all preparatory actions and forming ready solutions. The created system is web-based, which allows using it at any place with the Internet access.

Keywords: web-oriented decision support system, agreements execution planning, combined algorithm, programming module.

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THE ADALINE NEURON MODIFICATION FOR SOLVING THE PROBLEM ON SEARCHING FOR THE REUSABLE FUNCTIONS OF THE INFORMATION SYSTEM (p. 25-32)

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The problem of reducing costs in developing information systems and software products was considered. It was proposed to replace the IT project staff in a number of repeatable processes and the works connected with development of software products by intelligent information technologies provided that such a replacement is economically viable. It was proposed to use the apparatus of artificial neural nets as a tool for creation of such technologies.

Among the main directions of automation of the information system development processes, there is the problem of searching for reusable functions to implement the functional requirement to the system. To solve this problem, it was suggested to modify the formal description and block diagram of the ADALINE neuron. The essence of this modification is the use of frame networks for formal description of reusable functions and functional requirements to the information system. Comparison of these formal descriptions makes it possible to identify a reusable function that, to the extent possible, corresponds to the functional requirement to the IS. Solution of the search problem results in a formal description of the functional requirement to the system. This description is formed on the basis of formal descriptions of the function found and the functional requirement.

Proceeding from this representation of the search problem, a special algorithm of training the modified neuron was developed. Its essence consists in finding the maximum similarity of the formal description of the functional requirement to the system among the descriptions of reusable functions.

Proceeding from the results of modification of the elements, block diagram of the ADALINE neuron was modified. The approach was proposed and the main features of architectural solutions for implementation of the modified block diagram were considered.

Keywords: functional requirement, function, ADALINE, duplication, associator, training algorithm, repository.

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NETWORK TRAFFIC FORECASTING BASED ON THE CANONICAL EXPANSION OF A RANDOM PROCESS
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We studied the problem of forecasting network traffic in TCP/IP networks based on statistical observational data. We determined that existing protocols (SNMP, RMON) do not provide long-term forecasting, which is necessary for network upgrades. Regression methods (AR, ARMA, ARIMA, SARIMA), which are the basis of protocols, use only a sequence of values of forecasted series, which makes long-term forecasting impossible. We made a conclusion that there is no universal effective method for forecasting time sequences that describe traffic of a computer network.

We developed the model of a forecast of network traffic taking into account features of accumulation of statistical data: presence of a priori trajectories, a posteriori character of forecasting, finiteness of variance. We applied the apparatus of the canonical expansion of a random process, taking into account heterogeneity of traffic. We developed a mathematical apparatus to solve the problem of extrapolation of implementation; we obtained expressions for the estimation of an extrapolation error, and expressions for the reconstruction of a posteriori random process based on modeling. We took into account accuracy of a priori measurements, which makes it possible to use this model in networks with a minimum of diagnostic data. It provides accurate determination of parameters of a random process at control points and the minimum standard approximation error in the intervals between these points.

Application of the proposed method based on the canonical decomposition of random processes provides a solution to the problem of long-term forecasting of network traffic. A comparative analysis of forecasting methods indicates that the method of canonical decomposition of a random process comes close to intelligent forecasting methods.

Keywords: network traffic, forecasting control, random process, canonical decomposition of a random process.

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DEVELOPMENT OF METHODS, MODELS, AND MEANS FOR THE AUTHOR ATTRIBUTION OF A TEXT (p. 41-46)

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The level of accuracy of author attribution of a text is not high enough at the lexical and syntactic levels of a language as these levels are not strictly organized systems. In this study, the author attribution of a text is based on the differentiation of phonostatistical structures of styles.

We have developed a system of differentiation of phonostatistical structures of styles, which differs from the existing ones by the chosen level of a language – phonological. At this level of a language one can obtain results with a greater accuracy. In addition, the system constructed is based on a modular principle, which makes it possible to rapidly modify the developed software.

We have developed methods and models that are based on the theory of mathematical statistics and allow the improvement in the accuracy of differentiation of phonostatistical structures of styles. A method was devised for a comprehensive analysis of phonostatistical structures of styles, as well as a multifactor method for determining the degrees of action of factors related to style, substyle, and author's manner of presentation. We have constructed a statistical model of stylistic differentiation using the ranking method, and a statistical model for determining a general stylistic markedness of the examined text. A software system for the differentiation of texts was designed.

The criterion for the differentiation of texts is the mean frequencies of groups of consonant phonemes.

In the process of implementing a system we used the programming language java, which ensures that the software is platform-independent.

This study reports results of the application of the developed methods, models, and software tools. The research results confirm that author attribution of a text at the phonological level is more effective. The developed methods, models, and means for the author attribution of a text could be used when determining the percentage of creative contribution of each of the co-authors of scientific papers.

