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DEVELOPMENT OF A METHOD FOR CALCULATING THE SAFE POSITION OF MILITARY UNITS BY USING ARTIFICIAL NEURAL NETWORKS BASED ON SWARM ALGORITHMS

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The object of research is development of a method for finding a safe position for military units in combat conditions, using swarm algorithms and neural networks. One of the most problematic places is the complexity of testing the developed method. The difficulty lies in the fact that to check the method in real time, financial costs and military weapons are necessary.

The data are obtained due to a multicriteria problem, which allowed to calculate the errors of subjects and objects of research.

The obtained results show that the hybrid method allowed to calculate the safe position with greater accuracy, namely by 25–50 % more accurately than using the classical approach. This is due to the fact that the proposed method calculates all possible errors.

This makes it possible to obtain the flexibility of the method for finding a safe position. In comparison with the analogous methods known in the formulation of the classical problem of calculating the trajectory and the damage region, only one mathematical value (region, trajectory) is taken into account, and using a hybrid approach one can take into account a number of errors simultaneously. This approach ensures the flexibility of the system and the possibility of expanding a number of mathematical calculations and improving the accuracy of the result.

Keywords: neural networks, safe position, forecasting of solutions, cover of clusters.

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DEVELOPMENT OF METHODOLOGY FOR DATA AND KNOWLEDGE WAREHOUSE DESIGN IN COMPUTER SYSTEMS FOR INTELLECTUAL DATA PROCESSING

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At present, when developing data warehouses and knowledge of computer systems, it is not possible to use one end-to-end methodology, suitable for collective work and knowledge sharing. Such methodology should be understandable and objective from the point of view of the provability and validity of models at all stages of research and design work. The object of research is development of a methodology for designing efficient data warehouses and knowledge of modern computer systems for intellectual data processing. During the development of the methodology, the categorical-ontological approach developed by the author as a metalanguage of modeling and a means for verification of the design process and its results was used. In this case, the generic ontological model is mathematically rigorous, by imposing constraints on the objects and morphisms of category theory on the concepts and relationships that are presented. As a result of the development and application of this methodology, the semantic and linguistic barriers that arise between the members of the project team in the design of data and knowledge warehouses of computer systems have been overcome. Using a categorical-ontological approach to modeling and design makes it possible to formally substantiate the subjective results of knowledge engineering and use the objects of category theory in the form of design patterns at a high level of abstraction.

Keywords: computer system, data and knowledge warehouse, categorical-ontological model.

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BIG DATA ANALYTICS ONTOLOGY

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The object of this research is the Big Data (BD) analysis processes. One of the most problematic places is the lack of a clear classification of BD analysis methods, the presence of which will greatly facilitate the selection of an optimal and efficient algorithm for analyzing these data depending on their structure.

In the course of the study, Data Mining methods, Technologies Tech Mining, MapReduce technology, data visualization, other technologies and analysis techniques were used. This allows to determine their main characteristics and features for constructing a formal analysis model for Big Data. The rules for analyzing Big Data in the form of an ontological knowledge base are developed with the aim of using it to process and analyze any data.

A classifier for forming a set of Big Data analysis rules has been obtained. Each BD has a set of parameters and criteria that determine the methods and technologies of analysis. The very purpose of BD, its structure and content determine the techniques and technologies for further analysis. Thanks to the developed ontology of the knowledge base of BD analysis with Protege 3.4.7 and the set of RABD rules built in them, the process of selecting the methodologies and technologies for further analysis is shortened and the analysis of the selected BD is automated. This is due to the fact that the proposed approach to the analysis of Big Data has a number of features, in particular ontological knowledge base based on modern methods of artificial intelligence.

Thanks to this, it is possible to obtain a complete set of Big Data analysis rules. This is possible only if the parameters and criteria of a specific Big Data are analyzed clearly.

Keywords: Big Data analysis ontology, visualization data, data mining, Text Mining, MapReduce.

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SYSTEMS AND CONTROL PROCESSES

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DEVELOPMENT OF IMITATION MODEL FOR SELECTION OF TUG BARGE VESSELS FOR WORK ON THE LINE

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The object of research is the process of operation of TBV for route transport with a through form of traction and exchangeable form of coordination of the work of traction and tonnage at the points of departure and destination. One of the most problematic places is the lack of research in the scientific literature studied of solved the task of forming a number of priority vessels for the subsequent organization of their work in designated organizational form.

The imitation model proposed in the study makes it possible to perform a preliminary selection of vessels for work on traffic schema, which simplifies the calculations associated with the distribution of vessels. The model is based on the need to take into account the physical and geographical factors in the organization of the work of the TBV on inland waterways in order to ensure the greatest correspondence of the linear and technical characteristics of the ships to the conditions of the forthcoming voyage. The developed group of limitation takes into account the characteristic of the considered form of the organization of TBV and is rational only for it, since it takes into account that the TBV immersed in the port of departure should go to the destination without re-forming and loading (unloading).

