INFORMATION TECHNOLOGIES

INFORMATION AND ANALYTIC EVALUATION OF ACTIVITY INDICATORS OF MEDICAL STAFF IN THE DENTAL CLINIC

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Evaluation of the activities of an economic entity in any sphere of the national economy is an important process at all stages of the existence of such an entity. The results of this evaluation affect the planning of the institution for future periods of time, the formation of its personnel policy, the reorganization and the like. At the same time, facilities of the service sector should be considered separately, in addition to indicators reflecting the profit of the institution, indicators characterizing the quality of the services provided by the institution are also important. The object of the research is the processes of informational and analytical support for making managerial decisions to evaluate the effectiveness of the staff of dental clinics. Such support is necessary to analyze operational information about the activities of medical workers and make timely and effective decisions to optimize their activities in order to improve the quality of medical services. Particular attention should be paid to determining the criteria for the effectiveness of medical personnel.

In the work, methods of system analysis were used to study the processes of the activities of dental clinic workers when they provided medical services. As well as methods of mathematical modeling – to formalize the tasks that arise in the process of evaluating the performance of medical workers and a systematic approach – when analyzing the problem of information and analytical support in the process of evaluating the performance of medical workers.

In the course of the study, a method is proposed to increase the efficiency of managerial decision-making processes for the activities of dental clinics based on an analysis of the performance indicators of their employees by developing and implementing relevant software. An information-analytical system has been developed that allows to calculate and visualize in a convenient form the ratio between such indicators of medical workers as normative and actual load. The use of the developed software product will allow to develop and make timely and informed management decisions on the activities of dental clinics.

Keywords: information technology, information and analytical support, performance evaluations of medical personnel, management of a dental clinic.

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DEVELOPMENT OF A MODEL OF INTEGRATED RISK AND CONFLICT MANAGEMENT OF SCIENTIFIC PROJECT STAKEHOLDERS UNDER CONDITIONS OF BEHAVIORAL ECONOMY

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The object of research is the processes of conflict and risk management of stakeholders of a scientific project, in particular the project team, the main executors of the project (scientists) and other stakeholders, in a behavioral economy. At the present stage of the country's development, scientists work in very difficult conditions, in particular: limited resources (material, human, financial, time and others). The complexity of internal and external processes of a scientific project and the relationship between its stakeholders leads to risks and conflicts that may be caused by behavioral factors. Therefore, it is necessary to systematically approach the analysis of scientific project stakeholders, develop a unified approach to integrated risk and conflict management of scientific project stakeholders in a behavioral economy.

The paper proposes a model of integrated risk and conflict management of a scientific project in a behavioral economy, which is based on the following stages:

– identification of stakeholders and related risks, conflicts and behavioral economics that may arise in the planning and implementation of a scientific project and have an impact on it;

– building a model of integrated risk and conflict management of stakeholders of a scientific project in a behavioral economy;

– the modeling of integrated risk and conflict management of stakeholders of the scientific project in the conditions of behavioral economy is carried out on the basis of the identified risks, conflicts and factors of behavioral economy.

The developed model of integrated risk and conflict management of stakeholders in a behavioral economy will analyze the main factors influencing stakeholders, including risks, conflicts and behavioral economics, on the scientific project. The use of the principles of integrated management of various factors allows to determine the sources and causes of complications that may arise in the scientific project, and the simulation results will be useful to the project manager and its team in the planning and implementation of the project.

Keywords: scientific project, stakeholder, conflict and risk management, factor of behavioral economy, integrated management.

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SYSTEMS AND CONTROL PROCESSES

ENHANCEMENT OF THE ADAPTIVE ROUTING TENSOR MODEL IN THE INFOCOMMUNICATION NETWORK WITH PROVIDING QUALITY OF EXPERIENCE BY THE R-FACTOR

page 15–22

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The object of research is the routing processes and ensuring the quality of experience in the infocommunication network. To conduct research an improvement of the adaptive routing tensor model in an infocommunication network with quality of experience by the R-factor is proposed. The basis was a floe-based routing model that took into account possible packet losses caused by congestion of network elements and was represented by the conditions for implementing a multipath routing strategy, conditions of the flow conservation and conditions for preventing overload of communication links. To obtain in an analytical form the conditions for ensuring the quality of experience in terms of the R-factor, a tensor description of the infocommunication network is carried out. This allowed obtaining of analytical expressions for calculating the average end-to-end delay and the probability of packet loss, which were used to formulate the QoE conditions in terms of the R-factor.

