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INFORMATION REDUNDANCY OF DATA VISUALIZATION FORMS AS A MEANS TO IMPROVE RELIABILITY OF ELECTRONIC EQUIPMENT

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The author presents a formalized description of the process of data transmission from some technical facilities to the human operator. An analytical estimate of redundancy of information models when the messages are advancing over a channel without interference is suggested. The most widely used symbolic and discrete-analog forms of data mapping are analyzed and compared.

The high level of information technologies and functional decisions in contemporary radar and communications systems determines the increased attention to the bottleneck in the whole system — transmission from data systems to the human operator. The use of digital methods of signal representation and processing makes it possible to attain the necessary reliability and versatility of hardware implementations for all structural elements employed, and forms a basis for discrete realization of means of information output [1–3]. To map the data obtained, some rules have been established which define the correspondence between the messages produced and a set of visual images. In other words, we perform a special coding of signals with the aid of some information model (IM). The formation of IM is carried out by an electrooptical transducer (EOT) within a part of some space considered as an information field (IF) of the mapping device. For visual representation of digital data in radio and electronic devices, the most widely used information models are symbolic displays and discrete-analog devices with scales [1, 3, 4].

The reliable reception of messages by the human operator can be achieved due to improved noise immunity of the signal circulating in the "hardware–human operator" channel. One of the most popular ways to treatment of this problem is transmission of data with redundancy [5–7]. Thus, analysis of information parameters of signals used for coding the messages in the communication channel with a human operator at the end is of practical interest [7, 8].

The purpose of this work is a comparison of the reliability of a set of forms of data visualization widely employed in radio-electronic equipment based on quantitative estimation of their information redundancy.

The formalized representation of the process of transmission of a data flow to a human operator implies the presence of a structure including, in conformity with a chosen algorithm of signal processing, information source, transmitter, communication channel, receiver, and addressee connected in-series [7]. The technical devices of the system represent the information source. In a particular implementation, as a rule, a finite set I of messages, i.e.,

$$I = \{I_1, I_2, \ldots, I_\nu, \ldots, I_{l-1}, I_l\}, \qquad (1)$$

is generated, where I_ν is the νth message, $\nu = \overline{1, l}$; and l is the number of different messages in the system.

Usually, it is assumed that the message is formed in an arbitrary manner, and the addressee knows only that it belongs to the set I. The finiteness of the latter determines the discrete nature of information in the system [7].

The syntactical analysis of messages assumes independence from their semantic features, which permits us to estimate most objectively the properties of various IM — the information is defined as the measure of reducing the indeterminacy of knowledge concerning some object. Since the analyzed system deals with discrete transmission of data,

REFERENCES

1. P. P. Ornatskii, Theoretical Principles of Information-Measurement Facilities [in Russian], Vyshcha Shkola, Kiev, 1983.

2. S. A. Shilo, Izvestiya VUZ. Radioelektronika, Vol. 42, No. 12, pp. 3–9, 1999.

3. S. Gage, D. Evans, M. Hodapp, and H. Sorensen, Applications of Opto-Electronic Devices [Russian translation], Radio i Svyaz', Moscow, 1981.

4. F. M. Yablonskii and Yu. V. Troitskii, Information Mapping Facilities [in Russian], Vysshaya Shkola, Moscow, 1985.

5. V. A. Litvinov and V. V. Kramarenko, Control of Reliability and Reconstruction of Information in the Man-Machine Systems [in Russian], Tekhnika, Kiev, 1986.

6. N. M. Ashimov, Izvestiya VUZ. Radioelektronika, Vol. 44, No. 6, pp. 16–26, 2001.

7. L. F. Kulikovskii and V. V. Motov, Theoretical Foundations of Information Processes [in Russian], Vysshaya Shkola, Moscow, 1987.

8. L. D. Stashuk and A. V. Stashuk, Izvestiya VUZ. Radioelektronika, Vol. 45, No. 2, pp. 42–47, 2002.

9. V. I. Kostyuk and V. Ye. Khodakov, Systems for Information Mapping and the Engineering Psychology [in Russian], Vyshcha Shkola, Kiev, 1977.

10. Yu. A. Bystrov, I. I. Litvak, and G. M. Persianov, Electronic Devices for Information Mapping [in Russian], Radio i Svyaz', Moscow, 1985.

11. M. I. Krivosheyev and A. Ya. Breitbart (editors), Modern Methods and Devices for Information Mapping [in Russian], Radio i Svyaz', Moscow, 1981.

12. V. P. Sigorskii, The Mathematical Apparatus for Engineers [in Russian], Tekhnika, Kiev, 1977.

13. V. F. Bakhmutskii, N. I. Gorelikov, and Yu. N. Kuzin, Optoelectronics in Measurements [in Russian], Mashinostroyeniye, Moscow, 1979.

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