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Avdeev B.A.

APPLICATIONS OF NEURAL NETWORKS TO DETERMINE THE POWER OF A SHIP POWER PLANT

Abstract. The article discusses the use of neural networks to predict the number and power of synchronous generators on ships. The most common methods of determining the power of a ship's power plant are described, such as probabilistic, static modeling, tabular and analytical. Their advantages and disadvantages of each method are shown. Despite the fact that the development of a digital double gives the best results, the most common method is tabular, which is relatively accurate and less time-consuming, but it strongly depends on the qualifications of the designer. It is proved with the use of examples that the use of neural networks can predict the power of both a ship's power plant and a ship's power plant with a high degree of accuracy and with the highest ratio of reliability and efficiency. Examples of successful application of neural networks for these purposes are given. The description and operation of the software package for calculating the capacity of the electric power system of container ships is given. Further ways of development of neural networks in order to determine the power of a ship's power plant are considered.
Keywords: ship power plant, synchronous generator, emergency generator, neural networks, MSB, ASB

A.S. Bordyug

APPLICATION OF STATIC SOURCES OF REACTIVE POWER AND SUPERCONDUCTING INDUCTIVE STORAGE IN THE SHIP'S ELECTRICAL POWER SYSTEM

Abstract. To improve the reliability and quality of electricity in shipboard modern power plants with synchronous generators, controlled static reactive power compensators are used, which, in addition to providing the required balance of reactive powers and maintaining the voltage level, under certain conditions, can also dampen vibrations of machines. In addition, the paper considers the possibility of using an electromagnetic storage device paired with a static reactive power compensator. Considering that an electromagnetic storage device always consumes reactive power during normal regulation, which changes along with active power, and both components, sometimes with different signs, affect the movement of generators, such regulation may not give the desired effect. The paper shows methods for solving this problem. An electromagnetic storage device is much more effective here, providing both voltage level maintenance and damping. The installation of an electromagnetic storage device with a developed reactive part on weak branches between systems can make it possible to partially eliminate irregular power fluctuations between systems and increase the transmission capacity due to short-term voltage increases for the period of the greatest power excesses. Electromagnetic accumulators are capable of increasing the limits to dynamic stability, but at the same time it is necessary to increase the power of the converters and provide the opportunity not only to consume, but also to produce reactive power.
Keywords: Electromagnetic storage, ship power plant, static reactive power compensator, load, stability.

Keller M.V., Savenko A.E.

ASSESSMENT, MONITORING AND SAFETY DURING THERMAL HEATING FOR LITHIUM-ION BATTERIES

Abstract. Due to its long service life, lithium-ion batteries have found wide application in various spheres of human life, various devices, electric vehicles and on ships. But, there are

safety issues with lithium-ion batteries that need to be highlighted. More and more attention is being paid to the safety of lithium-ion batteries, because such incidents as fires and explosions initiated by thermal overheating have led to significant losses and loss of life. Thermal overheating may occur if lithium-ion batteries experience problems like electrical and thermal abuse. It is noted that the separator is critical to the energy density, power density, service life and safety of the battery. New alternative smart separator materials, failure detection methods, and other advanced technologies are being developed to address the current problem of mechanical and thermal separator failure and improve battery safety. A key direction for future research is to find a cathode battery that is more heat-resistant and better able to prevent the growth of lithium dendrites.
Keywords: lithium-ion batteries, thermal overheating, monitoring, protection, cathode battery.

I.L. Titov

STUDY OF THE PASSAGE OF THE MAGNETIC FLUX FROM THE STATOR TEETH TO THE ROTOR RINGS IN AN ALTERNATING CURRENT GENERATOR (AGA)

Abstract. In this article, we consider the passage of a magnetic flux following from the teeth of the stator to the rotor rings, where this magnetic flux gradually spreads over the entire width of the rings. We will study this phenomenon using formal calculus. It will be determined that the ring expands relative to its mean radius to have Cartesian geometry for analysis. Also in this article we will analyze the development of magnetic induction. The purpose of this analysis is to evaluate the effect of the length of the region on the magnitude. A simulation will be performed, with the help of which we will be able to determine four zones in the model: the first three of them will represent various changes in the cross-section of the ring, and the fourth will represent an auxiliary air gap.
Keywords: magnetic flux, formal calculus, rotor ring, ring cross section.