In the framework of the proposed model, solving the technological problem of adaptive routing solutions are reduced to solving the optimization problem of nonlinear programming for calculating route variables. The introduced optimality criterion allowed it possible to ensure the adaptive nature of route decisions, when an increase in QoE requirements led to an increase in the amount of network resource used. To solve the problem, methods of mathematical programming were used, which are implemented in the MatLab package.

A study on a fragment of the infocommunication network made it possible to evaluate the adequacy and effectiveness of the proposed model. Using the obtained research results, it was possible to ensure the fulfillment of the specified QoE requirements in terms of the R-factor for the services provided to end users. Using the proposed model is characterized by high efficiency on load balancing across multiple routes in the infocommunication network. This was evidenced by the fact that at a given value of the R-factor, with an increase in the intensity of traffic entering the infocommunication network, there was a gradual increase in the number of routes involved. In other words, the network resource was distributed evenly and efficiently by 7–10 % relative to known analogues, which, when solving the same problem, immediately use all possible routes.

Keywords: infocommunication network, quality of experience, R-factor, adaptive routing, tensor model.

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USE OF BIG DATA FOR ACTUALIZATION OF APPROACHES TO ROAD ACCIDENT ANALYSIS

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The death and injuries of road users is one of the biggest problems that negatively affect the development of society and socio-economic progress. The price of human life is too high to neglect the least opportunity to save it. Therefore, the object of research is the huge amounts of information that modern society generates and which are known under the general concept of Big data. Regarding highways and streets, Big Data means arrays of information about a network of highways and streets, design decisions applied to them, operational status, traffic conditions, interaction of pedestrian and traffic flows and the like.

The study used Big Data from road owners, suppliers of cartographic and navigation systems, intelligent transportation systems and law enforcement. For each of the Big Data sources, the methods of collection and processing, the scope, degree of selectivity, and accuracy of the measurements are evaluated.

The results confirm the fact that the main indicator characterizing the influence of road conditions, the technical condition of the car and psycho-physiological factors on the driver is the speed of both individual vehicles and traffic flows over a certain period of time and on a selected section of the road. The proposed approach is based on the fact that speeds with a high degree of reliability can be established using the Big Data in a form suitable for machine processing. Big data is not just a source of information, it allows to track trends, assess risks and make forecasts.

The obtained results indicate that Big data can and should be used to describe traffic conditions and analyze the behavior of road users, including in order to better understand the interaction of factors in the occurrence of road traffic accidents (RTAs). And also, as far as possible, to prevent emergencies and/or reduce the severity of the consequences of the traffic accident. Thus, Big Data can be used to update the current approaches to determining the concentration of traffic accidents and the existing methods for assessing the impact of road conditions on road safety.

Keywords: road safety audit, traffic safety, method for assessing the impact of road conditions, speed.

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REPORTS ON RESEARCH PROJECTS

DESIGN AND IMPLEMENTATION OF THE DISTRIBUTED SYSTEM USING AN ORCHESTRATOR BASED ON THE DATA FLOW PARADIGM

page 38–41

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The object of this research is distributed systems under the control of an orchestrator based on the data flow control paradigm, as well as microservice management methods. One of the most problematic places of modern distributed systems is the choice of a method for controlling the logic of the microservice and the processes of interaction between them. The existing concepts of microservice orchestration and choreography do not allow to fully use and distribute the load evenly throughout the system, which is primarily due to the heterogeneous nature of the distributed environment.

As part of the research, the concept of hybrid orchestration based on the paradigm of data flow control is proposed. This approach allows the orchestrator to be used only to initiate a «wave» of calculations on the microservice tree, and the microservices themselves are responsible for the further calculation and dissemination of data. This approach, unlike others, combines the more optimal qualities of orchestration: simple and understandable, at each stage of calculation, system management, coordinated microservice actions. Also, the use of a specialized hybrid orchestrator eliminated one of the main drawbacks, namely, it reduced the responsibility and the amount of computational burden assigned to the distributed system orchestrator, and computation nodes. As a result of an experiment using a distributed system with an orchestra, based on the data flow control paradigm, a several-fold decrease in the load on one orchestra was achieved. This makes it possible to use microcontrollers such as ESP8266, ESP32, Raspberry Pi as a distributed system. Such microcontrollers can act not only as an orchestrator, but also as dataflow nodes. At the same time, the data flow control paradigm allows to evenly and efficiently distribute the load on the system due to the fact that the input data of the system are presented in the form of a computational graph, where each node is a separate microservice.