Thanks to the proposed methodology, it is planned to increase the profit of the shipping company by increasing the carrying capacity of the vessel with the best alignment of the transport characteristics of the TBV and the route.

Keywords: imitation model of selection of tug barge vessels, routing dispatch, form of work organization.

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RECOGNIZING WHEELS WITH A LASER TO CALCULATE THE DEFORMATION OF TIRES

page 33–38

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The object of research is a system for recognizing wheels using a laser to calculate the deformation of tires. The main problem of this research, for the solution of which it is necessary to recognize the vehicle wheels with the help of laser illumination, with the subsequent restoration of their three-dimensional surfaces is the calculation of the coefficient of deformation of the vehicle wheels.

In the course of the study, the vehicle and its laser illumination are simulated using the Unity 3D system. The recognition of the laser beam and the minimization of its pixels in the wheel area are carried out using algorithms implemented in the EmguCV library (OpenCV for .NET) with empirical parameter adjustment to achieve optimal recognition quality. The software is developed in C# programming language in Microsoft Visual Studio 2017. The quality of such recognition is checked in real conditions.

The results of the calculation are in accordance with UNECE Standards No. 30. The implemented algorithm for recognizing the laser beam in the wheel region of a vehicle with subsequent reconstruction of its three-dimensional surface is of independent value, since it can be used to detect any objects using a vertical or horizontal laser of different colors. These results can be integrated with the TPMS (Tire Pressure Monitoring System) information to determine vehicle traffic.

Keywords: Canny edge detector, Sobel differential operator, computer vision, median filter, Hough transformations.

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DEVELOPMENT OF THEORETICAL AND EXPERIMENTAL DYNAMIC MONITORING OF LARGE-SCALE BUILDING STRUCTURE

page 38–45

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The object of research is the method of monitoring and assessing the technical condition of the large-sized building structure of the International Exhibition Center (Kyiv, Ukraine). The currently applied method of monitoring this structure is based on the use of deformation indicators. The indicators of this method do not allow estimating the global technical state of the structure. Taking into account the social importance of the structure, it is possible to use dynamic monitoring while monitoring its technical condition.

In the course of the study, two independent finite element models of the controlled facility are developed in the SCAD (Russia) and NASTRAN (USA) software complexes. With their help, a modal analysis was made and the values of the frequencies and forms of the natural oscillations of the structure were determined. The natural measurements of its natural frequencies have been made. It is found that the difference between the calculated and natural values of natural frequencies does not exceed 3 %.

In addition, version of an automated experimental control system is proposed, which includes the use of three-component accelerometers MS2002+, Geoscop software, controlled by the operating system MS Server.

The received results testify to the efficiency of the use of frequencies and forms of natural oscillations in the system of monitoring the technical state of the given structure. In comparison with static deformation parameters, they allow estimating the global technical condition and determining the integrity of the structure.

Keywords: dynamic monitoring, frequencies and forms of natural oscillations, finite element model.

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SUBSTANTIATION OF THE DEVELOPMENT VARIANT OF FREIGHT FORWARDING COMPANY UNDER UNCERTAINTY CONDITIONS

page 46–52

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The object of research is justification of the development of a freight forwarding company under uncertainty conditions. The main factors of uncertainty in the development of freight forwarding companies have been identified and characterized. The main factors of uncertainty in making decisions on the development of a freight forwarding company are potential volumes of cargo for servicing, which are formed under the influence of a competitive environment, volumes of foreign trade cargo and the state of the transport system.

The transformation of the uncertainty of information about the state of the market as a function of time is analyzed. It is characterized how the structure of information in terms of its degree of uncertainty changes as the planning horizon of development activities decreases and the moment of their realization comes.

Experimental calculations for the choice of the development of a complex of services of a freight forwarding company are developed and presented. For the selection procedure, an adaptation of a well-known method is suggested that takes into account the multicriteria choice, which corresponds to the actual needs of practice under uncertainty conditions. This method in the form of a combination of operations on fuzzy sets and Saaty pairwise comparison method is adapted to choose the direction of development of transport forwarding services by using a set of relevant criteria. This extends the boundaries of using the known method.

The proposed method will allow the freight forwarding company to determine the most appropriate development option, taking into account the system of criteria. The results of calculations from four variants of development have shown that the third and fourth development options have the greatest advantage, which obtained a maximum value of 0.70 and 0.68 with an insignificant difference. They received priority over the first and second development options, which make it the final choice when making a decision.

Keywords: theory of fuzzy sets, uncertainty factors, development of a complex of freight forwarding company's services.

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COMPENSATION OF THE SPATIAL DEVIATIONS OF MEASURING ELEMENTS IN CAD

page 52–60

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The object of research is the processes of computer-aided design of the elements of complex measuring instruments intended to work under conditions of significant deviations in space caused by mechanical or thermal stresses. One of the most problematic places is that any protection state completely eliminates unwanted deviations of the elements. This is especially true for measurement objects that have large dimensions (tens of meters) and weight, opacity, high temperatures (hundreds of degrees), significant external influences of unpredictable nature, and the like. Models of behavior of such objects under load are extremely complex, and methods of their analysis and use in CAD are not available at all, which leads to the laying of significant errors of the future measurement already at the design stage.