Bogatyreva E.V.

ASSESSMENT OF THE POSSIBILITY OF USING MARKOV PROCESSES IN MATHEMATICAL MODELING OF SHIP MAINTENANCE BASES

Abstract. The condition of the maintenance bases, regardless of the purpose, structure and production capacity, is characterized by the number of technical means located on them (serviced and awaiting maintenance) and the degree of readiness of work to restore them. The arrival of new and leaving of fully serviced technical means from bases, their sequential movement along the technological line from one maintenance site to another leads to a change in the state of the bases. Therefore, theoretically, service bases are multidimensional systems with a finite or unlimited set of states. For their mathematical modeling, one can use the theory of Markov processes discrete and continuous in time. The article considers the initial provisions of this theory, assesses the possibility of its use for ship maintenance bases.
Keywords: maintenance base, restoration of technical means, mathematical modeling, Markov processes, probability.

Ivanovskaya A.

FEATURES OF KINEMATIC ANALYSIS IN MODELING THE MECHANICAL PART OF THE SHIP'S WINCH DRIVE

Abstract. The paper considers another principle of modeling the drive of a ship's lifting device. The peculiarity of the operation of such a drive is movement in different environments: air, water and at their interface. Also, the dynamic processes arising in the system are significantly influenced by external hydrometeorological factors and unsteadiness of loading. All this leads to difficulties

in predicting the behavior of system elements. Therefore, it is proposed to consider the drive as a multibody system consisting of interconnected solid and deformable bodies experiencing various translational and rotational displacements. The paper considers the principle of performing kinematic analysis. The resulting kinematic constraints can be introduced into a dynamic formulation using a set of nonlinear algebraic equations that depend on a system of generalized coordinates and time. The presented vector form of kinematic constraints can be used to formalize the dynamics of drive elements, which is relevant in the development of an automated drive control system for ship lifting devices.
Keywords: lifting device drive, multibody system, kinematic analysis, movable coordinate system

Sharatov A.S.

COMPARISON OF RESULTS OF SEA TRIALS OF TANKERS EQUIPPED WITH MAN B&W LOW-SPEED MAIN ENGINE

Abstract. Ensuring the profitability of sea transportation will require increasing the cargo capacity of transport ships. The design of ships with significant coefficients of the overall completeness of the hull significantly affects the amount of power consumed to ensure the design speed. The paper defines the indicators of the propeller power curve and the resistance of the ship, obtained on the basis of the results of trial tests of typical large-tonnage ships. Based on the data obtained, the violation of the self-similarity between the speed of the ship and the rotation frequency of the main engine is justified. Based on the obtained approximating dependencies, an adjustment of the mathematical description of the operating points of the main low-speed engine to the fixed-pitch propeller is proposed. The results obtained make it possible to increase the reliability of mathematical modeling and computational study of the modes of operation of the vessel's propulsion system in changing operating conditions.
Keywords: main low-speed engine, rotation frequency, speed, running characteristic, propeller power curve.

Aleksei N. Ivanovskii

REMOTE TRANSMISSION OF MAGNETIC COMPASS READINGS USING COMPUTER VISION ALGORITHMS

Abstract. Due to the widespread use of gyrocompasses, in practice the magnetic compass is used solely as a reserve instrument. Also, despite the requirements of SOLAS to carry out regular monitoring of deviation, often measurements are falsified, which in the event of an emergency may leave the ship without course indicator. In order to ensure continuous monitoring of the magnetic compass state, it is proposed a method for the remote transmission of magnetic compass readings into the ship’s navigation and information system based on computer vision and machine learning algorithms. The proposed method can be largely standardized and used on different types of vessels. The installation of a digital camera on the optical compass system avoids the occurrence of additional deviation. Unlike the electronic transmission system, the proposed device can be portable and does not require wiring or interference with the vessel’s structure. The method makes it possible to automatically account for the magnetic declination and deviation of the vessel in real time.
Keywords: magnetic compass, data transmission, repeater, computer vision, navigation, safety of navigation.

Riazanova T.V.

