SYSTEMS AND CONTROL PROCESSES

DEVELOPMENT OF SIMULATION MODEL OF CENTRIFUGAL BLOWERS FOR GAS PUMPING UNIT TAKING INTO ACCOUNT BYPASS

page 4–9

After a thorough analysis of failures in the compressor stations that operate centrifugal blowers Ц-16, which are the object of this research, it was found that a significant proportion of failures are the failures caused by surge phenomenon (25 %). One way to improve reliability is to introduce of high-speed multi-parametric and fuzzy controllers in a system structure that will prevent a surge.

Gas dynamic characteristics of a centrifugal blower are approximated by regression model as a quintic polynomial. Characteristics of anti-blowing valve were approximated by a quintic polynomial, and characteristics of the actuator — derived from an active experiment, where rotation angle of the actuator output shaft was fixed by position sensor for abrupt change of the control signal. Moore-Greitzer model was used for describing of blower dynamics.

Based on the above parameters obtained from the studies, simulation model of centrifugal blower of compressor unit that synthesized in the software Matlab will make it possible to simulate surge phenomenon.

Based on the developed simulation model of automatic anti-surge control (ASC) system, multi-parametric and fuzzy controllers were synthesized. They were shown high rates of ASC speed.

Keywords: surge, centrifugal blower, simulation, anti-surge valve, control, speed.

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DEVELOPMENT OF A MODEL FOR IDENTIFYING AND FORECASTING THE HUMAN CONDITION AS THE MAIN INDICATOR OF SAFETY MONITORING SYSTEM IN THE ENTERPRISE

page 10–17

The article is focused on the development of new and improvement of existing mathematical models for identifying the human condition as the main safety indicators in the framework of an industrial enterprise. Existing models and methods for solving problems on safety are aimed at the formation and maintenance of accounting and reference documentation, and inadequate for solve the problem of quantitative monitoring, analysis, prediction and control of situations.

Safety protection in the workplace and the health preservation of employees is possible only at the account, control, analysis of their conditions and forecast of the changes in this condition during the labor process. Solution of these problems is possible only with the help of the information monitoring system covering the first level of the hierarchical management structure — the workplace, and implementing accounting, supervisory and regulatory system tasks, the results of which can be used for planning or regulation of safety on the object of management or its individual processes.

The proposed consideration of an employee condition is described by a set of parameters characterizing the activity of the organism. The use of this indicator in determining the employee condition and a change of condition under the joint influence of the complex of harmful factors will allow to realize the functional tasks of accounting, control and analysis of employee condition in the monitoring system that allows management decisions to ensure safety.

Use of the proposed models for condition determination under the joint impact of harmful factors on the human body make it possible according to set of quantitative parameters of body functioning:

— Determine the human conditions and predict changes in it.

— Take into account the initial condition of the employee.

— Take into account the change of this condition under the influence of the complex of harmful factors.

— Take into account the possible effect of the combined effects of this complex.

Keywords: labor safety, complex of harmful factors, parameters of employee condition, monitoring system.

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THE PROJECT MANAGEMENT OF THE BUILDING STRUCTURE REENGINEERING BY THE LIMITS IN ALL FUNCTIONAL AREAS

page 18–23

Management of repair and restore of the building objects is the object of this research. The main disadvantage of the object is a process management according to planned in advance, before the start, project network, which doesn't take into account in the process of repairing and restoring the numerous effects of internal and external environments in the process of repair and restore that slowing and expensing the process and deteriorating the quality of its results.

At the same time it is shown that repair and restore of the building structures are almost always is their reengineering, has a unique and performed in conditions of significant restrictions on resources in all functional areas that makes this kind of activity as the project by definition and its management — project management.

A reengineering management method for the building is developed. It is based on the project approach in resource-limited conditions. The method allowed to evaluate and predict the reengineering in terms of not only purely technological constraints, but also taking into account the turbulent environmental impact in all functional areas.

