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Analysis of the Data Transmission System Based on the Manipulation with Statistical Characteristics of a Random Process

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Abstract—An advanced system of data transmission in digital wideband communications channels based on the manipulation with statistical characteristics of random processes has been proposed and investigated.

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INTRODUCTION

In recent years much attention has been given to issues of enhancing the stealthiness of data transmission in the process of developing different kinds of electronic data transmission systems. A sufficiently large number of kinds of stealthiness are available [1]. Under stealthiness we shall understand the inability of extracting useful information by a standard intelligence receiver, the so-called "energy" receiver [1] and also the possibility of operating "under noises", i.e., at the signal-to-noise ratio below unity. In this context of much interest are the information systems using signals with stochastic properties. This may be purely random (stochastic) signals [2] or signals based on the deterministic chaos [3]. Such signals feature a number of advantages as compared with traditional signals [4]. Indeed, since stochastic signals are reasonably broadband, the data transmission systems using such signals are characterized by high interference immunity, a low level of signal, the economic use of the frequency resource, complexity of interception and selective jamming, etc. In this case the choice of the method of data modulation, i.e., the choice of the technique for introducing data into a carrier. The simplest manipulations with power or frequency of the radiated signal during data transmission do not meet the requirements of stealthiness and electromagnetic compatibility during the operation within the common frequency band. That is why the techniques of manipulation with statistical characteristics of stochastic wideband signals are most promising from the viewpoint of stealthiness. In the case of unauthorized access such data signal has the form of uniform wideband noise. This gives rise to the appearance of a much larger amount of opportunities, since the quantity of parameters significantly increases in comparison with the traditional amplitude, frequency, and phase. The systems where manipulation is performed by varying the coefficient of excess (or asymmetry) of stochastic oscillation are of major interest [4]. In view of the above the purpose of the present study is the development of a model for the data transmission system based on varying the stochastic characteristics of the original signal and the analysis of its performance efficiency during the transmission of binary data.

As an example let us consider the stationary (in the wide sense) centered random process $\xi(t)$. For its description one can introduce into analysis one-dimensional initial moments of different orders:

$$M_n = \int_{-\infty}^{\infty} x^n W_\xi(x)\mathrm{d}x, \quad n = 1,2,\ldots,$$

where $W_\xi(x)$ is the one-dimensional probability density of the process.

The coefficient of excess of such process is defined as follows:

$$\gamma = (M_4 - 3M_2^2)M_2^{-2}, \tag{1}$$