ANALYSIS OF THE POWER COMPATIBILITY OF A FISHING VESSEL AND A FISHING TRAWL

Abstract. The problems of the technical condition of the fishing fleet are considered. Along with the commissioning of new fishing vessels, trawlers whose age exceeds thirty years are actively being operated. Trawlers, for such a long period of operation, lose the ability to provide the necessary traction force due to an increase in the resistance of the vessel's hull and wear of the engine and propulsion complex. On the example of a freezing trawler of the "Eaglet" type, 333 Atlantic Ave., the possibility of an operational assessment of the vessel's traction characteristics is illustrated. A fishing trawl, as a complex technical structure, has mutually influencing characteristics, the most significant of them, including the dependence of the aggregate resistance of the trawl system on the speed of the vessel and other factors, are a system of equations called a trawl passport. Numerical examples of calculating the hydrodynamic drag of a fishing trawl and the actual thrust of the vessel at various speeds and loads of the main engine are given, allowing to assess the ability of a fishing vessel to optimally conduct fishing.
Keywords. Actual thrust, thrust losses, trawl passport, hydrodynamic resistance

Sviatskii V.V.

CONTENT MODEL OF THE TASK OF ENSURING NAVIGATIONAL SAFETY ON SEA ROUTES

Abstract. This paper investigates the problems of ensuring the safety of diverging from vessels that may pose a potential danger. The study considers a meaningful model developed to solve problems related to collision hazard assessment and selection of an optimal manoeuvre. The main result of this study is the creation of a catalogue of convergence scenarios and manoeuvre options to avoid collision. This catalogue can serve as a basis for the development of formalised models to automatically select optimal manoeuvres or to propose solutions for decision support. The considered principles and algorithms allow to synthesise the structure of manoeuvring control system for different sailing conditions, classes of solved problems and to create conditions for guaranteed safety of navigation.
Keywords: collision avoidance, safe manoeuvring, navigation safety

Tishchenko M.S. Ivanovskii N.V

APPLICATION OF THE EXTREME MODEL OF CONVEX PROGRAMMING TO SOLVE THE PROBLEM OF «SEARCH AND RESCUE OF PEOPLE AT SEA»

Abstract. The article solves the problem of construction of a mathematical model of a search operation in given areas of search with time limitation. Due to technological progress, ships are equipped with modern means of navigation and communication. Vessel designs are constantly being improved to improve seaworthiness, but disappointing statistics are accounting for the loss of about 200 ships per year. At the same time, search operations are carried out thanks to the disaster warning systems, but taking into account adverse hydrometeorological factors, the members of the crew of a vessel which is in a distance from the point of crash. Communication with crew members is often lost, so we have the task of locating people in a certain area and with time limitations. The proposed model can be used for introduction into the search and rescue system.
Keywords: ship, mathematical model, search and rescue, detection, programming.

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Avdeev B.A., Sobolev V.S.

DEVELOPMENT OF A VOLTAGE STABILIZATION SYSTEM FOR THE OUTPUT INVERTER OF A SOLID-STATE TRANSFORMER

Abstract. The article discusses issues related to the development and simulation of the output voltage stabilization system of a single-phase inverter as part of a solid-state transformer. The description of the solid-state transformer is given, the problems arising during its adjustment are shown. The structural scheme of the stabilization system is formulated and the principle of its operation is described. Numerical simulation of the output inverter operation is carried out under the following characteristic situations arising during the operation of a solid-state transformer: start-up, load increase by 50% and voltage increase at the second DC input by 15%. The waveforms of currents and voltages are given, as well as static and dynamic quality indicators are calculated, showing that the system has sufficient stability and high performance. The influence of the PID controller settings on the operation of the stabilization system as a whole is considered. The ways of further improvement of the control system of a solid-state transformer are given.
Keywords: solid-state transformer, direct current, invertor, voltage stabilization, controller

Vyngra A. V. Podunay S.V.