A «REBUS» system for optimization and support of design decisions, as well as reducing the cost and timing of project work, was developed on the basis of the proposed method. It was implemented in Odessa «Geomoras» LTD (Ukraine) with the positive technical and economic effect. This effect was achieved by replacing an open-loop reengineering management (planned — realized) to the closed — loop (planned — realized under constant monitoring and intervention), which allowed to quickly predict, prevent and eliminate the consequences of all possible risks that accompany a real unique reengineering.

Keywords: reengineering in the building, project management, resource limits, functional areas.

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CREATION OF NONPERTURBATIVE HORIZONTAL PANEL OF OPERATING TABLE FOR MOBILE HOSPITAL IN THE HELICOPTER

page 24–29

An elastic interaction of angular motion of the helicopter fuselage with the operating table panel is analyzed as the object of research. An urgent surgery for victim immediately after its delivery to the helicopter is made possible through three-axis stabilization of the operating table panel of mobile hospital in the vehicle, in particular, in the form of modular construction in a helicopter.

Functional content is based on the use of Petrov two-channel principle for formation of operating table structure that invariant to external disturbances.

A mathematical model of mobile hospital is developed and construction accuracy of horizontal panel in a stochastic structure of the angular motion of the helicopter is evaluated. The values of mathematical expectation of the platform drift relative to the stabilization axes are defined. It is recommended to use differential two inertial sensors for each stabilization channel. It is proposed to carry out a further increase in the stabilization accuracy by the introduction of negative feedback on the sum of the sensor signals that are common for two gyroscopes

The research results can be used by medical services in conjunction with transport organizations responsible for the maintenance of mobile hospitals. Advantages of two-channel scheme for inertial sensors are in suppressing of the influence of instantaneous values of external disturbances as a stochastic angular motion of the vehicle.

Keywords: three-axis gyroscopic platform, two-channel autocompensation, crosslinks, inertial sensor, gyroscope.

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DEVELOPING OF ADAPTIVE MODEL PREDICTIVE CONTROL SYSTEM FOR HEAT TREATMENT OF IRON-ORE PELLETS WITH USING RECURSIVE LEAST SQUARE ALGORITHM FOR ONLINE PARAMETER ESTIMATION

page 30–34

The article discusses the problems of development of the system of adaptive predictive control of pellets heat treatment with online estimation of parameters of the process model. Due to nonstationarity in time of the process parameters caused by fluctuations of particle size distribution and fractional void of the layer, changes in the process equipment characteristics and the presence of noise in measurement channels, the existing automation systems of pellets heat treatment do not always allow to solve the problem of stabilization temperature profile in the pellets layer, as well as reduce the specific consumption of energy. To overcome these disadvantages the recursive least squares algorithm is proposed to use for estimating the parameters of process model which subsequently is the base for calculating the manipulated variable (the gas flow to the burner of the leading side of the indurating machine) with using the methods of Model Predictive Control theory that provides maintenance of a preset temperature regime of pellets indurating under conditions of uncontrolled disturbances. In accordance with the described approach it is suggested the variant of the structure of the system of adaptive predictive control of the temperature regime of pellets indurating in the separate gas-air chamber of indurating machine, and the simulation of this system was performed in Simulink package with the use of real data about the dependence of temperature in the heart of firing zone from gas consumption on the burner of leading side, which were obtained in a mode of passive experiment at the indurating machine OK-324 of JSC «Central GOK (ME)». The resulting system has demonstrated the high quality of the online estimation of parameters and sufficient convergence rate for conditions of pellets heat treatment. The obtained results allow us to recommend the developed method of formation of adaptive predictive control for automation of pellets heat treatment.

Keywords: adaptive model predictive control, heat treatment of iron-ore pellets, online parameter estimation, recursive least square algorithm.

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INFORMATION AND CONTROL SYSTEMS

APPLICATION OF NEURAL NETWORKS IN THE STATISTICAL SYSTEM OF ANALYSIS AND MONITORING OF TELECOMMUNICATION NETWORKS

page 35–41

In this paper, based on the analysis of practical use of telecommunication systems, the necessity of a broad and scientifically proven implementation of statistical methods of their analysis and monitoring on the basis of open flow information is determined.

