ABSTRACTS

Key words: remotely operated vehicle, stability control, orientation control, quaternions, swimming pool tests.

Bykanova A.Yu., Kostenko V.V., Storozhenko V.A., Tolstonogov A.Yu. THE SMALL-SIZED REMOTELY OPERATED VEHICLE WITH STABILITY CONTROL // Underwater Investigation and Robotics. 2019. No. 3 (29). P. 4–12.

The results of design and development of the small-sized remotely operated vehicle with autonomous power supply and optic fiber tether are presented. The vehicle is capable to control position with arbitrary angles of orientation. The control of roll angle of the vehicle is being not only by the propulsion system of the vehicle but also by control of stability of one. The stability control is implemented by changing the position of center of buoyancy and gravity of the vehicle in the transverse plane. The quaternion-based kinematics was used to implement orientation control for achieving full-range regulation. The main technical solutions were proved during the test in pool of remotely operated vehicle "Millennium Falcon" for All-Russian underwater competition "AquaRoboTech-2018".

Key words: tracking algorithm, hydro acoustic station with linear antennas, target tracking

Voronina N.G. SOLVING PROBLEM OF BEARINGS-ONLY MARINE-TARGET TRACKING // Underwater Investigation and Robotics. 2019. No. 3 (29). P. 13–23.

The issues of construction of bearing-only target tracking algorithm in hydroacoustics using the Joint Probabilistic Data Association method, filtering trajectory parameters and threshold criteria of detection target is considered. To solve the problem of filtering trajectory parameters two filters were used: a recurrent Kalman filter and a non-recurrent filter with finite sampling based on the maximum likelihood function method. Simulation results of application the algorithm for the data obtained with broadband noise-finding on a linear antenna using two filtering methods are showed and compared.

Key words: arctic eddies, ADCP (acoustic Doppler current profiler), streamlet model.

Shupikova A.A., Kazansky A.V. APPLYING OF THE STREAMLET MODEL FOR RECONSTRUCTION OF THE VELOCITY FIELD OF ARCTIC EDDIES // Underwater Investigation and Robotics. 2019. No. 3 (29). P. 24–29.

Work deals with the reconstruction of the 3D velocity field of subsurface eddies in Arctic basin using the streamlet model. An initial velocity data is obtained

during the Ice-Ocean Environmental Buoy (IOEB) experiment. They are presented as a vertical profile series of ADCP measurements (Acoustic Doppler Current Profiler) located at some distance from each other along the ice drift trajectory. The 3-D velocity field of the Arctic eddies is restored through the parametric streamed model by searching the minimum of standard deviation between the streamlet model and measured velocity vectors. The optimal parameters are identifying with well-known nonlinear simplex downhill Nelder-Mead optimization algorithms. The results of the reconstruction of the velocity field using the streamlet model are shown for several Arctic eddies. The comparative analysis of the results of the approximation with the available velocity object models is given.

Key words: sonar communication, orthogonal frequency division multiplexing, OFDM, multi-frequency signals.

Rodionov A.Yu., Unru P.P., Kulik S.Yu., Golov A.A. APPLICATION OF MULTI-FREQUENCY SIGNALS WITH CONSTANT ENVELOPE IN UNDERWATER ACOUSTIC COMMUNICATION SYSTEMS // Underwater Investigation and Robotics. 2019. No. 3 (29). P. 30–38.

For hydroacoustic communication with underwater moving objects, more and more complex modulation methods are actively used. In this paper, a method based on the constant envelope OFDM method is presented. We consider a regime using precise frame synchronization of multi-frequency symbols, as well as modes with signal expansion coefficients of 2, 4, and 10. Based on the results of numerical experiments under gaussian noise conditions, reception error probabilities from 0.15 to 10-3 for multipath responses typical of hydroacoustic communication channels. Experiments with a distance of 25 km were carried out using low-frequency (400 Hz) sonar equipment. The characteristics of the communication line and the BER values are obtained for various signal spreading coefficients.

Key words: internal waves, boundary waves, an invariant, acoustic vector sensor, a sonogram.

Kasatkin B.A., Kasatkin S.B. MODULATION OF THE SOUND FIELD OF BOUNDARY WAVES INTERNAL WAVES IN THE TRANSITIONAL ZONE THE SHALLOW WATER - THE DEEP SEA // Underwater Investigation and Robotics. 2019. No. 3(29). P. 39–46.