ASSESSMENT OF THE INFLUENCE OF OPERATION OF ELECTRIC DRIVES OF PISTON COMPRESSORS ON THE APPEARANCE OF INTERHARMONIC COMPONENTS IN A SHIP POWER PLANT

Abstract. The article discusses aspects of regulating power quality indicators on ships and provides a theoretical analysis of methods and algorithms for identifying interharmonic current components in power circuits. A computer simulation model has been compiled that describes an electrical power system of limited power and includes a synchronous generator, a linear load, and a load with a nonlinear current-voltage characteristic. As a nonlinear load, the model uses asynchronous electric motors, acting as electric drives of piston compressors or other mechanisms with variable mechanical loads that consume a non-sinusoidal electric current, which is caused by a periodic change in the load torque depending on the angle of rotation of the shaft. The simulation results showed that the considered nonlinear loads create significant interharmonic distortions of the ship network current, which, in turn, negatively affects the power quality indicators**.**
Keywors: interharmonic components, ship electrical power system, asynchronous electric motor, active filter.

Bogatyreva E.V.

ASSESSMENT OF THE POSSIBILITY OF USING MARKOV PROCESSES IN MATHEMATICAL MODELING OF SHIP MAINTENANCE BASES

Abstract. The paper examines the determination of equilibrium loading modes of simple multilinear Poisson-type bases with homogeneous flows of restoration work. For high-quality maintenance and operation of ship equipment, local maintenance bases are created, structurally representing simple multi-line bases loaded with homogeneous flows of restoration work. A matrix of probabilities of bases transitioning from one state to another has been compiled depending on the ratio between the number of backup units and service areas. The results obtained can be applied to solve problems that have independent theoretical and practical significance. The work assumes

that the intervals between arrivals and the duration of restoration work are distributed exponentially. This assumption is not always justified and there is a need to study service bases of a non-Poisson type.

Keywords: maintenance base, restoration of technical means, Poisson type base, Markov processes, probability matrix.

Gorbenko A.N., Sharatov A.S.

ANALYSIS OF OSCILLATIONS OF A TURNING ROTOR WITH STATIC AND DYNAMIC IMBALANCES

Abstract. The paper considers the problem of vibration of rotary-type ship machines, caused by the unbalance of the rotating rotor. The article shows that with a certain combination of rotor parameters and operating mode, the level of its transverse and angular oscillations is significantly affected not only by the actual values of its static and dynamic imbalances, but also by their relative position. The conditions of special cases of spatial motion of an unbalanced rotor, when there are no its transverse or angular oscillations, are analyzed. In the work, expressions for the rotor speeds are obtained, at which the minimum possible vibration will occur. For a quantitative estimation of the degree of rotor sensitivity to the specified factor, it is proposed to use the coefficients of influence, for which the corresponding expressions are obtained. The results of the work will be useful in the design, manufacture and operation of ship rotary machines.

Keywords: ship rotary machines, unbalanced rotor, static and dynamic unbalance.

Bogatyreva E.V., Ivanovskaya A.V

FACTORS AFFECTING THE HYDRODYNAMIC RESISTANCE OF MOTION OF THE SYSTEM “CABLE-TRAWL”

Abstract. When solving problems related to determining hydrodynamic resistance, in a number of cases it is necessary to take into account the deformation of the free surface caused by an unsteady interaction pressure. In this work, we determine the deformation of a free surface that develops over a short period of time under the influence of rapidly changing pressure. The solution is sought in an approximate way - in the form of a power series, and linear theory is also used. The solution to the problem posed is presented as a sum of solutions to three particular problems. Boundary and boundary conditions are set. The equation of deformation of a free surface under the action of rapidly changing pressure is obtained. As an example of using the found solution, the effect of pressure on an unperturbed free surface is considered. The results obtained will allow us to evaluate the factors affecting the hydrodynamic resistance of the system movement.

Keywords: hydrodynamic resistance, boundary value problems, free surface deformation, vortex-free motion, air layer.

Konyukov V.L., Gorbenko A.N.