A promising approach to processing of implicit knowledge forms is developed on the basis of the technology of neural structures. The architecture of neural networks allows to implement them using the technology of a high degree of integration. An effectiveness of using neural networks and their analog models is proved to solve the approximation problems of continuous functions of several variables and forecast of the processes that take place in telecommunication networks over the time.

The procedures for initial processing parameters of telecommunication network for use as input data to the neural network are proposed. The developed procedures allow a closer consider and analyze the dynamics of information flows circulating in networks and identify the characteristics of random sequences and implementation of neural networks allows to predict the network behavior depending on seasonality and trend.

Keywords: information and telecommunication network, intelligent technology, neuron, neural network, traffic.

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TECHNOLOGY TRANSFER IN THE TRANSPORT INDUSTRY

FORMATION OF SOCIAL AND MARKETING EVALUATION OF SERVICE QUALITY OF URBAN PASSENGER TRANSPORT SERVICES

page 42–48

Service quality of passenger transport services, which are the object of this research, has a complex structure, needs to formalize its structure and revealing of the principles of state evaluation of its compliance with the requirements of social and marketing customers. To solve this problem it is offered to use SERVQUAL methodology, which confirmed its practical adaptability to evaluate the service quality in the field of consumer services. The basis of the proposed approach is the principle of service quality evaluation of urban passenger transport services through the perception of parameters of customer value by providing their compliance with social and marketing requirements of the passengers. The structure and the type of service quality performance of transport services are proposed on the basis of social and marketing criteria and their properties. Service quality evaluation of transport services is realized by providing gap between the levels of its formation by determining the state of compliance of technical proposal with the necessary conditions for the formation of the consumer potential of transport services. It is established that the level of service quality of transport services greatly affects the level of technical proposal, which formed on the basis of its internal resource capabilities and organization of technological processes.

Keywords: service quality, transport services, urban public passenger transport, social and marketing needs.

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THE DEVELOPMENT OF METHODS TO IMPROVE PERFORMANCE OF THE LOGISTICS CHAIN WITHIN THE TRANSPORT AND LOGISTICS CLUSTER

page 48–52

The problems are irreversibly occurred during the transportation process. It is lead to loss of quantity, quality of the cargo and increase of the transportation time, so that the cargo «hangs» in the turnaround. The main disadvantage is the quality performance of the transport services — quantitative characteristic of one or more consumer properties of services that make up its quality. Transportation quality is measured at the aggregate of characteristics that determine their suitability to meet the needs of consignors and consignees in the corresponding transportations. This disadvantage is associated with low functional performance of transport, such as maneuverability, low speed, ease of reception and delivery of the cargo, closure of the service system, adaptability to customer requirements.

The research is focused on the development of measures to improve performance during the transportation process. A process chain analysis on the basis of risk analysis is applied in order to develop these activities. At the same time, a reliable criterion based on the functional parameters of the object is proposed to reduce the risks of action on the logistics chain. Its essence lies in the fact that the criterion shows the degree of reliability of the transport company, thus creating potential and information to determine transportation priorities (quantity/quality).

This method can be used to create a database for characteristics of the transport company.

Keywords: transport and logistics cluster, transportation process, cargo owner, reliability, process chain, cluster approach.

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INFORMATION TECHNOLOGIES

DEVELOPMENT OF INTELLIGENT SUBSYSTEM FOR RELIABILITY FORECASTING OF DISCRETE DEVICES «FORECAST»

page 53–58

This article focuses on the process of developing intelligent subsystem for reliability forecasting of discrete devices «FORECAST». Created system enables according to the physical characteristics to perform analysis of discrete device to predict the reliability of its work in time.

Reliability forecasting of the discrete devices taking into account interphase layer will allow without financial and time costs accurately answer the question about depending a reliability of discrete unit on area interphase layer formed by the interaction of two basic materials of discrete device element.

The disadvantage of created system can be considered a necessity of its setting for separate type of discrete device. Later, this disadvantage will be eliminated by creating libraries of parameters.

Software implementation of intelligent subsystem for reliability forecasting of discrete devices allowed to implement a method of forecasting technical condition of discrete device on the basis of proposed model by taking into account the physical properties of composite materials. Set of the reliability function values is obtained during the test of discrete device elements.

