

INVESTIGATION OF A VECTOR-SCALAR RECEIVER PRACTICAL APPLICATION IN ACTIVE MODE

A.I. Mashoshin, V.S. Melkanovich

The purpose of the work is to consider aspects of the practical application of combined (vector-scalar) receivers (CR) in the active mode in distributed underwater surveillance systems. It is shown that it is advisable to detect low-noise underwater objects (LNUO) in the active mode in the range of 1.5...2.0 kHz; long tonal probing signals and complex signals based on Costas codes should be used to detect LNUO. The echo detection algorithm should simultaneously detect and suppress signals from interference devices and other highly noisy objects, and all procedures, including detection and suppression, should be performed over the echo duration interval. It is advisable to detect echoes simultaneously using the linear Bartlett algorithm, which provides the greatest noise immunity when detecting weak signals, and adaptive the Capon algorithm, which has the property of super-resolution. It is advisable to suppress strong local signals masking echo signals using a well-known compensation algorithm, taking into account the replacement of accumulation of correlation matrices in time with accumulation in frequency.

Keywords: combined (vector-scalar) receiver, sonar, adaptive spatial processing, detection and classification algorithms.

References

1. Peshekhonov V.G., Braga Yu.A., Mashoshin A.I. A network-centric approach to solving the problem of underwater lighting in the Arctic. – SFU news. Technical sciences. 2012. No. 3. P. 219–227.
2. Borodavkin A.N., Bogomolov A.P., Durnev I.N., Titkov I.V. Radio hydroacoustic systems of naval aviation. VUNC Navy “Naval Academy”. St. Petersburg, 2022. 287 p.
3. Gordienko V.A., Ilyichev V.I., Zakharov L.N. Vector-phase methods in acoustics. Moscow: Nauka Publ., 1989.
4. Mashoshin A.I., Melkanovich V.S. Investigation of aspects of practical application of a vector-scalar receiver in the noise direction finding mode // Underwater research and robotics. 2025 (in print).
5. Malyshev G.S. Optimal and adaptive methods of hydroacoustic signal processing. In 2 volumes. Volume 2. Adaptive methods. JSC Concern Central Research Institute Electropribor. 2011. 374 p.
6. Malyshev G.S., Melkanovich V.S. Classical and fast projection adaptive algorithms in hydroacoustics. St. Petersburg: SSC RF JSC “Concern “Central Research Institute “Electropribor”. 2022. 268 p.
7. Costas J. P. Properties of signals with an almost ideal uncertainty function in the range-Doppler frequency coordinates // TIIEE. 1984. Vol. 72, No. 8. P. 5–18 (Translated from English: Costas J.P. A study of a class of detection waveforms having nearly ideal range-Doppler ambiguity properties // Proceedings of the IEEE. 1984. Vol. 72, No.8. P. 996–1009).
8. Davydov V.S. Recognition in sonar. St. Petersburg: LETI, 2014. 188 p.
9. Konyukhov G.V., Mashoshin A.I. Algorithm for determining the coordinates and motion parameters of an underwater target during bistatic sonar // Gyroscopy and navigation. 2025. Vol.33, No. 2(129). P. 98–122.
10. Patent of the Russian Federation No. 2830066 with priority dated 06/26/2024 under application No. 2024117609. A method for determining the coordinates and motion parameters of underwater objects during multistatic sonar / Konyukhov G.V., Mashoshin A.I. Publ. 12.11.24, bulletin No. 32.

Information about authors

MASHOSHIN Andrey Ivanovich, doctor of science, professor, chief of the research center
JSC «Concern «Elektropribor»
Address: 197046, Saint-Petersburg, Malaya Posadskaya str., 30
Scientific interests: in underwater acoustic, AUV control systems
E-mail: aimashoshin@mail.ru
Phone: +79217632345
ORCID: 0000-0002-4785-966X

MELKANOVICH Victor Sergeevich, PhD, leading scientist
JSC «Concern «Elektropribor»
Address: 197046, Saint-Petersburg, Malaya Posadskaya str., 30
Scientific interests: in underwater acoustic, AUV control systems
E-mail: vmelkanovich@mail.ru
Phone: +79112670573
ORCID: 0009-0006-4402-1411

Recommended citation:

Mashoshin A.I., Melkanovich V.S. INVESTIGATION OF A VECTOR-SCALAR RECEIVER PRACTICAL APPLICATION IN ACTIVE MODE. Underwater investigations and robotics. 2025. No. 4 (54). P. 22–30. DOI: 10.37102/1992-4429_2025_54_04_02. EDN: IINZTA.