INFLUENCE OF SETTING THE FUEL EQUIPMENT OF A MARINE FOUR-STROKE DIESEL ENGINE ON ITS PERFORMANCE IN VARIOUS OPERATING MODES

Abstract. The work analyzes the sensitivity of the defining performance indicators of a marine four-stroke diesel engine to changes in the settings of its fuel equipment. The study was carried out by a theoretical calculation method using shop test protocol of the modern high-powered four-stroke diesel engine operating according to the load characteristic over a wide load range. Qualitative and quantitative dependences of diesel operating process parameters on the fuel supply advance angle were obtained. An assessment is made of the sensitivity of operational parameters

to an increase in the absolute value of the fuel supply advance angle. It was found that when the diesel load decreases, there is an increase in the sensitivity of some indicators of the work process to changes in control parameters. The results of the work will be useful in the design and operation of marine diesel engines.
Keywords: marine four-stroke diesel engine, fuel equipment, fuel supply advance angle, load characteristics.

Ivanovskaya A.V.

FORMALIZATION OF THE MOVEMENT OF A TOWED OBJECT ON THE SURFACE AS PART OF A SYSTEMATIC APPROACH TO MODELING A SHIP'S WINCH

Abstract. The creation of modern competitive domestic marine equipment is one of the priorities identified in the economic development plan of the Russian Federation. The ship's lifting equipment is often in a single copy on the ship. Therefore, when it fails, technological processes that may be key on this vessel, such as trawling, mooring and towing operations, also stop. In order to increase the reliability of the ship's deck equipment, it is necessary to carry out calculations using formulas obtained as a result of mathematical modeling, taking into account most random factors that occur during the operation of machines. The formalization of dynamic processes in such studies is based on a systematic approach, each complex task in which must be divided into a number of specific, interrelated solutions to achieve the overall goal of the process under study. The paper presents a solution to one of the problems of modeling the movement of a towed object on the surface as part of a comprehensive modeling of a ship's winch.
Keywords: system approach, modeling stages, surface movement, towed object, equation with variable coefficients

Klimenko N.P., Sharatov A.S., Chernuha V.S.

A METHOD FOR ACCELERATED EVALUATION OF RELIABILITY INDICATORS OF SHIP TECHNICAL MEANS

Abstract. A method for assessing the reliability of ship technical means using a system of criteria that allows you to get a general picture of the functional reliability of machines in operation is presented. High reliability of the accelerated assessment of the average operational life can be achieved if accelerated tests are carried out in a combined mode. At the test planning stage, the question of sufficient conditions under which it is permissible to use a linear damage summation model in the case of parametric failures is considered. Power dependences are widely used in describing monotonous changes in various technical parameters of machine elements depending on their operating time. In many cases, the use of a linear damage model is justified. However, it must be borne in mind that in real conditions, various factors determining the resource during testing are random and have statistical dispersion. The analysis of the obtained mathematical model is carried out, it should be considered as a basis for describing the accumulation of damage on average and constructing a linear regression model of damage, the parameters of which are statistical estimates for the average resource in operational and tightened test modes.
Keywords: reliability, ship technical means, reliability prediction, degradation failures, stochastic reliability models.

Konyukov V.L.

INFLUENCE OF THE WEIGHT COEFFICIENT OF THE SCREW CHARACTERISTIC ON THE OPERATIONAL PARAMETERS OF A MARINE TWO-STROKE DIESEL ENGINE

Abstract. The work carried out research on the effect of increasing the weight of the propeller characteristics of a vessel on the main operational parameters of a marine two-stroke diesel engine, which is widely used as the main engine on sea vessels. The studies were carried out using a theoretical calculation method for wide ranges of changes in the weight coefficient of the screw characteristics and the relative power of the diesel engine. The dependences of operational parameters at characteristic points of the cycle and the criteria that determine the thermal stress of a diesel engine are obtained. The transition to a heavier characteristic lead to a decrease in the power of the turbocharger, a decrease in air consumption and a decrease in boost pressure, as a result of which the coefficient of excess air for fuel combustion decreases and the specific effective fuel consumption increases. A comparison was made of individual indicators of a two-stroke diesel engine with similar indicators of a four-stroke diesel engine. The obtained dependencies of operational parameters and criteria for wide ranges of changes in the weight coefficient of the screw characteristics and relative power made it possible to evaluate additional indicators, on the basis of which it is recommended to formulate restrictive characteristics of permissible diesel operating modes.
Keywords: diesel, operational parameters, load, screw characteristic, weight factor, limiting characteristic, thermal stress, mechanical stress.

Matveev Yu.I., Kazakov S.S., Kuritsyn S.Yu.

