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ADAPTATION OF FLEXIBLE PROJECT MANAGEMENT MODELS BASED ON SCRUM AND KANBAN TECHNOLOGIES

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This paper shows the conduct and result of an experiment regarding combining two software development technologies – Scrum and Kanban – into one technology that will take the best sides of these methodologies and will be convenient and efficient to use. Scrum and Kanban development methodologies are the object of study. Existing flexible development methodologies are analyzed, including XP, Lean, FDD, as well as Scrum and Kanban in more detail. A comparative table of the last two methodologies is also drawn up, reflecting their differences in a number of criteria. These methodologies are found to have some drawbacks and could be removed in the new methodology, thus improving existing methodologies for specific purposes. The new methodology should be fairly flexible and adaptable for all members of the software development team. This methodology should be easy to use and have some set of rules. An experiment is conducted to demonstrate how to combine the methodology with maximum efficiency using Petri nets. First, the Scrum and Kanban methodologies were modeled. Then, based on these two models, as well as the new rules, a new model for the methodology was formed. After conducting the experiment, the model reveals what the proposed development methodology should look like. It can be used in software development. Creating this methodology on the basis of two existing ones is a very challenging task today, as it has 3 tasks – to improve the existing methodologies of Scrum and Kanban, to create a set of rules for the new methodology, and to make it as flexible, adaptive and useful as possible.

Keywords: software development methodology, Agile methodology, Scrum and Kanban methodologies, Petri net.

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ANALYSIS OF PROBLEMS OF FORECASTING OF FINANCIAL INSTRUMENTS IN STOCK MARKETS

page 10–15

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The object of the research is the forecasting processes of financial instruments in stock markets in the face of uncertainty. A high degree of uncertainty in the stock markets significantly complicates the process of forecasting the dynamics of financial instruments. This problem matters both for states and for investment companies. As well as for other market participants who need to make long-term investment decisions based on preventive measures to reduce the impact of the risks of financial crises on their activities. In this paper, the authors analyze a number of prognostic models used in the field of numerical series calculations. In the context of forecasting prices on stock markets, the strengths and weaknesses of popular models in practice are identified. Their mathematical functions are presented, calculation algorithms are explained, and author's conclusions are given on the degree of effectiveness of the application of individual models in the field of financial instruments.

In the course of the study, the authors studied a number of different scientific works on this problem and analyzed the obtained information. The result of the analysis shows that decision-making processes in forecasting changes in financial instruments will be complicated by the presence of external factors, but also these external factors are the result of the activities of individual market participants. This is due to the fact that when forecasting financial instruments in the stock markets, pseudo-random environmental events can be leveled. Many existing forecasting solutions allow low accuracy in forecasting modeling, so it is more rational to use multi-agent technologies. Thanks to them, greater accuracy of indicators is ensured, in comparison with similar methods, such as econometric models (the most famous of which are: ARCH, GARCH, VAR).

The research results obtained in this work can be used to predict financial crises, as well as to develop methods to counter them.

Keywords: forecasting models, stock market, Markov chain, long-term investment decisions, multi-agent technologies.

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SYSTEMS AND CONTROL PROCESSES

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CONTROL SYNTHESIS FOR 4WS VEHICLE-ROBOT MODEL FOR TRAFFIC PROGRAM MOTION

page 16–23

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The object of research is an autonomous wheeled mobile robot model 4WS (Four Wheel Steering). The need for such studies is dictated by the limitations of using 2WS (Two Wheel Steering) robots to solve the problem of achieving multiple goals associated with insufficient maneuverability and traffic safety. This is one of the most problematic places of this model.

Such a task was successfully solved to achieve a single goal with this model, including reverse movements for an articulated crew, but the nature of the trajectory with multiple goals makes such a task practically unsolvable. To solve it, the design of the autonomous mobile robot DDMR model was successfully applied. The advantages of the 4WS model compared to the 2WS in terms of increasing maneuverability have led to the study of the possibility of using it to solve this problem.