Results of pilot studies of influence of internal waves on interferential structure of the sound field created by boundary waves of Rayleigh – Sholte are given in a transitional zone the shelf – the deep sea. This influence is shown in periodic modulation of frequency of a maximum of spectral power density on the sonograms of a sound field registered by the acoustic vector sensor (AVS) in infrasonic frequency range, and amplitude of modulation is proportional to frequency. The dependence of the period of modulation on a relative positioning of receiving modules, the rustling vessel creating a sound field discrete components of a shaft -bladed sound row, and estimated traveling direction of internal waves is analyzed. It is noted that internal waves have the greatest impact on structure of a vortex component of a vector of intensity.

Key words: internal waves, surface manifestations, density estimation.

Aleksanin A.I., Kim V., Konstantinov O.G., Korotchenko R.A., Yaroshchuk I.O. OBSERVATION OF INTERNAL WAVES ON IMAGE SEQUENCES // Underwater Investigation and Robotics. 2019. No. 3 (29). P. 47–53.

The experiment results of long internal gravity waves (IGW) registration on image sequences obtained by polarized camera are described. The IGW velocities and wavelengths were determined. Image sequences were accompanied by detailed in-situ water density structure measurements made by vertically arranged temperature sensors. It allows to compare the observed IGW velocities and the velocities obtained as a solution of extended Korteweg-de Vries equation. During summer time there was stable gradual increase of water density with depth. The autumn months were characterized by two-layer density structure with thin pycnocline layer. The 17 cases of IGW registration during two years are analyzed. The IGW amplitudes were not more than 3 m. The observed IGW velocities were in the range 0,34–0,45 m/sec. In general, the observed and calculated velocities were close. The discrepancies were explained by uncertainties of data processing. The exception was the autumn cases, when the thickness of the bottom layer was significantly less than the surface one. In these cases the observed IGW velocities were significantly greater than the solutions of extended Korteweg-de Vries equation. The observed velocities were the same for the image sequences and for spatial sequence of temperature sensors.

Key words: hydroacoustic, geoacoustic model, low-frequency hydroacoustic radiator, Peter the Great Bay.

Samchenko A.N., Dolgikh G.I., Kosheleva A.V., Pivovarov A.A., Shvyrev A.N., Yaroshchuk I.O. EXPERIMENTAL STUDIES ON THE SHELF OF PETER THE GREAT BAY USING LOW-FREQUENCY

HYDROACOUSTIC RADIATORS // Underwater Investigation and Robotics. 2019. No. 3 (29). P. 54–60.

The paper considers the results of hydroacoustic experimental studies in Peter the Great Bay, Sea of Japan, conducted in May and October, 2016. Low-frequency radiators with a carrier frequency of 22 and 33 Hz were used in the course of work, and the signals were received by means of time-dependent autonomous hydroacoustic stations (AHS). The group velocities of various modes obtained as a result of measurements allow us to estimate the geoacoustic properties of the bottom. The results of seismicoacoustic studies are compared with the geoacoustic model of the shelf site in the area of the experiments. The geoacoustic model is based on the available geological and geophysical information of the bay with the calculation of the acoustic properties of the bottom.

Key words: fluorescence, phytoplankton, chlorophyll-a, dissolved organic matter, autonomous optical modules, sub-satellite measurements.

Krikun V.A., Korotenko A.A., Salyuk P.A. MULTIPURPOSE AUTONOMOUS MODULE FOR NETWORK UNDERWATER MEASUREMENTS OF BIOPOPTICAL PARAMETERS // Underwater Investigation and Robotics. 2019. No. 3 (29). P. 61–67.

To solve many fundamental and applied problems, there are not enough regular measurements made in the water column or under the ice. The organization of marine expeditions is expensive, satellite optical sounding provides measurement only in the surface layer of the sea with significant errors in the waters of the second optical type and does not work in the presence of clouds or ice cover, a network of autonomous buoys with optical sensors are extremely small. This article describes the results of the development of a low cost multipurpose stand-alone optical module for network and / or complex sub-satellite measurements of seawater fluorescence. The relevance of the study is determined by the need in autonomous networks of global underwater observation of the sea water bio-optical parameters. The scientific novelty of the research consists in the development of universal optical modules that can be combined, both in a complex and unified complex for hydro-optical studies, and separately organized into a distributed network of hydro-optical measurements. This solution will allow to create a universal system of underwater hydro-optical measurements, as well as to modernize existing underwater vehicles and instruments that do not have optical sensors.