In the course of the study, the theory of analysis of technical systems, the theory of measurements, the theory of the resistance

of materials and oscillations, the theory of computer-aided design were used. To develop a capacitive method for measuring the density of parts of large-sized reinforced concrete objects from heterogeneous materials, methods of pattern recognition and a virtual object are used.

Theoretical and experimental virtual models of electrical characteristics of the elements of measuring instruments and models of their deviation are obtained. Models are used in automated design systems for complex means of capacitive measurement of concrete. The first is mathematical, in which compensation is performed solely by making changes to the measurement results. The second is mechanical, in which compensation is made by changing the geometry of the measuring tool (with static deviation) or depreciation of their elements (with dynamic).

Thanks to this, it is possible to create a new subsystem of CAD «DEVICOM», with the help of which shock absorbers were designed to control the technological process of manufacturing the reinforced concrete product «Power transmission line support», which, as a result, reduced the amount of defective products by 7.4 %.

Keywords: elements of metrological instruments, spatial deviation, computer-aided design, error and reliability of measurements.

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DEVELOPMENT OF THE DESIGN METHOD OF THE ENTERPRISE FOR THE RELEASE OF NEW PRODUCTS

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The object of research is the method of designing an enterprise for the release of new products, the basis of which is played with nature and the method of analyzing hierarchies. The sustainability of the project is determined by the break-even point. With the help of the game's criteria with nature, the task of determining the optimal output of paving slabs is solved. The criteria of Wald, Bayes, Laplace and Savage are used. The method of analyzing hierarchies is used to determine the optimal location for an enterprise. The criteria are the compliance of the land plot, the opportunity to recruit the necessary personnel from the surrounding areas, access to material resources and transport. As alternatives, 3 sites in different regions of the Dnieper, Ukraine, is considered. The break-even point is determined by analytical and graphical methods. One of the most problematic places is the use of only two mathematical methods when designing an enterprise. There are still many design problems that can be solved with the help of modern mathematical methods and information technologies, but these are tasks of the future.

The volume of paving slabs is received, not less than the level of demand, so as not to lose the potential income from the sale of products, and not more than the level of demand, otherwise the enterprise will incur losses mainly due to lower prices. This volume is 34 thousand m² per year. The optimal place is chosen for locating the enterprise according to the criteria: compliance of the land plot with 43.9%; the opportunity to recruit from the surrounding areas the necessary staff 43.7%; access to material resources and transport 42.3%. The safety zone is 44%. The breakeven point value corresponds to 53% of the possible sales volume of paving slabs, that is, the project is recognized as sustainable.

The introduction of the methodology will reduce the design of modern enterprises and new products. This is due to the fact that the proposed methodology is based on mathematical methods and information technologies. There are no analogues in the world.

Keywords: enterprise design, mathematical methods, one-type products, location of the enterprise, break-even point.

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INFLUENCE OF RESERVE OF CARRYING CAPACITY OF STOPPING POINTS ON THE TIME IDLE PARAMETERS OF PASSENGER TRANSPORT VEHICLES

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The object of research is the process of functioning of a stopping point within the transport-transfer station of urban public passenger transport. One of the most problematic places in the organization of the work of transport and transfer stations is the reduction of unproductive idle time of vehicles. The prerequisite for the occurrence of unproductive idle time is the simultaneous presence of vehicles at a stopping point in excess of its carrying capacity. A qualitative assessment of the level of organization of the stopping point of the transport and transfer station is carried out on the basis of calculating the correspondence coefficient between the actual idle time of vehicles and the duration of productive technological operations. The simulation of the functioning of the stopping point is used in the work. In combination with analytical calculations vehicle's idle time parameters it is possible to obtain patterns of change in compliance with the actual downtime ratio depending on the level of SP reserve capacity. It is established that the type of empirical dependence of the change in the correspondence coefficient of the actual idle time is logarithmic. The presented dependence differs from existing considering the stochastic changes in the parameters of

the incoming route flow. For the stopping point «Metro station Prospect Gagarina», Kharkiv, Ukraine (49.981225, 36.241933) it is determined that at the existing level of capacity:

- correspondence coefficient of the idle time is 0.879;
- average time of unproductive idle of one vehicle – 0.57 min;
- specific weight of non-productive idle time is 13.8 % of the total time of technological operations. The use of established regularities makes it possible to justify the number of service posts. Compared with existing scheduling methods this form determine the suitable number of positions based on the calculation parameters of routing incoming stream that enables efficient use of territorial space of transport-transfer stations.

Keywords: urban public passenger transport, transport and transfer station, stopping point, idle time.

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