In this study, the possibility of synthesizing the controlled movement of an autonomous mobile robot of the 4WS model along a program path specified in an explicit, implicit, parametric form or by the law of change in its curvature is realized. In this case, the angle of rotation of the front wheels is a function of the curvature of the program path, and the rear wheels are a function of the angle of rotation of the front. A feature of synthesized control for the 4WS model is the connection with control for the 2WS model.

Control for this model is synthesized initially and is an independent value. Such a reference control: the empirical dependence determines the virtual radius for which such a control is calculated for the 4WS model so that it moves along the path of the 2WS model. The rotation of the rear wheels (in phase with the front or out of phase) is considered in this case as an additional control.

An important feature of the study was the development of software that made it possible to perform numerical modeling of the synthesized control in the Maple mathematical package and visualization of maneuvers of movement in the Unity 3D system.

The results of numerical modeling and their visualization allow to conclude that it is possible to use the synthesized law to control autonomous mobile robots created using the 4WS model.

Keywords: autonomous mobile wheeled robot, 4WS, 2WS, Ackerman condition, control law, mechatronic system, lateral sliding angle, yaw angle.

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REPORTS ON RESEARCH PROJECTS

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DEVELOPMENT OF A SYSTEM MODEL FOR THE FUNCTIONING OF DISTRIBUTION ELECTRICAL SUPPLY SYSTEMS IN TRANSPORT INFRASTRUCTURE PROJECTS

page 24–28

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The object of research is the power supply system of railway transport, which is part of a unified system and belongs to the class of geographically distributed electrical facilities. The main component of the system are electric networks, which represent a key technological chain of the transport process, provide it with energy, make up a significant part of the costs, connect geographically distributed objects and therefore represent one of the technological foundations for the integration of transport control. This significantly affects the efficiency of all links of the railway transport, which is especially important from the point of view of the corporate interests of the industry.

In the course of the study, a systematic approach, system analysis methods, approaches to optimal production management with the support of the technological process of current repair and maintenance of electricity distribution systems were used. As well as ways of organizing a single information space of primary information that reflects the state of the power supply system. An information model of the control system for the processes of ongoing maintenance and repair is obtained, which will improve the efficiency of the control system already at the initial stages of their design. This is due to the fact that the proposed model has a number of features of the functioning and organization of repair work. In particular, the planning of the work of power distribution systems, operation, taking into account the optimization of repair work, management decisions, the interaction of the structural units of the power supply service based on set of problems Z_{jk}.

Thanks to this, it is possible to obtain information about individual processes of organizing the planning of the current maintenance and repair of the distribution system of power supply of structural units of the service. Compared with similar ones, this provides such advantages as the ability to register, transmit and process information in the power supply control mode. As well as the ability to implement periodic and occasional control and assessment of the reliability of the system, software and hardware and information, quick system analysis of various situations, the ability to form the most effective management decisions.

Keywords: systematic approach, distribution power supply system, transport process management, management decisions.

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DEVELOPMENT OF A DIFFERENTIAL BLOCK CODING METHOD FOR APPLICATION IN MOBILE RADIO COMMUNICATION SYSTEMS USING MIMO SYSTEMS

page 28–33

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The object of this research is the methods and algorithms of space-time block coding, which are also used in multi-antenna radio communication systems (Multiple Input Multiple Output – MIMO). The implementation of MIMO systems for coherent reception or precoding of data implies knowledge of information about the state of the communication channel and, accordingly, compensation for its impact. For channel estimation, together with information signals, pilot signals are transmitted, previously known at the receiving side. The frequency of sending these signals depends on factors that change the state of the communication channel, for example, one of which is the high speed of movement of mobile stations. But since the pilot signals do not carry user information, the resource of the system is consumed, which impedes the efficient use of the radio frequency spectrum.

In the course of the study, a method was considered that admits the absence of the need for knowledge of the state of the communication channel – relative phase modulation, which was taken as a basis and distributed for use in MIMO systems. This method provides for incoherent reception, but, despite this, its use is fully justified, based on the results of the study. Effective tree coding and an algorithm for compensating the noise components of the received signal were also developed and integrated into the system. This, accordingly, allows to optimize the computational power of the system implementation and to approximate the proposed method of differential space-time block coding (DSTBC) to the methods of coherent reception.

