ABSTRACT AND REFERENCES

CONTROL PROCESSES

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DESIGN OF THE SYSTEM TO CONTROL A VIBRATORY MACHINE FOR MIXING LOOSE MATERIALS (p. 4-13)

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Based on the analysis of special features in the implementation of process of mixing a loose material, we have proven a prospect of using vibratory machines. The application of vibratory machines for mixing loose materials makes it possible to increase performance efficiency of the machine, reduce its energy consumption and improve quality of the obtained mixture. Intensive oscillatory motion of controlling elements of the vibratory machine contributes to the creation of a circulating transportation of mixture in the processing zone and ensures destruction of coagulated structures of the treated material.

To ensure the highly-dynamic state during treatment of a material, regardless of the physical-mechanical properties of raw materials and the degree of its loading, we designed a system of control over operational parameters of the vibratory machine.

The designed system improves control systems based on the adapted vibration drive that may enable a change in the arrangement of its unbalanced masses during operation of the vibratory machine. However, the shortcoming of these systems is the assessment of amplitude-frequency characteristics of the machine only. In contrast, in the proposed system, the monitoring unit runs a comprehensive analysis of kinematic and speed characteristics of both the machine and the dynamic state of the treated material.

The proposed control system includes the unit for active analysis of the dynamic state of oscillatory system and the control unit over a drive mechanism of the vibratory machine. Functional interaction between specified units, depending on the type of a raw material, ensures independent adaptation of the vibratory machine to the technologically optimal parameters of its work.

By using designed control system, we obtained operational parameters for the kinematic and speed indicators of the vibratory machine for preparing a premix, which ensure high homogeneity of the resulting mixture at minimum energy consumption for its preparation. Specifically, at angular velocity of drive shaft ω=110–120 rad·s-1and oscillation amplitude A=2.0–2.2 mm, homogeneity of the resulting mixture of premix is 96–98 %. Total energy consumption for these indicators is equal to 1,250 W·h.

Keywords: effect of vibration on the process of mixing, loose material, control system, optimal operational parameters of vibratory machine.

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DEVELOPMENT OF AUTOMOTIVE COMPUTER SYSTEMS BASED ON THE VIRTUALIZATION OF TRANSPORTATION PROCESSES MANAGEMENT (p. 14-25)

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We proposed the concept of creating automotive computer systems based on the virtualization of transportation processes management. It was proven that the implementation of basic principles and rules of the virtual management of the enterprises of a transportation services market makes it posssible to improve efficiency of operation of transportation and road enterprises of Ukraine. A new approach is proposed to the creation of a unified informational space of the market of transportation services based on using cloud computing. A special feature of such a synergistic approach to the informational development of the market of transportation services is zero capital investment on their implementation and introduction to the transportation and traffic organizations. We investigated interactive monitoring of the chosen route. An artificial neural network for estimating a route is designed. A transportation information matrix is proposed to use a source of information about state of the routes of respective transfer, both of cargo and passengers, in contrast to conventional transportation processes.

Keywords: virtual management, transportation services, unified information space, synergetics, automobile computer systems, interactive monitoring, road transport portal.

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INTEGRATED APPROACH TO THE DEVELOPMENT OF THE EFFECTIVENESS FUNCTION OF QUALITY CONTROL OF METAL PRODUCTS (p. 16-34)

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The principle of development of the integrated effectiveness function of quality control of metal products is proposed. A characteristic feature of this function is that it combines different criteria, expressed through the coefficients of technological effectiveness, economic and legal capacity. Within this framework, the approach to formalization of the description, which can be used to search for optimum control of the metallurgical duplex process on the basis of the universal mathematical description of both process stages is proposed. This approach is very convenient, since it allows using the same mathematical model, but with different variables when searching for optimum control. The control of the induction duplex process, chosen on the basis of this mathematical description, allows maximizing the product quality, and, accordingly, the coefficient of technological effectiveness included in the description of the integrated effectiveness function of quality control of metal products.

It is shown that the greatest uncertainty is present in the assessment of the legal capacity associated with the possibilities of legal regulation as a mechanism of promotion of Ukrainian metal products to the European market. However, despite the difficulty of evaluating the coefficients included in the description of the integrated quality control effectiveness function, at the conceptual level it can be considered reasonable. In this case, this function can be considered as an analog of the risk function and used to select a control strategy based on the statistical game theory.

Keywords: induction duplex process, heat treatment, quality control of metal products, legal regulation, control effectiveness function.

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DEVELOPMENT OF THE DECISION MAKING SUPPORT SYSTEM TO CONTROL A PROCEDURE OF FINANCIAL INVESTMENT (p. 35-41)

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The model of continuous control of the procedure of mutual financial investment for the decision support system was proposed. The model makes it possible to optimize finding multi-variant strategies in mutual financial investment of projects. From the mathematical point of view, this model is based on solution of a bilinear differential quality game with multiple terminal surfaces. A specific feature of this game is that the right part of the system of differential equations is bilinear functions with arbitrary coefficients.

The model is implemented in the high-level language C++ in the software product “Decision support system for mutual investment – SSDMI”, which was tested in a number of investment projects. The model allows solving the problem of improvement of effectiveness of the procedure of mutual financial investment for participants at different ratios of interaction parameters. There can be found a condition, under which the procedure of mutual financial investments

becomes beneficial to all participants. Apparatus of the theory of differential games was proposed as a toolkit for development of an effective strategy for mutual financial investment. In the framework of this research, the process of interaction between an investor from one country and its counterparty from another country is explored. The selected approach enables us to identify the areas of possible initial states of resources (financial capitals) of interacting objects. The objects are supposed to have the following property: if interaction starts from these initial states, there can be a loss of financial capital either by one interacting party or the other at one of the moments of time.

Solution to the game lies in the identification of sets of preference of the parties and the strategies (control actions) of the parties, by applying which it is possible to obtain the outcomes, preferable for each side. Based on the findings, conclusions were made and recommendations were given to investors in terms of their subsequent actions with a view to obtaining the best possible outcome in terms of financial investment and a decrease in investment risks.

Keywords: decision support system, investing, financial capital, selection of strategy, game theory.

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DEVELOPMENT OF THE METHOD FOR DETERMINING OPTIMAL PARAMETERS OF THE PROCESS OF DISPLACEMENT OF TECHNOLOGICAL OBJECTS (p. 41-48)

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The optimization of technological processes is the only tool that can ensure maximization of financial resources of the owner of an enterprise. The most numerous class of managed systems is the systems of displacement.

It is believed that finding an optimum of the displacement process can be implemented using the methods of dynamic programming. However, in this case, the search process is carried out under the assumption that an increase in the displacement velocity has no effect on the magnitude of wear of the technological mechanism of a

displacement system. In this case, parameters of the acceleration and the established process of displacement are determined employing different criteria for the quality of control.

In contrast to the conventional approach, within the framework of present study, a two-stage operational displacement process is optimized based on a single criterion of the efficiency of resource use. However, the optimization model of a displacement process is essentially non-linear. Classical methods of searching for a global optimum under such conditions imply unnecessarily long work of technological equipment under non-optimal modes.

The idea of the method is to significantly narrow the region of a two-parametric search optimization using a one-parametric search for local extrema of the sub-processes of acceleration and uniform displacement and to maximally close approach the global optimum at its first step.

The research has shown that the narrowing of the region of a two-parametric search optimization of the process of displacement can be ensured through preliminary four-stage single-parametric search for local extrema for the sub-processes of acceleration and the process of uniform displacement. Within the range of the first and second stages of search for local minima of the sub-processes costs we determine initial conditions in the search for local maxima of the efficiency of displacement sub-processes. The coordinates of the found extrema enable determining a starting point of the search optimization and limit the search region.

The proposed method significantly reduces the dimensions of region of search optimization (by seven times in the considered example) and reduces the number of steps in the search optimization by an order of magnitude.

Therefore, the proposed practical method of searching for the optimal trajectory of control is robust in its essence.

Keywords: optimal trajectory, practical optimization method, two-stage optimization, search optimization.

