ABSTRACT AND REFERENCES

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DEVISING A METHOD FOR MAINTAINING MANAGEABILITY AT MULTIDIMENSIONAL AUTOMATED CONTROL OF TETHERED UNDERWATER VEHICLE (p. 4-16)

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Automated control of spatial motion of remotely operated underwater vehicle (ROV) is a known scientific problem since as an object of control it is essentially nonlinear. Operational control of ROV is a multi-dimensional problem. The synthesis of regulators separately for each degree of freedom is complicated by mutual influence of kinematic parameters of ROV. Nonlinearity of the "restrictions" type, typical for ROV, leads to the occurrence of "strong" and "weak" degrees of freedom. This degrades the quality of automated control system (SAC) as a whole.

We obtained a matrix notation of the basic law of dynamics of marine movable object as a solid body. Own and added masses and moments of inertia of the body and the fluid are brought into a separate matrix. This makes it possible to apply the resulting equation without structural changes to study the dynamics of spatial motion of ROV with different parameters. The equation is used in direct form to model the motion of ROV and in the inverse form for the synthesis of SAC over its spatial motion.

An inverse regulator (IR) of ROV with six degrees of freedom is synthesized based on the method of inverse dynamics and decomposition of the reference model. We simulated the work of inverse controller IR of ROV and demonstrated a loss of manageability by the weak rotating degrees of freedom. The fundamentals of the method for maintaining manageability with automated control of a multidimensional object are formulated. The essence of the method is in driving the contours of SAC out of the modes of saturation by scaling control errors.

We designed SAC of spatial motion of ROV based on the synthesized IR and the unit for maintaining manageability. It provides controlled motion of ROV by six degrees of freedom without losing manageability.

A simulation of the developed SAC of spatial motion of ROV is performed. The simulation results revealed that the unit for maintaining manageability provides for the operation of SAC on the verge of saturation of its contours. This enables the ROV motion by six degrees of freedom without losing manageability.

Keywords: multi-dimensional automated control, method for maintaining manageability, remotely operated underwater vehicle.

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DEVISING A METHOD FOR THE ACTIVE COORDINATION OF VIDEO CAMERAS IN OPTICAL NAVIGATION BASED ON THE MULTI-AGENT APPROACH (p. 17-25)

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Here we present results of research into multi-agent approach to solving the problem of constructing a wireless Ad Hoc network to transmit video stream during optical navigation. When obtaining data from video cameras in real time, there is a problem of realization of effective coordination of video data. To improve the algorithms of capturing an object, it is necessary to get better the architecture of devices that utilize network metadata for the analysis of scenes from video surveillance. As a result of exploring the ways of solving the specified problems, we proposed a method for active coordination of video cameras based on the multi-agent approach (MAC-on-MAA). The application of this method increases efficiency of network cameras through their reconfiguration.

We examined the problem of determining an adequate level of illuminance normalization of a video frame based on analysis of the modules throughput of multi-agent system for encoding transmitted video data. It was revealed that the time of analysis of video stream from a network decreases when ignoring the decoding of certain domains of graphic elements in the received video frames.

The devised MAC-on-MAA method allows effective updating of routing tables in the reactive protocol AODV. We obtained analytic expressions for the assessment of quantitative characteristics of energy consumption by mobile agents. Protection of communication channels of video surveillance network is improved through the integration of steganocontainers in the free bits of RGB characteristics of video frames pixels.

Keywords: Ad Hoc, multi-agent system, video stream analysis, steganocontainer, reduction in power consumption by unmanned vehicles.

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DEVELOPMENT OF SPECIALIZED MODELING COMPLEX TO STUDY CONTROL SYSTEMS OF MOVABLE MARITIME OBJECTS (p. 26-33)

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We designed, created, and tested a specialized modeling complex for examining and assessment of effectiveness of control systems for electric drives of direct and alternating current, which includes software and electromechanical parts. The latter is a metrologically certified training-research set-up "Testing Stand SV-1", that allows conducting experimental studies with required accuracy. We presented characteristics and capabilites of electromechanical part of the modeling complex. The possibility is demonstrated to synthesize control systems for a propulsion device with barounloaded induction motor at rectilinear motion of underwater vehicle with different types of regulators and their subsequent correction by means of the specialized modeling complex.

Experimental studies conducted on the specialized modeling complex of control system confirmed effectiveness of the received laws of control during motion of underwater vehicle under arbitrary law of change in its horizontal rectilinear speed, the discrepancy between results of computer simulation and experimental research is 5–8 %. The results we obtained are implemented in teaching process, and are used to solve relevant scientific, research and military tasks.

Keywords: controller, propulsion device, underwater vehicle, specialized modeling complex, control accuracy.

