

On Information Hiding System With Multiple Messages*

Mariam E. Haroutunian and Smbat A. Tonoyan

Institute for Informatics and Automation Problems of NAS of RA
e-mail armar@ipia.sci.am, smbatt@ipia.sci.am

Abstract

Many algorithms and schemes of multiple watermarking, fingerprinting and multimedia data creation are implementing to hide more than one watermark. Information theoretical analysis of information hiding system with multiple messages is considered in this paper. The rate-reliability-distortion function (which we call *the information hiding E-capacity* [5, 9]) for this system, in case of two messages (watermarks) is investigated. The inner bounds for information hiding *E-capacity* and for information hiding capacity [1] regions are constructed.

References

- [1] P. Moulin and J. A. O'Sullivan, "Information-theoretic analysis of information hiding", *IEEE Trans. Inform. Theory*, vol. 49, no. 3, pp. 563-593, Mar. 2003.
- [2] F. A. P. Petitcolas, R. J. Anderson, and M. G. Kuhn, "Information hiding—A Survey," *Proc. IEEE (Special Issue on Identification and Protection of Multimedia Information)*, vol. 87, pp. 1062-1078, July 1999.
- [3] P. Moulin, "The role of information theory in watermarking and its application to image watermarking," *Signal Processing*, vol. 81, pp. 1121-1139, 2001.
- [4] E. A. Haroutunian, "Upper estimate of transmission rate for memoryless channel with countable number of output signals under given error probability exponent", (in Russian), *3rd All-Union Conf. on Theory of Information Transmission and Coding, Uzhgorod, Publication house of Uzbek Academy of Sciences, Tashkent*, pp. 83–86, 1967.
- [5] M. E. Haroutunian and S. A. Tonoyan, "Random coding bound of information hiding *E-capacity*", *Proc. of IEEE Intern. Symp. Inform. Theory*, p. 536, USA, Chicago, 2004.
- [6] N. P. Sheppard, R. Safavi-Naini and P. Ogunbona, "On multiple watermarking", *ACM Multimedia Conference, ACM Multimedia*, pp 3-6, 2001.
- [7] I. J. Cox, J. Kilian, T. Leighton, and T. Shamoon. "A secure, robust watermark for multimedia", *Information Hiding: First International Workshop*, pp. 185-206, Springer, Berlin, Germany, 1996.

*The work was partially supported by 04.10.31 Target Program of RA.

- [8] F. Mintzer and G. W. Braudaway, "If one watermark is good, are more better?", *IEEE International Conference on Acoustics, Speech and Signal Processing*, pp. 2067-2069, 1999.
- [9] M. E. Haroutunian and S. A. Tonoyan, "Bounds of information hiding E -capacity", Submitted to *IEEE Trans. Inform. Theory*, (15 pages), 2004.
- [10] N. Merhav, "On random coding error exponents of watermarking systems", *IEEE Trans. Inform. Theory*, vol. 46, no. 2, pp. 420-430, Mar. 2000.
- [11] N. Merhav and A. Somekh-Baruch, "On the error exponent and capacity games of private watermarking systems", *IEEE Trans. Inform. Theory*, vol. 49, no. 3, pp. 537-562, Mar. 2003.
- [12] T. M. Cover, "Broadcast channels", *IEEE Trans. Inform. Theory*, vol. IT-18, no. 1, pp. 2-14, 1972.
- [13] T. M. Cover, "An achievable rate region for the broadcast channel," *IEEE Trans. Inform. Theory*, vol. IT-21, pp. 399-404, 1975.
- [14] M. E. Haroutunian, "Random coding bound for E -capacity region of the broadcast channel", Transactions of the Institute for Informatics and Automation Problems of the NAS of RA and of YSU, *Mathematical Problems of Computer Science*, vol. 21, pp. 50-60, 2000.
- [15] S. I. Gel'fand and M. S. Pinsker, "Coding for channel with random parameters," *Problems of Control and Information Theory*, vol. 9, no. 1, pp. 19-31, 1980.
- [16] M. E. Haroutunian, "New bounds for E -capacities of arbitrarily varying channel and channel with random parameter" *Trans. IIAP NAS RA and YSU, Mathematical Problems of Computer sciences*, vol. 22, p. 44-59, 2001.
- [17] M. E. Haroutunian, "Bounds of E -capacity for multiple-access channel with random parameter", special book issued in the framework of research project "General Theory of Information Transfer and Combinatorics" at ZiF, Bielefeld University, Germany, 2004.
- [18] I. Csiszár and J. Körner, *Information Theory: Coding theorems for discrete memoryless systems*, Academic Press, New York, 1981.
- [19] I. Csiszár, "The method of types", *IEEE Trans. Inform. Theory*, vol. 44, no. 6, pp. 2505-2523, 1998.
- [20] A. Somekh-Baruch and N. Merhav, "On the random coding error exponents of the Single-User and the Multiple-Access Gelfand-Pinsker Channels," *Proc. of IEEE Intern. Symp. Inform. Theory*, p. 448, USA, Chicago, 2004.

Բազմակի հաղորդագրություններով տվյալների թաքցնող համակարգի մասին

Մ. Ե. Հարությունյան, Ս. Ա. Տոնոյան

Անփոփում

Բազմակի ջրանշման, ինչպես նաև մուլտիմեդիայի ստեղծման մի շարք ալգորիթմներ և սխեմաներ նախատեսում են թաքցնել մեկից ավելի հաղորդագրություններ: Աշխատանքում

կատարված է բազմակի հաղորդագրություններով տվյալներ թաքցնող համակարգերի ինֆորմացիոն-տեսական հետազոտություն: Երկու հաղորդագրությունների դեպքի համարներն ուժվել և հետազոտվել է համակարգի արագություն-հուսալիություն-շեղում (*E*-ունակություն) ֆունկցիան: Կառուցվել են ներքին գնահատականներ համակարգի *E*-ունակության և ունակության տիրույթների համար: