ABSTRACT AND REFERENCES

INFORMATION TECHNOLOGY. INDUSTRY CONTROL SYSTEMS

DEVELOPMENT OF THE MODEL AND METHOD OF SELECTING THE DESCRIPTION OF RATIONAL ARCHITECTURE OF INFORMATION SYSTEM (p. 4-12)

Maksym Evlanov

The results of research of the model and method of selecting the description option of the rational architecture of the developed information system are considered. The method of synthesis of description options of the architecture of the developed IS based on the CLOPE algorithm is proposed. The following is developed:

a) formal descriptions of the functions of the Provider's and the Customer's objectives that maximize the degree of satisfaction of their functional requirements to IS;

b) the game-theoretic model of selecting the option of description of the rational architecture of the developed information system, which is a bimatrix noncooperative game of the IT service Provider and Customer;

c) the method of finding a solution to the game of the Provider and the Customer to select the option of description of the rational architecture of the developed information system based on pure strategies by finding the Nash equilibrium point, which is a sequence of actions aimed at finding the option of description of the architecture of the developed IS, which to the greatest extent meets the Provider's and the Customer's requirements.

The proposed solutions allow considering the process of designing the architecture of the developed IS as the decision-making problem of selecting the rational option of description of the architecture of the given system. The initial data for solving this problem are formal descriptions of the knowledge obtained from the descriptions of the system requirements. In the course of solving this problem, it is proposed to synthesize a set of descriptions of the architecture of the developed IS on the basis of formal descriptions of knowledge about individual requirements. Then, it is suggested to select an option in the set that to the greatest extent meets the expectations of the Provider and the Customer of the developed system. This approach to designing the architecture of the developed IS is unique in current research and existing requirements management systems.

The formal descriptions of the functions of the Provider's and the Customer's objectives, game-theoretic model and method allow automating the process of designing the architecture of the developed information system. This is achieved through the development of formal models and methods, describing the operations of forming the representations of IS requirements on the knowledge level, synthesis of a set of the architecture description options on the basis of the generated representations of requirements and selection of the description option of the rational architecture of the developed IS.

These methods allow transition from the synthesis of descriptions of the information system as a plurality of individual functional requirements to the synthesis of a unified description of the information system, taking into account the overlapping of individual functional requirements. This will improve the system-wide effect of the developed system through harmonizing the descriptions of individual functions of this system in the early stages of its life cycle.

The developed model and method, as well as information system development tools on their basis, allow unifying and simplifying the processes of pre-project survey and design of information systems. This, in turn, reduces the time and cost to implement IT projects of development and upgrading of information systems. In addition, the use of the developed methods allows adapting the Provider's previous solutions to the peculiarities of the Customer's new requirements.

Keywords: information system, functional requirements, design patterns, frame, interface, communication.

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KNOWLEDGE-ORIENTED DATABASE FORMATION FOR DETERMINATION OF COMPLEX METHOD FOR QUALITY IDENTIFICATION OF COMPOUND SYSTEMS (p. 13-21)

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Feasibility substantiation of resorting to the provisions of synergy and the theory of nonlinear processes of compound systems in modeling the system object behavior is considered. Any self-organizing system of social, ecological and economic content is open dissipative, which removes entropy growing in destructive phenomena in the interaction with the environment.

The use of the entropic approach to the analysis of complex objects allowed reviewing the structure of the analytical system and representing it as "0-state of the object – process – i-state of the object", the estimate of which is agreed due to the versatility of quantitative analysis based on the entropy function.

The proposed analytical system allows applying methodical approaches to solving complex problems for safety evaluation of different objects of the study.

Software for implementing the complex method for quality evaluation of compound systems is provided. The proposed software allows speeding up the solution of problems regarding the computation of the overall state of the object with the identification of risk factors using the considered method. The computer application with the user-friendly interface is made, which allows displaying results in an analytical form and in the form of graphs. This simplifies the perception of information regarding the research results obtained.

Keywords: decision making, quality identification, probabilistic entropy evaluation, information software, natural and man-made object.

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SYNTHESIS AND RESEARCH OF AUTOMATIC BALANCING SYSTEM OF VOLTAGE CONVERTER FED INDUCTION MOTOR CURRENTS (p. 22-34)

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Synthesis of methods for investigating unbalanced operating conditions of thyristor voltage converter fed induction motors is performed. The voltage unbalance factors of the power source are calculated, and the formation conditions are determined. Attention is paid to the harmonic analysis of the induction motor currents. The influence of power source voltage unbalance on the induction motor performance is determined on the basis of simulation and experiments. The results of power source unbalance – phase current unbalance, overload capacity reduction, oscillating nature of torque and speed, dynamics deterioration are outlined. The system of automatic balancing of the induction motor stator currents using the thyristor voltage converter is proposed. The synthesis of the elements of control channels and feedback channels of the balancing system, as well as operation principles, are examined. It is determined that balancing reduces the current unbalance factors by more than an order

of magnitude, and virtually ensures the equality of the active stator currents in the induction motor phases. The benefits and drawbacks of the automatic balancing system are presented, and recommendations on its application are given.

Keywords: induction motor, thyristor converter, electric drive, voltage unbalance, unbalance factor, automatic balancing system.

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A MATHEMATICAL DESCRIPTION OF THE SEPARATION OF GAS MIXTURES GENERATED BY THE THERMAL UTILIZATION OF WASTE (p. 35-41)

Sergij Vambol, Yurij Shakhov, Viola Vambol, Ilya Petukhov

The study focuses on the problems of the mathematical description of separating the flows of gas mixtures in the technological process of an environmentally-friendly utilization of waste. The devised mathematical calculation models use the conventional ratios of thermodynamics and the heat-and-mass exchange, including the Peng-Robinson equation of state (PR EOS) for describing the coefficients of thermal and physical properties of the working media. These models represent systems of equations that allow determining the temperatures of the coolant and the cooling air at the outlet of the heat exchanger with predetermined ratios of the mass of coolant and the air flow. In addition, the suggested equation systems allow determining the component composition of the product that is a part of the rectifying column and its output final products. The calculation shows that the rectifying column generates two flows of a gas mixture. The first flow is a gas mixture with a methane content of 89.2 % and, therefore, is a valuable motor fuel for vehicles or a fuel for household purpose. The second flow of the gas mixture, given its high hydrogen content (about 34.0 %), may be used as a source of energy for maintaining the gasification of waste during its utilization. The preparation of such energy sources makes the waste utilization process cost-effective.

Establishing links between the functional elements that are used in a power technology plant allows devising a system of equations for the entire plant. The subject of further research is the mathematical description of the entire system and the selection of an acceptable option of the PTP arrangement that would facilitate its practical implementation.

Keywords: utilization, waste, environmental safety, multi-component gas mixtures, low-temperature separation, source of energy.

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MODELING OF TRACTION ELECTRIC DRIVE WITH DC SERIES MOTORS (p. 42-48)

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Analysis of existing models of the Weber-ampere characteristic of the DC motor is performed. It showed that the use of the universal magnetization curve is not always correct, since traction DC motors have local features of design and magnetic system. It is proposed to define the value of the flux KF as a function of the magnetomotive force of the currents of the series field winding I_{SFW} and the anchor winding I_A. The model of the Weber-ampere characteristic of the DC motor is developed. It takes into account the actual values of the currents of the anchor winding and series field winding, which enhances the computation accuracy in the field reduction modes. The structure of the automatic control system of the traction electric drive using the functional converter to determine the field reduction factor based on the above model is proposed.

Keywords: mathematical modeling, traction electric drive, DC-DC converter, DC motor, urban electric transport, Weber- ampere characteristic, power IGBT transistors.

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DESIGN OF ROBUST CONTROLLERS FOR PLANTS WITH LARGE DEAD TIME (p. 48-56)

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The robust control system design problem for plants with large dead time is analyzed. Such plants are distributed in industry. The plants are hard controlled because controllers use past state of the plant output. The control quality analysis is provided with the help of direct, integral and frequency performance indexes. The analysis results show that the best design method is SIMC for PI-controller among classic controllers. Some better result gives PIDF design of the modified PID-controller with aperiodic filter, and frequency Matlab design of PI controller using the Smith predictor modified by Huang. The design of special model predictive controllers is not efficient for the plants with large dead time.

Keywords: proportional, integral, differential, controller, predictor, model, predictive, robust, hard controlled, dead time.

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DETERMINATION OF THE CLASS OF DYNAMIC MODELS OF TARGET OPERATIONS (p. 57-63)

Igor Lutsenko, Elena Fomovskaya, Olga Serdiuk

Existing classes of models of operations are limited to the class of accounting models. As a basis for the research, a simple model of the target operation was used. Expert estimates of input products of the operation are reduced in this model to the start time, and expert estimates of output products of the operation – to the time of its completion.

The well-known class of operations provides the possibility of compact storage of information in a database and identification of these operations. However, as the experience of the studies showed, these models could not be used to develop the efficiency indicator. To overcome this restriction, the class of dynamic models of target operations was identified. The class of models of system operations, in which the input and output of the operation products are reduced to comparable measures, and the dynamics of the bound state of product operations is determined on the whole range of research, is defined in the paper as the class of dynamic models of target operations.

The results of research of test operations using the comprehensive profitability indicator, which was obtained using the features of the dynamic model have shown that such indicator can solve the problems of identification in the area, formerly the part of the area of restrictions for conventional economic indicators.

Keywords: classification of operations; accounting model of target operation, dynamic model of target operation, efficiency of operation.

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