

RESEARCH OF RECEPTION IMMUNITY IN COMMUNICATION SYSTEM USING MIMO TECHNOLOGY

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This article examines the study of the noise immunity of MISO (Multiple-input and single-output) and MIMO (Multiple Input Multiple Output) radio channels with space-time noise-correcting coding.

Here, the main assumptions are the presence of common Rayleigh-type signal fading and additive white Gaussian noise in the communication channel, as well as the presence of a message on the receiving side about complex channel factors [1-7].

It is known that the quality of any communication channel is usually assessed by the totality their properties, determined by the corresponding indicators [1, 2]. One of the main properties radio channels is their noise immunity, assessed by the probability of an error per elementary symbol.

Analytical expressions for determining the probability an error in communication channels depend on the type modulation and the variant of the criterion for making a decision on the transmitted symbol implemented on the receiving side.

Such expressions are known for a number of simple cases.

In certain situations, the assessment of the noise immunity of a channel implementation option in a communication system is carried out using simulation models [1, 2, 3].

A significant complication of expressions occurs when assessing the noise immunity of signal reception in communication channels with fading [1, 2, 3].

It is known [1, 2, 3] that the cause of signal fading at the reception point is multipath propagation of radio waves, and this phenomenon is combated by forming a set parallel channels through:

diversity reception (SIMO channels),

diversity transmission (MISO),

or the use of multiple receiving and multiple transmitting antennas (MIMO).

Let additive white Gaussian noise with zero mean and variance act at the input of each receiving antenna, and let the noise parameters σ_n^2 on the time interval $0 \leq t \leq \tau$ and $\tau \leq t \leq 2\tau$ be independent and equal.

It is assumed that the mutual arrangement of the transmitting antennas is such that a complete absence of fading correlation is ensured.

The complex channel factors between the transmitting and receiving antennas are known and unchanged over the interval under consideration $0 \leq t \leq 2\tau$ [2].

For such conditions, analytical expressions were obtained to determine the error probability for the MISO scheme [2, 3]:

$$P_{BER} = 0.5 - 0.5 F \left[\sqrt{\frac{4E_S \cdot (1 - \rho_S)}{N_0}} \cdot (M \cdot \xi)^2 \right], \quad (1)$$

where N_0 – spectral power density of interference; E_S – energy of the transmitted signal via communication channels.

The bit error probability for a system MIMO is expressed as follows [2, 3]:

$$P_{BER} = 0.5 - 0.5 F \left[\sqrt{\frac{2E_S \cdot (1 - \rho_S)}{N_0}} \cdot (M \cdot \xi)^2 \right]. \quad (2)$$

Formulas (1) and (2) define the parameters of the reception resistance and characterize the quality of the communication systems using technologies MISO and MIMO.

To determine the average probability error for all possible values of the multiplier $(M \cdot \xi)^2$ it is necessary to determine the distribution density of this random variable.

Thus, a comparison of the obtained analytical expressions with known studies allows us to conclude that the introduction of joint diversity of transmitting and receiving antennas using space-time coding increases the diversity factor.

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