Underwater Investigations and Robotics. 2017. № 1 (23). P. 39-56.

**COMBINED SYSTEMS OF COMMUNICATION AND NAVIGATION FOR AUTONOMOUS UNDERWATER ROBOT EQUIPPED WITH A FLOAT TOWED UNIT**

**Kostenko V.V., Lvov O.Ju.**

Institute for Marine Technology Problems FEB RAS

5a, Sukhanov Str., Vladivostok, 690950. Ph.: (423) 243-24-16.690059, E-mail: kostenko@marine.febras.ru

**ABSTRACT**

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](http://context.reverso.net/%D0%BF%D0%B5%D1%80%D0%B5%D0%B2%D0%BE%D0%B4/%D0%B0%D0%BD%D0%B3%D0%BB%D0%B8%D0%B9%D1%81%D0%BA%D0%B8%D0%B9-%D1%80%D1%83%D1%81%D1%81%D0%BA%D0%B8%D0%B9/underwater%2Bengineering%2Bworks)*.* The possible [technological solutions](http://context.reverso.net/%D0%BF%D0%B5%D1%80%D0%B5%D0%B2%D0%BE%D0%B4/%D0%B0%D0%BD%D0%B3%D0%BB%D0%B8%D0%B9%D1%81%D0%BA%D0%B8%D0%B9-%D1%80%D1%83%D1%81%D1%81%D0%BA%D0%B8%D0%B9/technological%2Bsolutions) arereviewed 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](http://context.reverso.net/%D0%BF%D0%B5%D1%80%D0%B5%D0%B2%D0%BE%D0%B4/%D0%B0%D0%BD%D0%B3%D0%BB%D0%B8%D0%B9%D1%81%D0%BA%D0%B8%D0%B9-%D1%80%D1%83%D1%81%D1%81%D0%BA%D0%B8%D0%B9/practical%2Bresults)of combined systems of communication and navigation engineering [are given](http://context.reverso.net/%D0%BF%D0%B5%D1%80%D0%B5%D0%B2%D0%BE%D0%B4/%D0%B0%D0%BD%D0%B3%D0%BB%D0%B8%D0%B9%D1%81%D0%BA%D0%B8%D0%B9-%D1%80%D1%83%D1%81%D1%81%D0%BA%D0%B8%D0%B9/are%2Bpresented) in [the article](http://context.reverso.net/%D0%BF%D0%B5%D1%80%D0%B5%D0%B2%D0%BE%D0%B4/%D0%B0%D0%BD%D0%B3%D0%BB%D0%B8%D0%B9%D1%81%D0%BA%D0%B8%D0%B9-%D1%80%D1%83%D1%81%D1%81%D0%BA%D0%B8%D0%B9/the%2Barticle)*.*

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

**REFERENCES**

1. Ageev M.D, Kiselev L.V., Matvienko Yu.V. et al. Avtonomnye podvodnye roboty. Sistemy i tekhnologii [Autonomous underwater vehicles. Systems and technology/ Institut problem morskikh tekhnologiy [Institute of Marine Technology Problems]; edited by M.D. Ageev. Moscow: Nauka. 2005. P.400.

2. Roger E. Race. Towed Antenna System Allows Two-Way, Real-Time Communication with UUVs. http://www.sea-technology.com/features/2011/0511/towed\_antenna.php

3. Roger Race. Tethered Antennas for Unmanned Underwater Vehicles. http://www.dtic.mil/dtic/tr/fulltext/u2/a497819.pdf.

4. Dave Kraige. Retractable UUV Antenna Buoy with Smart Tether GPS. KCF Technologies, US Naval Sea Systems Command SBIR N04-T020

5. David F. Rivera, Rajeev Bansal. Towed Antenas for US Submarin Communications: A Historical Perspective. IEEE Antenas and Propagation Magazine,Vol. 46, No 1, February, 2004, P. 23–36.

6. Patent No. US 8,813,669 B2. Towed Antenna System and Method. Roger E. Race, Jacob C. Piscura, David S. Sanford. Aug. 26. 2014.

7. Fallon M., Papadopoulos G., Leonard J., Patrikalakis N. Cooperative AUV Navigation using a Single Maneuvering Surface Craft. Journal of Robotics Research, 29 (12). October, 2010. P. 1461–1474.

8. Dubrovin F.S., Scherbatyuk A.F. Studying some algorithms for AUV navigation using a single beacon: The results of simulation and sea trials // Gyroscopy and Navigation. Vol. 7. Issue 2. April 2016.

P. 189–196. ISSN: 2075-1087.

9. Kostenko V.V., Mokeeva I.G. Issledovanie vliyaniya kabelya svyazi na manevrennost' teleupravlyaemogo podvodnogo apparata // Podvodnye issledovaniya i robototekhnika. 2009. No 1 (7). P. 22–27.

10. Kostenko V.V., Mokeeva I.G. Metodika opredeleniya trebovaniy k dvizhitel'no-rulevomu kompleksu podvodnogo apparata privyaznogo tipa // Materialy 3-y nauchno-tekhnicheskoy konferentsii «Tekhnicheskie problemy osvoeniya mirovogo okeana». Vladivostok, 22–25 sentyabrya 2009 g. P. 71–77. ISBN 978-5-8044-0988-4.

11. Egorov V.I. Podvodnye buksiruemye sistemy: Uchebnoe posobie. L.: Sudostroenie, 1981. P. 304.

12. Pantov E.N., Makhin N.N., Sheremetov B.B. Osnovy teorii dvizheniya podvodnykh apparatov. L.: Sudostroenie, 1973. P. 209.

13. Pat. 2602078 Rossiyskaya Federatsiya, MPK N02J 7/00. Ustroystvo dlya zaryadki akkumulyatornoy batarei podvodnogo ob"ekta / Gerasimov V.A., Filozhenko A.Yu.; zayavitel' i patentoobladatel' IPMT DVO RAN. – No 2015146625/07 zayavl. 28.10.15; opubl. 10.11.16, Byul. No 31. P.17: il.