A STAND FOR ACCELERATED TESTS OF THE CYLINDER PISTON GROUP, CLOSE TO REAL CONDITIONS

Abstract. The creation of any new equipment, its modernization or the extension of its life requires a significant contribution of human efforts. From the creation of an idea to its implementation, a long period passes, which can actually be divided into several components. The initial work takes place in the form of a sketch project, which consists in the descriptive part of the idea and giving it content. The next stage is technical design, forms a solid foundation for further work and consists in carrying out calculations, which include the selection of materials, calculations of strength, durability, setting the dimensions of the future product or structure. Further design, based on the data of the technical project, consists of the development of working drawings, including the elaboration of manufacturing technologies, assembly, etc., and the estimated financial calculation necessary to identify material costs, payback period and, of course, the profitability of the conceived idea. The final point of any design is full-scale tests that can confirm the correctness of the idea or show the need to refine some elements, or completely destroy the idea. A significant part of the time is devoted to testing, since the test object must be brought as close as possible to the working conditions, otherwise, when it is introduced into production, not only the developed object, but also the equipment adjacent to it, may fail. In this paper, a stand designed for testing parts of a cylinder-piston group close to real conditions is demonstrated.
Keywords: stand, cylinder piston group, tests, piston rings, resource, durability.

Khalyavkin A.A

DEVELOPMENT OF THE "2KUSSH" TEMPLATE FOR VISUAL AND MEASURING CONTROL OF AN ANGULAR WELD

Abstract. The paper considers the visual and measuring control of welded joints. It is noted that it is the first non-destructive testing method in which external defects and mismatch in the dimensions of the parameters of the weld itself are detected. The main parameters of angular welded joints and their general appearance are presented. It is indicated that the dimensions of the angle weld catheter, depending on the welding method and the thickness of the parts to be welded, must comply with regulatory and regulatory documentation. The importance of the resulting catheter for the service life and reliability of the welded joint itself is noted. It is proposed to use a special welder's template for visual and measuring control. It is indicated that the development and implementation of additional and auxiliary welder templates should be based on the geometric, mechanical and strength parameters of the controlled welded joints. The rationale for choosing the sizes of the proposed template and the material is investigated. Expressions of template parameters are presented.
Keywords: template, weld, corner seam, weld catheter, regular polygon, non-destructive testing.

Perkov I.E.

INHIBITORY COMPLEXES FOR DIESEL COOLING SYSTEMS, THEIR SHORTCOMINGS AND A NEW APPROACH TO THE PROBLEM

Abstract. The article analyzes the results of the application of newly developed compositions for diesel cooling systems, which allow solving multifactorial tasks within a single technology, including protecting the system from electrochemical and microbiological corrosion, improving the quality of ship's water used in systems, bringing it into compliance with regulatory documents using reagent-free methods, which meets the requirements of GOST R 58880-2020 [1]. The energy method of water treatment (EMW) considered in the article refers to non-reactive methods. EMW, based on the introduction of nanostructured, environmentally friendly natural minerals into the system, creates additional electric fields at the phase interface (liquid-metal), which allows you to influence the potential of the diffuse layer, changing the direction and speed of the reaction. At the same time, as experience has shown, the introduction of EMW on water-cooling systems of diesel locomotives reduces the intensity of corrosion processes, including those caused by iron-producing bacteria. This positive experience can be reasonably transferred to the cooling systems of marine diesel engines [2].
Keywords: electrochemical and microbiological corrosion, inhibitor complexes, diesel cooling systems, energen, additional electric fields

Aleksei N. Ivanovskii

APPLICATION OF NEURAL NETWORKS IN FISH GRADING SYSTEMS ON FISHING FLEETS

Abstract. Despite the significant superiority of new domestic super-trawler vessels to world counterparts, as well as the high level of their technical equipment, a number of tasks on a fishing vessel are still performed manually. One such task is to sort fish. The low level of efficiency of this procedure leads to deterioration of working conditions, attendant labor shortage, decrease of economic efficiency, increase of risk of reputational losses of fishing companies. This work involves the theoretical development of an automatic fish grading system to solve the problems identified. With a combination of YOLO, U-Net, EfficientNet, computer vision algorithms, digital signal processing and classical automation, the system will assess the state of fish along the belt,

its geometric characteristics and will automatically collect catch statistics. The system under development is intended for use both on fishing vessels with a fish processing facility and in coastal fish processing facilities.
Keywords: fish sorting, composite neural networks, image processing, automation, fishing vessel

Riazanova T.V.

