ABSTRACTS

Keywords: underwater vehicle, navigation and control system, middleware, typical configurations.

Vaulin Yu.V., Inzartsev A.V., Lvov O. Yu., Matvienko Yu.V., Pavin A.M. THE CONFIGURABLE NAVIGATION AND CONTROL SYS-TEM FOR MULTIFUNCTION UN-DERWATER ROBOTS // Underwater Investigation and Robotics. 2017. \mathbb{N} 1 (23). P. 4–13.

The range of operations performed by autonomous underwater vehicles (AUV) is permanently expanding and currently includes such operations as survey of specified objects and performance of actions over these objects. The control system of such robots should have facilities for integrating and coordinating the operation of heterogeneous on-board devices, provide navigation parameters with the required accuracy, and process information from sensory devices in real time.

The article considers the configurable system of navigation and control for autonomous underwater robots, which summarizes many years of IMTP FEB RAS experience in this area. The system contains the necessary set of sensors, integrates with a wide range of payloads and can be adapted for use in vehicles of various classes and purposes. The software of the system implements the functionality to solve the surveillance and survey tasks. The interaction of the system software modules is organized on the basis of a distributed event-driven software platform. The software platform enables the integration of heterogeneous software modules which are located both within the local area network of one AUV, and in different vehicles. The variants of system configurations for heavy, light and medium classes of vehicles are given as an example.

Keywords: mobile robotic systems, mobile robotic technology complex, the operational group of heterogeneous robotic systems.

Oparin A.I., Pechnikov A.N. ON SOME PROBLEMS OF FORMATION AND USE OF GROUPS OF HETERO-GENEOUS MOBILE ROBOTIC SYS-TEMS AND APPROACHES TO THEIR SOLUTION // Underwater Investigation and Robotics. 2017. № 1 (23). P. 14–22.

The aim of this work was to identify the main problems of acquisition and use of the cash generated by heterogeneous robotic technological complexes and justification of approaches to their solution. A comparative analysis of approaches to the creation and practical application of the methods of underwater research and work were justified interpretation of mobile robotic technological complex as quickly formed groups of heterogeneous mobile robotic systems. On the basis of presented in the media data on the actual use of such groups was highlighted distinctive characteristics, the problems of recruitment and use of quickly formed groups of heterogeneous underwater vehicles and other technical means of conducting underwater research and work. On this basis, was developed a conceptual model quickly formed a mobile robotic technological complex and identifies appropriate approaches to the implementation of procedures for speedy recruitment and organization management.

Keywords: laser sensor, chlorophyll-A, ROV, laser induced fluorescence, dissolved organic matter, laser induced breakdown spectroscopy.

Bukin O.A., Mayor A. Yu., Proschenko D. Yu., Bukin I.O., Moun S.A., Lyakhov D.G., Chekhlenok A.A., Bolotov V.V., Burov D.V. LASER SENSOR ELEMENTS OF UNDERWATER RO-BOTICS // Underwater Investigation and Robotics. 2017. № 1 (23). P. 23–30.

The paper analyzes the possibilities presented by laser technologies for the development of sensor elements of underwater robots and the results of the latest developments in the field of underwater robotics for the implementation of laser spectroscopy methods for monitoring underwater environments. An overview of the main directions of using laser sensors in underwater robotics was made. The prospects of using laser induced fluorescence (LIF) and laser induced breakdown spectroscopy spectroscopy (LIBS) for the development of sensor elements for underwater robotics are discussed in detail. The main technical characteristics and results of the development of a submersible module of a laser spectrometer designed for the study of Raman spectra and laser induced fluorescence are presented. The spectrometer was developed as an element of the sensorics of a remote-controlled unmanned underwater vehicle, providing the possibility of remote detection and measurement of the concentration of organic substances in sea water and underwater objects in various forms. The results of full-scale tests of the immersed LIF spectrometer, which were carried out in various marine areas, including the Arctic, are described. Parameters of the laser spectrometer allow using it on a remote-controlled uninhabited device of the survey class. Based on the experience of the development of a laser spectrometer and Remotely operated underwater vehicle (ROV) that provides operation of the spectrometer, the main directions for the further development of sensory elements that provide a remote LIF and LIBS sensor elements.

Keywords: autonomous underwater vehicle, satellite navigation receiver, radio equipment, float towed unit, load-bearing micro cable ties.

Kostenko V.V., Lvov O. Yu. COM-BINED SYSTEMS OF COMMUNICA-TION AND NAVIGATION FOR AU-TONOMOUS UNDERWATER ROBOT EQUIPPED WITH A FLOAT TOWED UNIT // Underwater Investigation and Robotics. 2017. № 1 (23). P. 31–43.

Existence of the high-speed traffic channel of information exchange with the control vessel in real time significantly expands possibilities of work performance of the autonomous unmanned underwater vehicle (AUV). Besides, data

from the satellite navigation receiver for periodic compensation AUV's location errors stored on-board navigation system requires. It is advisable to use float towed unit equipped radio and satellite antennas to increase the effectiveness of underwater engineering works. The possible technological solutions are reviewed in the article, and alternative options are offered for its execution. The article presents the results of calculating the force effects of the towed communication cable. The practical results of combined systems of communication and navigation engineering are given in the article.

Keywords: remotely operated underwater vehicle, information control system, underwater operations, navigation equipment, software.

Filaretov V.F., Konoplin A. Yu., Konoplin N. Yu. APPROACH FOR DEVELOPMENT OF INFORMATION CONTROL SYSTEMS FOR REMOTE-LY OPERATED UNDERWATER VEHI-CLES // Underwater Investigation and Robotics. 2017. № 1 (23). P. 44–49.