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STRUCTURAL-PARAMETRICAL SYNTHESIS OF ELECTRONIC CONTROL UNIT OF FUEL FEEDING SYSTEM OF VEHICLE DIESEL ENGINE (p. 34-44)

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We draw a conclusion that in the fuel feed system of the transport diesel engine, it is expedient to use a two-channel electronic control unit. The selection of appropriate channel of the electronic control unit is done by the driver depending on road conditions. This scheme of electronic unit makes it possible to minimize both dynamic errors, which appear during motion of vehicle in the rough terrain, when there is a significant change in load within a short time interval, and the static errors, which appear when moving along the routes with high-quality road surface, but with lengthy ascends and descents.

The proposed fuel feed system is in a certain sense universal. The channel, providing high dynamic accuracy of fuel feed control, contains ae sensor of angular velocity of crankshaft rotation of the diesel engine, and the sensors of position of fuel pump lath and the pedal of fuel feed control, the outputs of which are connected to inputs of the electronic unit, which implements a linear combination of the input signals of sensors. The channel that provides for invariance of the fuel feed system to the action of external disturbances realizes a control algorithm, which uses, in addition to the output signals of the above-indicated sensors, information about the displacement velocity of the fuel pump lath of the diesel engine. High accuracy and interference protection of the closed fuel feed system may be achieved by using a digital electronic control unit with the implementation of digital Butterworth and Lanczos low-frequency filters.

Keywords: transport diesel engine, all-mode fuel feed regulator, electronic unit, invariance of fuel feed system.

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ESTIMATION OF HEAT FIELD AND TEMPERATURE MODELS OF ERRORS IN FIBER-OPTIC GYROSCOPES USED IN AEROSPACE SYSTEMS (p. 44-53)

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Numerical-analytical models of the nonstationary thermal process and the associated with it measurement errors were designed and investigated for fiber-optic gyroscopes (FOG). The models were used for simulating output data of the measuring gyroscopic module (MGM) consisting of a FOG of the studied type at arbitrarily assigned operation temperature conditions. Numerical simulation of nonstationary thermal fields in the instruments at an arbitrarily varying ambient temperature was carried out. Taking into account the temperature values, magnitude of the instrumental measurement errors characteristic of the studied FOG type is predicted. Further, these errors are taken into account when simulating output of the MGM having characteristics similar to the characteristics of the real instrument. To confirm the thermal model veracity, comparison of the numerical modeling results with experimental data was made. Adequacy of the models of instrumental errors for the studied FOG type is ensured by the instrument pre-calibration. A procedure for calibrating models of MGM errors notable for the possibility of joint identification of all IEs using one redundant volume of measurements has been developed. Further evolvement of this procedure will enable refinement of configuration and layout of temperature sensors in the MGM in order to improve quality of the measurement error compensation in the subsequent operation of the instrument and improve the layout of the MGM electronic and structural components in terms of reducing influence of the perturbing thermal factors.

Keywords: gyroscope, finite element model, nonstationary thermal conductivity, instrumental errors, temperature model, calibration.

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SELECTING A MODEL OF UNMANNED AERIAL VEHICLE TO ACCEPT IT FOR MILITARY PURPOSES WITH REGARD TO EXPERT DATA (p. 53-60)

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The issue of equipping Armed Forces with modern unmanned aerial vehicles and accepting them into service remains unresolved. At present, the needs of Armed Forces of Ukraine in unmanned aerial vehicles have not been clearly identified, as well as the approaches regarding the choice of particular models. Present article proposes to select a model of armament based on the set of basic indicators (criteria) that may have quantitative and qualitative nature. We substantiate the necessity to predict the values of indicators under conditions of nonstochastic uncertainty. It is noted that should the research utilize statistics, then the task of predicting the given characteristics could be solved under conditions of stochastic uncertainty. In this case, it is necessary to take into account the assumption that the set of factors, which defined statistical significance of TTC, remains unchanged over the predicted time period. Under such assumption, long-term prediction of the TTC values cannot be considered satisfactory. It is obvious that the prediction of TTC values of UAV samples is considered under conditions of nonstochastic uncertainty based on the setting of appraisal and processing expert data. We proposed a decomposition of problem into hierarchy that reflects the content of multi-criteria optimization problem, in this case, it is characterized by a fuzzy description of the predicted values of basic UAV TTC, which have distinctly expressed quantitative and qualitative nature and are measured in appropriate magnitudes. An appraisal was performed to determine the predicted values of each characteristics of UAV. When processing expert data, values for each of the quantitative characteristics are represented by a fuzzy triangular number.

Regarding the indicators of qualitative nature, we examined relevant linguistic variables. According to the method of hierarchy analysis, we carried out a comparative assessment of the indicators' significance. In order to obtain generalized indicators for the priority UAV model, the principle of synthesis is proposed.

Keywords: unmanned aerial vehicle, decomposition of problem into hierarchy, linguistic variable.

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