

DOI: 10.15587/1729-4061.2017.118329

ASSESSMENT OF FUNCTIONAL EFFICIENCY OF A CORPORATE SCIENTIFIC EDUCATIONAL NETWORK BASED ON THE COMPREHENSIVE INDICATORS OF QUALITY OF SERVICE (p. 4-15)

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In order to evaluate effectiveness of using a corporate scientific-educational network, we propose to apply an integrated indicator of the quality of services for users of CSES based on the combination of main technical and economic indicators (functional efficiency). The assessment techniques, proposed in the present work, for cryptographic procedures, for the formation of an integrated indicator of threats based on the synergistic approach to assessing the impacts on elements of CES, taken together, make it possible to estimate resistance of the applied cryptographic algorithms in technical systems of information protection within a corporate educational network. The devised procedure for estimating the effectiveness of investment into information security of CSES enables effective control over capital investment into effectiveness of technical solutions for information safety based on the proposed technique for assessing investment into TMIP, which takes into consideration the synergy and hybridization of contemporary threats. The obtained expressions for efficiency of using TMIP (their resistance and implementation based on the method of express-analysis), investment into TMIP (based on the proposed procedure) in the comprehensive indicator of assessment of functional efficiency of a corporate scientific-educational network at different techniques for managing data exchange make it possible to obtain comparative estimates to ensure the required indicators of quality of services when using different protocols for managing CSES data exchange.

Keywords: synergistic approach to threat assessment, integrated indicator of quality of service, corporate scientific-educational network.

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DOI: 10.15587/1729-4061.2017.118377

A METHOD TO EVALUATE THE SCIENTIFIC ACTIVITY QUALITY OF HEIS BASED ON A SCIENTOMETRIC SUBJECTS PRESENTATION MODEL (p. 16-22)

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The study suggests a method of integral assessment of the scientific activity quality of higher educational establishments and other structural research units or organizations dealing in one way or another with scientific activities. This method involves the development of a model for representing scientometric subjects. According to the developed model, it is necessary to evaluate consistently the entire chain of subjects of scientometrics – published works, authors, and journals. Hence, it will produce estimates for each higher education institution.

Taking into account that a number of requirements and criteria to be met by each institution of higher education are presented, the expedient task is to develop a method for converting qualitative indicators of scientific activity of institutions into quantitative ones. This can be achieved using a set of activities that underlies the method of assessing the quality of scientific work of HEIs. Having calculated the indicators of the quality of scientific activity for universities, it is possible to obtain prerequisites for the definition of similar indicators for subjects located at the lower levels of the scientific hierarchy. These include structural units of universities, published scientific works and scholars who are the authors of the published scientific works. It can be done by using the metric that is described in this study.

The research observations on the assessment of the significance of higher education institutions and research units show that more often than not institutions must follow a certain template of requirements and criteria that is common to all institutions and organizations. It is obvious that such an approach should be considered inappropriate in the view that each higher education institution exists only within its category and institutions are compared as equivalent. Therefore, an urgent need is to categorize higher education institutions, which clearly outlines the boundaries to which one or another institution relies on a number of parameters. It is substantiated that the categorization of HEIs should be carried out using fuzzy logic methods, taking into account the similarity coefficients of the institutions. A sequence of actions is also identified in the study, which should be followed to ensure that the selected HEI categories have been correctly formed under a number of reporting settings.

Keywords: evaluation of scientific activity quality, scientometric subjects, integral estimation, analysis of scientific activity, interpretation of reporting activity.

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DOI: 10.15587/1729-4061.2017.118833

DEVELOPMENT AND STUDY OF TECHNOLOGICAL VISUAL PROGRAMMING OF LOGIC CONTROL PROBLEMS (p. 23-31)

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The approach to logic control programming using a technological language was described. It is based on the use of a tabular cyclogram directly as a programming language. It was shown that using a cyclogram, it is possible to describe the complete algorithm of logic control of industrial equipment, and with its use to generate automatically a program code in standard languages of programming of industrial controllers. This approach will make it possible to involve engineers-technologists, who are the most competent experts in the field of automated process, in the process of developing and debugging of control programs.

The benefits of technological visual programming in comparison with the conventional approach to control programming were described. The requirements for the necessary structure of a specialized programming environment with the use of a tabular language of technological cyclograms were stated. During experiments in the developed environment, the authors described in the cyclogram language the algorithm of controlling a portal industrial robot, by which a specialized translator automatically generated the complete program code in the language of IEC 61131-3 standard for PLC microprocessor. In addition, within the proposed approach, the authors described the possibility to generate automatically a complete description of a logical controlling automatic machine of increased reliability in HDL-language using the same cyclogram and the template.