Using the MATLAB software package, the proposed DSTBC method is simulated for various options for the number of transmitting and receiving antennas and types of modulation. A comparison is made and the advantages of the DSTBC method are determined. The described method can find application in modern radio communication systems with rapidly changing communication channel parameters due to the high speed of movement of mobile stations.

Keywords: relative phase modulation, complex orthogonal form, coherent reception, space-time coding, MIMO system, tree coding.

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PROGNOSIS OF HYDROCARBON RECOVERY COEFFICIENTS OF OFFSHORE GAS AND GAS-CONDENSATE FIELDS

page 34–37

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One of the main and important sections of the offshore gas and gas condensate field's development project is the forecast of hydrocarbon recovery coefficient. The most accurate forecast of the hydrocarbon recovery factor of offshore gas and gas condensate deposits is of particular importance for the quality management of their development processes through the timely establishment and implementation of the necessary priority measures. In view of this, the object of research is prediction of hydrocarbon recovery of offshore gas and gas condensate deposits at different stages of their development. The task of selection of models of prediction of coefficients of current and final gas and condensate recovery of sea gas and gas condensate deposits is investigated by creation of special models of their determination for different periods before watering. It is noted that for long-term gas and gas condensate fields, the use of evolutionary models is more efficient and efficient for accurate forecasting of recoverable gas reserves at certain stages of development. Evolutionary models were constructed in two stages – preliminary analysis stage (training interval) and prediction stage (examination interval). As a result of the research, reliable models are proposed for forecasting the coefficients of current and final gas and condensate recovery of offshore gas and gas condensate deposits by different stages of development. A distinctive feature of this definition of hydrocarbon recovery field coefficient prediction models is the use of balance and recoverable deposit reserves data for different stages of development. The study used geological and field data on the VII horizon of the Sangachal-Sea-Duvanna-Sea-Hara-Zira field (Azerbaijan). On the basis of selected mathematical models, coefficients of current and final hydrocarbon recovery can be determined at different stages and efficiency of the process of development of deposits can be estimated. The obtained results will create opportunities to control the development strategy of the deposit and to select the optimal method of determining geological and technical measures used to increase the coefficient of final hydrocarbon recovery.

Keywords: hydrocarbon recovery factor, gas and gas-condensate field, exploration data, field development efficiency.

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INVESTIGATION OF ONE LINEAR NON-SMOOTH TWO-PARAMETER DISCRETE OPTIMAL CONTROL PROBLEM

page 38–41

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The object of research is the linear optimal control problem described by discrete two-parameter systems under the assumption that the controlled process is stepwise.

The work is aimed at deriving the necessary first-order optimality conditions in the case of a non-smooth quality function. And also to establish the necessary conditions of second-order optimality in stepwise control problems for discrete two-parameter systems. The paper investigates one linear two-parameter discrete optimal control problem with a non-smooth quality criterion. A special increment of the quality functional is calculated. Cases under the condition of a convex set are considered. The concept of special control in the problem under study is given. A number of necessary optimality conditions for the first and second orders are established. And also the necessary second-order optimality conditions are obtained in terms of directional derivatives. In the case of a linear quality criterion, the necessary and sufficient optimality condition is proved using the increment formula by analogous arguments. Under the assumption that the set is convex, a special increment of the quality criterion for admissible control is defined.

The methods of calculus of variations and optimal control, the theory of difference equations are used. The result is obtained for the optimality of a special, first-order control, in the case of convexity of the set. The case when the minimized functional is linear is considered. In this case, a necessary and sufficient condition is obtained for the optimality of the admissible control.

Thanks to the research results, it is possible to obtain the necessary first-order optimality conditions in terms of directional derivatives in the stepwise problem of optimal control of discrete two-parameter systems. As well as the necessary conditions of optimality of the second order in the case of convexity of the control domain and the necessary optimality conditions of special controls.

The theoretical results obtained in the work are of interest in the theory of optimal control of step systems and can be used in the further development of the theory of necessary optimality conditions for step control problems.

Keywords: optimal control problem for discrete systems, necessary optimality condition, special control, non-smooth functional.

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