The paper describes the approach for the information control system creation for remotely operated underwater vehicles, which is based on information from the various navigation equipment. This system provides the failsafe performing of underwater operations by means of vehicle displacement route planning, recommendations and warnings producing in the work process. Due to the architecture features this information control system can be used for simple construction and implementation of various control algorithms for underwater vehicles and their multilink manipulators. The system also has the ability of scaling and adding of the different equipment. It has a user interface that visually displays all the necessary information for the successful implementation of underwater operations and allows to load and create working area maps, set waypoints, save data, etc. The experimental researches of the created information control system were implemented in the deep-sea research expedition in the Bering Sea with the working class remotely operated underwater vehicle Sub-Atlantic Comanche 18. The developed system was actively used during the expedition. It was used for seabed surveying, searching for various objects, video shooting, selective sampling of marine organisms, and sampling of soil and geological rocks. The using of the implemented algorithms improved the quality of underwater operations and reduced the time of their implementation. The sea investigations of the developed information control system fully confirmed its high efficiency with relative simplicity of its practical implementation.

Keywords: remote systems, robotic platforms, unmanned vessels, autonomous systems.

Chensky D.A., Grigoriev K.A., Chensky A.G. REMOTE CONTROL AUTOMATIC SYSTEM OF UN-MANNED SURFACE VEHICLE // Underwater Investigation and Robotics. 2017. № 1 (23). P. 50–56.

Key element of unmanned surface catamaran is the remote control automatic system (RCAS).Multipurpose catamaran was designed to investigate hydroacoustics and hydrophysics in aqueous media. IMS consists of hardware and software. Software is written in graphic language by applying such system-design platforms as: LabVIEW, Real-Time и FPGA Module. The approach allows developing the whole system within one project using software functions to synchronize data communication between various devices. The usage of protocols gives a boost to a process of software programming and hardware development. Test results show advantages of approaches applied to development of unmanned surface vessels.

Keywords: hydroacoustic, sound propagation, pseudo-random signals, underwater navigation.

Morgunov Yu.N. THE ACOUSTIC UNDERWATER RANGEFINDING PECULIARITIES IN THE SEA OF JAPAN WINTER HYDROLOGICAL CONDITIONS // Underwater Investigation and Robotics. 2017. № 1 (23). P. 57–61.

Aspects of the development of navigational systems for the positioning supporting of the autonomous unmanned vehicle (AUV) on large command center-to-detector distances are connected with solutions of tasks of the underwater rangefinding in complex hydrological and bathymetry conditions of signals distributions. The studies of the acoustic energy distribution from shelf zone into deep see peculiarities have an applicational significance in the questions of solving abovementioned tasks. These studies are especially essential in a substantiation and development of the AUV positioning and control systems supporting operations in hundreds of kilometers in winter conditions. The results of the experiment done in the Sea of Japan in March 2016 on the 194 kilometer long acoustic track are discussed. The most complicated case of the impulse wideband pseudo-random signals distribution from a shelf into a deep sea crossing the eddy is investigated. The analysis of the experimentally achieved impulse responses showed that the maximal first arrival detected in all measurements points has a good correlation with the calculations. It witnesses that the impulses propagated in the near-surface sound channel on a shortest range with an angles close to zero are received first on the studied receiving horizon. The methodic of the average sound speed on a track calculation using data from satellite monitoring of the surface temperature is proposed. The methodic allows counting on successful application of the achieved results in the tasks of the acoustic rangefinding and navigation.

Keywords: mobile laser strainmeter, low-frequency hydroacoustic radiator, ice, seabed tomography.

Chupin V.A., Budrin S.S., Dolgikh G.I., Dolgikh S.G., Pivovarov A.A., Samchenko A.N., Shvyrev A.N., Shvets V.A., Yakovenko S.V., Yaroshchuk I.O. DEVELOPMENT OF METHODS OF THE SEABED TO-MOGRAPHY THE WATER AREAS, COVERED WITH ICE. THE FIRST EXPERIMENT // Underwater Investigation and Robotics. 2017. № 1 (23). P. 62–67.

A mobile laser strainmeter (MLS), created in POI FEB RAS, is widely used in experimental researches of seabed structure. An important research stage is related to the development of a method for application MLS in ice-covered water areas with the prospect of creating the bases of seabed tomography in the shelf areas of the Arctic and Antarctic. The developed method is oriented to solving problems of geoacoustic inversion and creation a real model of the earth's crust of the shelf areas. As a source of the useful signal the low-frequencyhydroacoustic radiators of various types are used, generating complex phase-shift signals and the coastal stationary and MLS, registering seismic signals with characteristic amplitude-frequency properties in experimental research. As a result of the experiment, steady registration by the receiving system of all radiated signals was observed in the conditions of ice covering of the water area. The next stage of the work involves mathematical processing of the obtained information, necessary for studying the arrival time of all reflected signals and comparing them with data of the monitoring equipment of the radiating system.

Keywords: methane, gas flows, groundwater, abnormal gas fields, gas genesis, economic activity.

Okulov A.K., Obzhirov A.I., Mishukova G.I., Okulov Al.K. METHANE DISTRIBUTION OF THE WATER PETER GREAT GULF // Underwater Investigation and Robotics. 2017. № 1 (23). P. 68–73.

The paper presents results research of natural gas coastal shelf zone of the Peter Great Gulf. Data were obtained on the composition and distribution of gas in the bottom and surface layers of water. Several genetic types gas are identified in the area under study, the main ones are microbial, coal, oil and gas, and intrusive. The ways of gas migration from deep horizons to the surface are fault zones. The observed anomalous fields of methane and other natural gases in the bottom sediments and water Peter Great Gulf require more detailed studies using underwater robotics, since these areas are dangerous for engineering construction. At the same time, they can be favorable for aquaculture breeding and it is important to evaluate them for other economic activities.