Technological visual programming makes it possible to involve engineers-technologists directly in the process of control programming, which decreases labor consumption of developing control systems and enhances the quality of a program code. The technological cyclogram itself can be widely used by various specialists at the stages of launch-adjusting operations, maintenance and moderniza-

tion of control systems, and as technical documentation during the operational phase.

Keywords: problem-oriented language, tabular cyclogram, automation of programming, programmable logic controller.

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DOI: 10.15587/1729-4061.2017.117743

APPLYING A NEURAL TUNER OF THE PICONROLLER PARAMETERS TO CONTROL GAS HEATING FURNACES (p. 32-37)

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In order to optimize the quality of transition processes on a heating object of control, it is proposed to apply a neural-network tuner, which changes parameters of the PI-controller in real time. The aim of present study is to determine effectiveness of application of the tuner using a model of the heating furnace, containing a gas supply control circuit and a controlling element of this circuit. Simulation was performed on the model of a gas furnace obtained through recalculation of thermal power from the model of an electric furnace. The study confirms the capability of the proposed adaptive system to effectively execute adaptation of parameters of the controller in the presence of a controlling mechanism whose dynamics may negatively affect the quality of control.

The result of applying the tuner is a decrease in the time of transition process by 25.8 % and a reduction in the total controlling influence by 22.85 %. The presence of the controlling element in this case had no significant effect on the work of a neural-network tuner. The result of research makes it possible to extend the class of objects for which a neural-network tuner can be applied. Previously, the tuner demonstrated its effectiveness only for electric furnaces where influence of the controlling element is minimal. Result of the present study makes it possible to scale up the solution for gas thermal furnaces despite a markedly greater influence of the controlling element.

Keywords: PI-controller, perturbation action, neural-network tuner, adaptive control, heating furnaces.

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DOI: 10.15587/1729-4061.2017.118753

PARAMETRIC SYNTHESIS OF COMBINED AUTOMATIC REGULATING SYSTEMS WITH DIGITAL PID-CONTROLLERS (p. 37-44)

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The problem of calculation of combined digital automatic regulation systems was considered. The main purpose of the study was to develop, on the basis of the principle of invariance, a method of parametric synthesis of combined systems with digital PID-controllers. To calculate the closed loop of the combined system taking into account the requirements to its stability and quality of regulation, the method of multicriterial parametric optimization was used. Conditions of physical realization of the ideal compensator on the basis of absence of a link with a negative net delay and ideal differentiating links in its transfer function were indicated. Choice of the structure of the transfer function of the real compensator was substantiated on the basis of coincidence of its complex frequency response with the complex frequency response of the ideal compensator at zero and operating frequencies. The results of synthesis of a combined system with a digital PID-controller and a real object have shown that the proposed method ensures quality of the digital system practically equivalent to that of the continuous system which is ensured by the choice of the structure of the discrete algorithm of the closed loop operation and the corresponding choice of the period of discreteness. In particular, it has been found that the use of the compensator enables an approximately fivefold reduction of the maximum dynamic deviation of the regulated value and approximately threefold improvement of the system dynamic precision according to integral absolute quality estimates. The developed approach can be applied for synthesis of combined systems with digital PID-controllers and a wide class of objects.

Keywords: combined systems, digital control systems, multicriterial parametric synthesis, PID-controller.

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DOI: 10.15587/1729-4061.2017.116019

ASSESSMENT OF PERFORMANCE OF A DISTRIBUTED INFORMATION SYSTEM BASED ON TIME PROFILE (p. 44-52)

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The problem of determining performance parameters for distributed information systems, which are formed by heterogeneous hardware, is examined. The information system, designed to perform distributed computing, based on the interaction between elements, is presented in the form of a combination of operation processes of software objects (agents) in interaction with operators.

To provide a possibility of algorithmic and quantitative analysis of the system's operation process, the authors used time diagrams,

which can be obtained based on time profiles of serial and distributed actors. Construction of the time profile of an actor is provided by knowledge of the sequence of performed actions and the average time to perform each action. Based on the knowledge of a typical time profile, estimations of different kinds of performance were obtained and the ratio, linking the main forms of performance to a variety of quantitative characteristics of the system, was derived.

