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NUMERICAL MODELING OF HIDING

PROPERTIES OF UNDERWATER ACOUSTIC COMMUNICATION

SIGNALS WITH LINEAR SWEEP OF THE CARRIERMEAN

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**ABSTRACT**

Based on the results of the numerical modeling, the vanishingly small differences between the probability distributions of the envelope and phase of the sum of Gaussian noise and (weak) underwater acoustic signal with linear carrier sweep, and the same distributions for the Gaussian noise all alone are demonstrated. Utilization of the continuous spectrum spread of the communication signal may be applied to the task of covert data exchange, where detection of the communication session by the intercepting equipment must be complicated or impossible. Using numerical models, we analyzed the capabilities of implementation of the signals with continuous spectrum spread for covert digital underwater acoustic communications through the standard underwater acoustic transducers, which are in service on the operational ready vessels.

**Key words:** underwater acoustic communication, carrier frequency, underwater acoustic telemetry, underwater acoustic data exchange.

**REFERENCES**

1. Varakin L.E. *Teoriya slozhnykh signalov*. *M.: Sov. radio*, 1970.

2. Kilfoyle D. B., Baggeroer A.B. The State of the Art in Underwater Acoustic Telemetry // IEEE Journ. of Oceanic Engineering. 2000. Vol. 25, No. 1. P. 4–27.

3. Kebkal K.G., Kebkal A.G., Yakovlev S.G. *Metod tsifrovoy peredachi dannykh v gorizontal'no-stratifitsirvannykh podvodnykh akusticheskikh kanalakh* // *Akusticheskiy zhurnal*. 2004. Vol. 50, No. 2. P. 220–230.

4. Denisenko A.N. Signaly. *Teoreticheskaya radiotekhnika*. M.: *Goryachaya liniya-Telekom*, 2005. 704 p.

5. Urik R.D. *Osnovy gidroakustiki*. L.: *Sudostroenie,* 1978. 448 p.

6. Sklyar B. *Tsifrovaya svyaz. Teoreticheskie osnovy i primenenie, 2-e izdanie: per. s angl*. M*.: Izdatel'skiy* *dom «Vil'yams»,* 2003. 1104 p.

7. Kebkal K.G. *Teoreticheskoe obosnovanie i prakticheskaya realizatsiya sredstv tsifrovoy svyazi dlya gidroakusticheskikh sred s kharakteristikami povyshennoy slozhnosti*: *diss. ... d-ra tekhn. nauk*: 05.09.08 – *prikladnaya akustika i zvukotekhnika*. Kiev, 2011. 450 p.

8. Tikhonov V.I., Kharisov V.N. *Statisticheskiy analiz i sintez radiotekhnicheskikh ustroystv i sistem.* M.: *Radio i Svyaz'*, 2004. 608 p.

9. Weisstein E.W. Gaussian Integral. MathWorld – A Wolfram Web Resource. 2010. – URL: http://mathworld.wolfram.com/GaussianIntegral. html. (usage date: 05.05.2020).

10. Ramanujan G.H. Twelve Lectures on Subjects Suggested by His Life and Work. Chelsea Pub Co. Auflage: UK ed., 1999. 254 p. ISBN-10: 0821820230.

11. Koryakin Yu.A., Smirnov S.A. Yakovlev G.V. *Korabel'naya gidroakusticheskaya tekhnika: Sostoyanie i aktual'nye problemy. SPb: Nauka*, 2004. 410 p.

12. Averin A.B. *Admiraly i marshaly*. *Korabli proektov 1134 i 1134 A.* M.: *Voennaya kniga,* 2007. 80 p. ISBN 978-5-902863-16-8.