Keywords: data flow control paradigm, distributed systems, high-power computing, Internet of things devices, microservice choreography.

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DEVELOPMENT OF THE CONCEPT OF ELECTRONIC GOVERNMENT CONSTRUCTION IN THE CONDITIONS OF SYNERGETIC THREATS

page 42–46

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The object of research is the process of forming the concept of building electronic government in the context of the synergy and hybridity of modern threats. The development of high technologies, the rapid growth of information and communication technologies (ICT) and computing resources allow us to improve not only the sphere of life and services for society, but also to create both individual elements and full-scale projects of the digital state. One of the most problematic places in the formation of a digital state and/or e-government remains the security of a single portal and/or registry. In the context of the rapid growth of computing resources, cybercriminals are realizing a combination of threats with social engineering methods, which allows to obtain a synergistic effect and hybridity.

An assessment of the capabilities of a quantum computer is obtained, which significantly reduces the level of security when using traditional and asymmetric cryptography. This is due to the fact that the proposed methods for breaking symmetric and asymmetric cryptosystems are implemented in the post-quantum period with polynomial complexity. The paper proposes a hierarchical concept of introducing a governance model based on e-government, which allows deepening the principles of democracy and virtually eliminating corruption with the required level of security. For its deployment, it is necessary to ensure at each level the protection of information and communication and mobile technologies that ensure the functionality of electronic government. The paper studies the main threats to critical cyberphysical systems, as the basis of the mechanisms for fulfilling the functions of e-government. Given the construction of full-scale quantum computers, the main goals and objectives of the concept of building electronic government are formed in the work. Thanks to this, it is possible to obtain the basic principles and functionality at each level of the Concept of the formation of electronic government. Compared with similar well-known approaches, this ensures that the necessary level of not only computer and cyber literacy of the population is taken into account, but also that the state's cyberspace is fully covered. It allows to provide the functionality of electronic government in the context of the integration of modern threats.

Keywords: e-government, cyberphysical systems, critical cyber information systems, digital state, information security.

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ASSESSMENT OF THE INFLUENCE OF THE TIME SPENT BY VEHICLES AT THE STOPPING POINT OF URBAN PASSENGER TRANSPORT ON THE LEVEL OF CONFLICT IN THE INTERACTION OF THE ROUTE FLOW

page 47–51

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The object of research is the effect of the time spent by vehicles at the stopping point on indicators of the level of conflict in the interaction of the route flow. As a controlled parameter that determines the level of reserve capacity of the stopping point and reproduces the characteristic effect on the conflict of interaction, the additional service downtime of vehicles is allocated. Simulation and statistical processing of the results are used, which allow to establish typical types of patterns for stopping points with different intensities of the input route flow. It has been established that for stopping

points with low and medium intensity (up to 40 vehicles/h), the reserve of throughput has an inverse linear dependence on the service time and for exponentials with high intensities (more than 40 vehicles/h) it is exponential. Changing the reserve of bandwidth by setting a rational service idle duration allows to affect the number of conflicts and the length of time in the queue. This makes it possible to determine its acceptable values for the corresponding intensity level of the route flow. Based on the conducted experimental studies, it is established that an additional service downtime for a stopping point with intensity of up to 40 vehicles is an acceptable duration of up to 40 s. With the introduction of more than 125 s – in 71.2 % of the incoming stream, conflict situations will be observed. From the position of minimizing the conflict of interaction between stopping points with an input route flow intensity of more than 40 vehicles/h, the introduction of an additional service downtime is not at all possible. Establishing dependence is the methodological basis for the formation of elements of a management decision support system based on an analysis of the impact of vehicle downtime on the conflicting interaction of the route flow. They introduce certain orderliness in the processes of planning the work of passenger infrastructure facilities, make it possible to systematize their service-resource parameters and contribute to improving the safety of passenger transport services.