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EVALUATION OF THE RAILWAY TRAFFIC SAFETY LEVEL USING THE ADDITIVE RESULTANT INDICATOR (p. 48-57)

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A comprehensive approach to determining the level of safety of train traffic on the objects of the railway infrastructure was proposed. This approach involves taking into account a wide range of factors of influence when determining the safety level. These factors include technical means, personnel management, production practice and investments to the traffic safety. Each factor is characterized by its indicators. The total number of indicators is twelve. They have different dimensionality. In this case, the problem of complex estimation is considered as a multicriteria optimization problem. Solution to this problem is proposed using an additive resultant indicator. It was proposed to introduce a term that determines quality of the safe operation of the sector dealing with transportation of goods and passengers: the level of safety of the transportation process at an infrastructure object. As a criterion for assessing the traffic safety, a resultant additive indicator was formed which determines the level of traffic safety of the train traffic at an infrastructure object. This indicator represents the sum of monotonically growing positive additive functions each of which has its weight (weight factor). The resultant indicator is dimensionless and does not exceed the value of 1. In determining the weight factors, the method of expert estimates is used.

The proposed method of assessment of traffic safety will provide analysis of the situation at the railway range at a higher quality level. It is possible to identify more dangerous infrastructure objects that affect the overall level of safety of the railway net. Application of this method will optimize allocation of resources to ensure traffic safety while adhering to its permissible level. The method can be used in the design of infrastructure projects to determine their level of safety in the process of transportation of goods and passengers.

Keywords: traffic safety, method of assessing the level of traffic safety, complex indicator.

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DEVELOPMENT OF THE SYSTEM FOR PREDICTION OF SECURITY STATE OF AN ENTERPRISE USING SEMANTIC–FRAME FUZZY MODELS OF KNOWLEDGE BASE (58-65)

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The system based on results of prediction of technical and technological potential was proposed; it provided clear current values of indicators of the enterprise's operation, properties and permissible restrictions of these properties. It was proved that the proposed system has a special purpose and consists of units of classes of indicators and the base of the facts of individual instances of classes, and can be used for the implementation of prediction problems in any industry.

As a result of modeling, it was found that introduction of the prediction unit into a system allows us more accurately and objectively to consider and evaluate a whole range of indicators of the enterprise's operation. The proposed prediction system calculated approximated prospective value of the indicator of the state of technical and technological potential of an enterprise in time, which greatly affects probability of bankruptcy of an enterprise. It is appropriate to use the prediction system for complex processes with fuzzy logic, when there is no simple mathematical model and expert knowledge can be formulated without fuzzy logic only in linguistic form. This proves that the proposed system can be used for prediction of all other potential of an enterprise that also influence probability of bankruptcy of an enterprise.

Keywords: semantics, frame, knowledge models, knowledge base, output machine, regressive dynamic models, prediction, security, potential, expert knowledge, taxonomy.

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A PROCEDURE FOR OPTIMIZATION OF ENERGY SAVING AT HIGHER EDUCATIONAL INSTITUTIONS (p. 65-75)

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A base of the methodology of optimization of an energy saving system in higher educational institutions of Ukraine is maintenance of a given level of thermal comfort. Its aim is the increase of HEI efficiency. The methodology of optimization of an energy saving system in higher educational establishments should be realized in two stages. At the first stage, we should carry out an energy audit of premises. The audit is a compilation of a balance of heat loss and heat supply of each HEI premise. At the second stage, we carry out optimization of energy saving and making managerial decision on loading of premises. We carry out optimization of energy saving by means of a model of optimal control of a thermal mode of premises with minimization of energy consumption for heating and energy loss.

The given methodology is substantiated and correct for estimation of potential efficiency of HEI premises and making up an energy-efficient plan for use of an auditorium during a heating period. We carried out a pilot testing of the energy saving system optimization project at Kyiv National University of Technology and Design. The testing confirmed a high level of its energy efficiency.

Keywords: heat supply, heat loss, ABC-XYZ-analysis, game theory, optimal mode of heat consumption, higher educational institutions.

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