ANALYSIS OF THE POWER COMPATIBILITY OF A FISHING VESSEL AND A FISHING TRAWL

Abstract. The problems of identifying the power of power plants of fishing vessels are considered. Since the traction characteristics of trawlers towing a trawl depend on the power of the main engine, it is necessary to be able to accurately and promptly determine the degree of loading of the main engine. The paper analyzes which indirect characteristics are the most informative in order to determine the engine power and how many of them are sufficient to obtain adequate mathematical models. Dependences are obtained that allow us to determine the relative engine power from such indirect characteristics as exhaust gas temperature, boost pressure, maximum combustion pressure and fuel consumption, both from each of these, and the most accurate model – from four indirect characteristics. With sufficient accuracy for practical purposes, it is recommended to use a dependency containing two indirect characteristics.
Keywords. Main engine, traction characteristics of the vessel, indirect characteristics, exhaust gas temperature.

Sviatskii V.V.

ANALYSIS OF METHODS FOR CALCULATING THE SAFE LANE OF A SHIP USING A NAVIGATION SIMULATOR IN DIFFERENT CONDITIONS

Abstract. Fast and timely specification of the parameters of safe vessel movement is one of the primary tasks when travelling in narrow areas and in the vicinity of hazards. Ensuring navigational safety is always the main task of a ship operator, therefore, it is always necessary to know as accurately as possible the deviation of the vessel from the line of the set path under the influence of external factors. In this article using Navigator PRO 6000 navigation simulator the comparative analysis of the main practical methods of determining the change of safe lane width under the influence of wind is carried out. The optimum method of calculating the safe lane width under the influence of wind from different heading angles, as well as changes in lateral displacement is determined.
Keywords: navigation, navigation safety, safe driving width

Tishchenko M.S. Ivanovskii N.V

SOLVING THE PROBLEM OF ESTIMATING THE PROBABILITY OF FINDING A SEARCH OBJECT IN A GIVEN AREA

Abstract. The paper presents the results of research aimed at solving the problem of building a decision support system for conducting search and rescue operations at sea. Based on the analysis of existing research in this area, the following conclusions were obtained: there are several directions in the formalization of the search process for objects; there are no decision support systems in this area; the existing cardinal rescue centers do not have a strictly formalized methodology for assessing the probability of finding a search object in a given area and planning this operation. Thus, there is a request from practice to conduct further research in the field of search and rescue at sea. As a result of the conducted investigations, dependences were obtained

that allow us to estimate the probability of finding the search object in a given area in the presence of initial parameters of its movement (obey the normal distribution law) and in their absence. The results obtained can be used in complex models for searching for objects at sea, as well as as independent models when planning a search operation. The research presented in this paper is part of the solution of the main task: building a decision support system for planning and performing search operations at sea.
Keywords: search and rescue at sea; decision support system; object search at sea.

Titov I.L.

DEVELOPMENT OF AN ALGORITHM FOR CONTROLLING AN AUTONOMOUS UNDERWATER VEHICLE USING A SLIDING MODE

Abstract: This paper proposes an adaptive sliding mode fault tolerant control method using the adaptive reaching law for the AUV with ocean current disturbance, model uncertainty, sensor noise, unknown sensor faults, and unknown thruster faults. This method is independent of the results of the fault diagnosis. To address the chattering problem caused by sliding mode control, this paper adopts a weighted hyperbolic tangent function instead of the traditional sign function in sliding mode control. Simulation experiments are carried out for different fault magnitudes, fault change types, and fault sources under ocean current disturbance, model uncertainty, and sensor noise. Compared with the traditional fault tolerant control method, the simulation results show that the proposed method can accelerate the convergence speed of the state point and improve the trajectory tracking effect of the AUV. As a result, the effectiveness of the proposed method is confirmed.
Keywords: autonomous underwater vehicle (AUV); sliding mode control; adaptive reaching law; fault tolerant control.