Keywords: urban passenger transport, stopping point, downtime, number of conflict situations.

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ADAPTATION OF FUZZY INFERENCE SYSTEM TO SOLVE ASSESSMENT PROBLEMS OF TECHNICAL CONDITION OF CONSTRUCTION OBJECTS

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The main task, the solution of which the work is focused on, is the automation of the fuzzy inference system, which is one of the subsystems of the system for assessing the technical condition of construction objects. The proposed assessment system is assigned to services that specialize in conducting construction and technical examinations. The process of conducting examinations in this area is accompanied by uncertainties of a different nature, and the production activities of specialists are often based on heuristics. That is why, the object of research are models and tools that can function

in fuzzy conditions. To automate expert activities in the field of assessing the influence of external factors on the technical condition of compacted urban areas, a specialized assessment system has been designed based on knowledge and an artificial neuro-fuzzy network of the Takagi-Sugeno-Kang category. The use of neuro-fuzzy models for fuzzy inference makes it possible to automate the process of obtaining logical conclusions from input according to fuzzy rules specified by experts. At the same time, settings for membership functions can be carried out using artificial neural networks. The Takagi-Sugeno-Kang fuzzy neural network is designed to solve this problem. The feasibility of using this model to solve the problem of assessing the technical condition of construction objects with damage is justified by its ability to solve the problem of fuzzy classification. The second main criterion for choosing this model is the ability to set the rules by the input function, since under the conditions of compacted urban development, the factors affecting the external environment on the technical condition of objects are complex non-linear. The principle of adaptation of the fuzzy inference system is shown by the example of fuzzification of environmental influences caused by vibrations of a different nature. The studies carried out in the work, unlike the previous ones, expand the knowledge base of the system by presenting information about the real state of the environment in which the construction objects operate. It is expected that the use of the Takagi-Sugeno-Kang artificial neural network will significantly reduce the influence of the human factor on the performance of construction and technical examinations performed under conditions of compositional uncertainty. The practical significance of the work is to reduce the timing and increase the reliability of the assessment of the technical condition of construction objects with damage of a different nature.

Keywords: fuzzy inference system, specialized intelligent system, dense urban development, artificial neural network.

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CONTROL OPTIMIZATION OF ELECTROMECHANICAL SYSTEMS BY FRACTIONAL-INTEGRAL CONTROLLERS

page 56–59

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The object of research in the work is electromechanical systems, a characteristic feature of which is the presence of significant power dependence in the mathematical description. Because of this, problems arise when choosing the structure and parameters of controllers. In particular, in a DC motor with series excitation, a switched reluctance motor and electromagnetic retarders, saturation of the magnetic system in static and dynamic modes can occur. The apparatus of fractional-integral calculus used in the work allows us to describe such nonlinear objects with high accuracy by linear transfer functions of fractional order. So, when approximating the anchor circuit of a DC motor with series excitation by a fractional transfer function, the smallest standard error was obtained. The combination of a conventional PID controller with fractional integral components of the order of 0.35 and 1.35 ensured the best quality of the transient process – the current reaches the set value as quickly as possible without overshoot. Secondly, the switched reluctance motor, in the model of which it is necessary to take into account the power dependences, is described by the aperiodic function of the order of 0.7 when describing the transient processes of the speed during a voltage jump. From the family of controllers studied, the traditional PI controller with additional fractional-integral components of the order of 0.7 and 1.7 ensured the astaticism of the speed loop of the order of 1.7 and the smallest overshoot. Thirdly, the electromagnetic retarders of the driving wheels of a car, used to tune the internal combustion engine, are also most accurately described after testing by the fractional transfer function. Using the $PID\Gamma^r I^\mu$ controller, which ensured closed loop astaticism of the order of 1.63, stabilization of the rotation speed of two wheels

without out-of-phase oscillations and the accurate development of a triangular tachogram were achieved. Thus, thanks to the apparatus of fractional-integral calculus, a more accurate identification of object parameters is provided, the mathematical description is reduced to linear transfer functions of fractional order. And in closed systems it is possible to ensure astaticism of fractional order 1.3–1.7 and to achieve a better quality of transient processes than using classical methods.

Keywords: fractional integral calculus, fractional integral differentiating controllers, closed-loop control system, electromechanical system.

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