As the key indicator of performance assessment, it is proposed to apply throughput, which for a serial actor is the ratio of loading of an actor and total time of actions per task. It was shown that within a single distributed actor, total throughput remains constant regardless of redistribution of the number of tasks between serial actors.

As another performance indicator, it is proposed to apply response time of the system as the average time to fulfil a task by an actor. Relationship between response time and throughput of the system was established analytically. It was determined by modeling that at an increase in throughput, response time of the system decreases, reaching 0 at a certain ratio of throughput and the number of fulfilled tasks.

The introduction of these ratios, in addition to the key indicators, also makes it possible to determine derivative parameters of the system, such as minimal computation time, average time of waiting for requests and amount of memory, required to fulfil tasks. In this case, it was determined that the minimum computation time is a magnitude, dependent on the capacity of an actor and the number of actions performed, as well as the ratio of computation time and exchange time. The average time of waiting for a request is the difference between total operation time and direct time for fulfilling the task by actors. The amount of required memory is determined based on knowledge of amount of memory, involved in performance of certain processes and atomic operations.

Presented ratios make it possible to evaluate quantitatively parameters of distributed information systems and to synthesize systems with assigned parameters of throughput and response time.

Keywords: distributed information system, time profile, serial actor, throughput capacity, system response time.

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DOI: 10.15587/1729-4061.2017.118429

DEVELOPING A MATHEMATICAL SUBSTANTIATION FOR THE PHYSICAL MODELLING OF THE SOILRIPPING EQUIPMENT WORK PROCESS (p. 52-60)

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In the course of a theoretical study, we examined ways to enhance effectiveness of the ripping unit by improving its control system. This is important because the most effective technique for destroying frozen and rocky soils in terms of machine performance and the cost of soil development is the horizontal layer-wise loosening by mounted rippers based on powerful tractors.

During work of the ripping unit, it running equipment interacts with soil, which causes uncontrolled displacements of the working body in space. This leads to a change in the depth of loosening and, consequently, to a change in the soil reaction on the working body.

The soil reactions during its destruction that were identified and described lead to uncontrolled displacement of the working body with low-frequency and high-frequency oscillations that act on the mounted equipment, reducing the reliability of the working equipment.

The mathematical apparatus that we constructed made it possible to formulate conditions for the minimization of dynamic loads on the base machine by the creation of a controlling signal to the mounted equipment of a ripping unit. Depending on the statistical analysis of terrain relief, by levelling a section, it is possible to send a controlling signal to the mounted equipment of the working body, which would reduce dynamic loads.

Adequacy of the proposed models of micro relief and work process of the ripping unit is achieved based on the statistical processing of soil relief, the introduction of a controlling signal for the motion of a base machine and the operational equipment.

Keywords: calculation of tractor mounted ripper, soil relief, model of work of a ripper, ripper's working body.

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DOI: 10.15587/1729-4061.2017.114333

DEVELOPMENT OF THE PROGRAM FOR SELFTUNING A PROPORTIONAL-INTEGRAL-DIFFERENTIAL CONTROLLER WITH AN ADDITIONAL CONTROLLING ACTION (p. 61-66)

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The development of tuning tools proceeds in the direction of broadening the range of supported controllers, using artificial intelligence techniques, methods of diagnosis, development of the user interface. One of the constituent factors of the complex problem on control tasks is the automated maintenance of parameters at the assigned level using proportional-integral-differential (PID) controllers. The spread of the algorithm is limited by the complexity of tuning (non-linearity of the object, external disturbances) to ensure the desired quality.

We proposed the structures of PID-controllers with an additional controlling action of the differentiator (PID-CACD). The structure of the controllers includes additional differentiation unit whose input receives the output signal proportional to the sum of output signals of one (two, three) components of a standard PID-controller. The output signal of the additional unit is added to the output signal of the PID-controller as an additional controlling action.

The settings of PID-CACD are calculated using the express-method. Dependences of settings on the dynamic characteristics of the object are obtained based on the experimental-statistical data while conducting the classic single-factor experiment and changing one of the dynamic characteristics. The control quality is determined based on the indicators: over-regulation, time of control. It is established that the proposed controller ensures the desired form of ACS transitional characteristic for indicators: over-regulation, time of control.

The possibility of creating a graphical user interface of auto-tuning in the MatLab programming environment is shown. The proposed software automates all stages of development: identification of the object, calculation of controller's settings, construction of the

transitional characteristic, controller's quality assessment; manual fine-tuning based on the user's experience is also featured.

Keywords: proportional-integral-differential algorithm, transfer function, quality, interface, Matlab/Simulink.

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