Verification of the results of intelligent subsystem for reliability forecasting «FORECAST» based on the physical condition of discrete devices is conducted to assess the working capacity of electronic control unit of the car system.

Accuracy of the results of the reliability values using the method of reliability forecasting of discrete devices based on modeling the degradation process of computer components is 7 %.

The workers of technical section spent 5 % more time to diagnostics by hardware maintenance compared with the time of application of intelligent subsystem for reliability forecasting «FORECAST».

Keywords: reliability, discrete device, intelligent forecasting system, block diagram.

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ENSURING A STABLE WIRELESS COMMUNICATION IN CYBER-PHYSICAL SYSTEMS WITH MOVING OBJECTS

page 58–64

The data transmission process in cyber-physical system (CFS) with wireless communication channels between cyber-physical objects (CFO) is studied in the article. In the presence of obstacles (mechanical and electromagnetic),zero direct visibility or exceeding the allowable distance between CFO (Wi-Fi communication modules of unmanned vehicles — UMV — and/or mobile devices) that need to share data, it is necessary to take measures to restore broken communication line or to stabilization of the data transmission rate.

The method for regularly radio situation overriding in CFS coverage area is proposed. The stability of wireless communication is achieved by changing energy and frequency characteristics of the communication line between CFO, as well as through the use of intermediate CFO as the signal transmitters. An algorithm for performing the specified settings depending on the model of used cyber-physical components, the distance between CFO and the delay of time interval is described. The full-scale experiment in the field using real hardware and software and with the presence of electromagnetic interference has been recreated to verify the algorithm. It is shown that for certain set of initial parameters, reducing a Wi-Fi module maximum power by 50 % improves the quality of communication in almost 8 times.

Assessment of changes in the data transmission rate depending on the number of retransmissions is conducted. The stability performances of data transmission rate up to 90 %are improved by transition of communication line to another frequency range with less interference and introduction of signal retransmission function using intermediate CFO.

The direction of future research is dependent on trends in the market of construction materials for UMV and computer components with built-in Wi-Fi communication modules.

Keywords: moving objects, stability of wireless communications, cyber-physical objects, computer components, Wi-Fi transmitting modules.

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IDENTIFICATION OF THE CONTEXT ELEMENTS OF KNOWLEDGE-INTENSIVE BUSINESS PROCESSES BASED ON THE LOG ANALYSIS

page 65–71

Knowledge-intensive business processes are studied. They are characterized by the direct influence of performer's knowledge on the sequence of process execution. Performers use formalized personal knowledge for correcting of the process. Therefore, to increase the control effectiveness of knowledge-intensive business processes it is necessary to formalize the performer's knowledge and include them in the process model. Relationship between the context elements and process actions is shown based on the analysis of business processes logs. Context elements are displayed in the log using the event attribute values, and that leads to the ability to highlight the links between the context and process. The method for extraction of context elements of knowledge-intensive business processes is proposed based on the log analysis. The method allows to identify context elements, change the values of which are associated with process activities. The method creates the conditions for increasing the efficiency of process control by inclusion of dependencies, which identified by analyzing the context elements, in the process model.

Keywords: knowledge-intensive business process, intelligent process analysis, process control.

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IDENTIFICATION OF THE STANDBY INTERVALS IN THE BUSINESS PROCESSES BASED ON ANALYSIS OF THE SEQUENCE OF EVENTS

page 71–76

Business processes that share resources are studied. It is shown that reduction of control efficiency of these processes associated with waiting for access to shared resources. The necessary and sufficient conditions for the occurrence of standby intervals during the process execution are identified based on the study of business processes logs. A method for identifying standby intervals of process resources is proposed based on the attribute analysis, recorded in the event log, in the case that the number of available resource varies during process execution. The method allows to obtain association rules, which establish a change connection of the event attributes to the transition from the process action to the expectation interval. The inclusion of such rules in the business process model, which is obtained by the methods of process mining, allows to predict the emergence of delays in the process implementation. This method creates conditions for improving the process control efficiency by reducing delays in practice.

Keywords: business process, intelligent process analysis, process control, resources, expectation interval.

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