Keywords: mean frequencies of groups of consonant phonemes, style, substyle, author differentiation of texts, software system, method, phoneme, phonological level.

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MODELING AN INTELLIGENT SYSTEM FOR THE ESTIMATION OF TECHNICAL STATE OF CONSTRUCTION STRUCTURES (p. 47-53)

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The study investigates issues related to modeling and development of intelligent systems for estimation of the technical state of building constructions. The study considers mathematical bases of modeling of an estimation system based on a fuzzy knowledge base and one of modifications of Takagi-Sugeno-Kang fuzzy network. It

describes the structure of a network in detail and substantiates a choice of the algorithm for its learning. The main criteria for choosing this modification were its ability to solve a classification problem under conditions of uncertainty and the ability to set rules by the function of inputs. We adapted the structure of a network to the task of estimation of the technical state of real building constructions. We showed that it is advisable to learn a network with a use if an algorithm with a trainer. In this case, we suggested to use a direct method of random search, which is adapted to the solution of this problem, to minimize an error. In order to identify the state of structures, we suggested to use membership measures obtained by the clustering method. Implementation and introduction of neural network technologies in solution of tasks of estimation of the technical state of building constructions expands and improves capabilities of intelligent systems, reduces risks of making incorrect decisions by increasing reliability and speed of modeling.

Keywords: knowledge base, intelligent system, fuzzy implication, estimation of technical state, construction design.

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THE SYNTHESIS OF CONTROL ALGORITHM OVER A TECHNICAL CONDITION OF THE HYDROGEN GENERATORS BASED ON HYDROREACTIVE COMPOSITIONS (p. 54-60)

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We have synthesized a control algorithm over technical condition of the hydrogen generators, which includes the following: forming initial data, determining the values for a phase-frequency characteristic of the generator at control points, comparing the a priori assigned and measured values of the phase-frequency characteristic of a hydrogen generator at control points in accordance with the selected criterion.

When describing the dynamic characteristics of a hydrogen generator based on hydro-reactive compositions we used an integrated transfer function, for which an analytical expression was obtained. Taking into consideration the properties of an integrated transfer function of the hydrogen generator, we justified the selection of control points that define initial data for constructing a hydrogen generator control algorithm. Control points are characterized by the fact that at these points the algebraic components of an integrated transfer function of the hydrogen generator coincide by modulo, or each of them tends to zero. As a criterion for determining a technical condition of the hydrogen generator, according to the control algorithm, we employed a system of inequalities, built for control points.

The system of inequalities includes the a priori assigned values for a phase-frequency characteristic of the hydrogen generator and its values measured under condition of using a reaction of the gen-

erator to a test influence in the form of a jump change in the area of its outlet opening. Solving the test problem revealed that a methodological relative accuracy in determining a phase-frequency characteristic under these conditions does not exceed 3.7 %. Frequency acts as a parameter for control points.

It is shown that the values of these frequencies are the solutions to a system of algebraic equations whose parameters are the time constants of a hydrogen generator.

Keywords: hydrogen generator, generator control algorithm, phase-frequency characteristic of hydrogen generator, control points, test-influence, hydro-reactive composition.

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ANALYSIS OF INFLUENCE OF TECHNICAL FEATURES OF A PIDCONTROLLER IMPLEMENTATION ON THE DYNAMICS OF AUTOMATED CONTROL SYSTEM (p. 60-69)

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Under conditions of intensification and maximization of production profitability, a problem of regulation, optimization and improvement of the structure of automatic control systems arises. To date, there are many topical problems associated with the practical implementation of the PID controller, e.g. unification of the PID controller structure, implementation of a differential component, integral saturation and nonimpact switching of parameters and operating modes.

Influence of nonlinearities, noise, disturbances, functions, and peculiarities of the PID controller on dynamics of the automatic control system was studied. It was shown that for the maximum efficiency of implementation of the PID controller for controlling inertial objects with a transportation lag, a complex approach must be applied: limiting the rate of growth of the target disturbance and conditional integration to eliminate integral saturation; simultaneous application of an exponential filter of the measured value and a differentiator with a low-cut filter to minimize the effect of noise and interferences on the transient processes; tracing the current state of the system allows one to prevent an “impact” when changing the operating modes of the PID controller; introduction of the controller insensitivity zone will potentially provide a longer operation life of the actuator.

Mathematical modeling of the system of automatic regulation of rarefaction in the boiler furnace was performed taking into account the proposed set of solutions. These recommendations enable

implementation of a PID controller suitable for practical use taking into account stochasticity, nonlinearity, quasi-stationarity and limitations of the technological processes.

Integrated assessment and consideration of these problems will contribute to improving efficiency and reliability of equipment, reducing energy consumption and time to reach the set goal in the process of automatic regulation without changing the structure of the control system.

Keywords: PID controller, integral saturation, noise filtering, differentiator, nonimpact transmission.

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