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DISCRIMINATION AT RECEIVING DISCRETE SIGNALS

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Abstract.

This article presents the results in a digital radio communication systems at the input of the receiver it is known in advance the shape of the received signal. The study found that discrete messages and their corresponding signals are trying to use the opposite or orthogonal signals, which provides a degree of distinctiveness.

Keywords.

manipulation, trunking communication, radio systems, power signals, radio transmission systems, carrier frequency shift keying.

1. Introduction

In digital radio communication systems at the input of the receiver it is known in advance the shape of the received signal: the carrier frequency; kind of manipulation and speed signals. Currently, well studied statistical theory of radio systems for various purposes. Known probability of correct reception is primarily dependent on the modulation method used in the transmitter and the RTS signal-to-noise ratio at the receiver input. Typically, the sizing of the radio link is not considered a form used in the RTS signal, the correct choice of which depends largely on the probability of correct detection, distinction and as a result the playback quality message [1].

2. Main part

When the transmission of discrete messages and their corresponding signals are trying to use the opposite or orthogonal signals, which provides a degree of distinctiveness и $\gamma = 1 - R_{i,j}$, where - $R_{i,j}$ coefficient of correlation signals used. So that $\gamma = 1 - R_{i,j}$, it is sufficient for discriminate between signals when they are mutually orthogonal reception signals used.

When the transmission of discrete messages to each element of message u_j is assigned a signal S_j, to be transmitted over the air with minimal distortion. This requires the ability to build a reception amount of signal and noise, allowing

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optimal way to distinguish between the signals detected by the receiver $S_j(t)$ $(j = 1,2, \ldots, N)$ between themselves.

As an example, consider the transmission of binary messages, U_1 and U_2 using signals $S_1(t)$ and $S_2(t)$ with a priori probabilities P_1 and P_2 their distinction between a fluctuation in the presence of interference [3]. At the same time, we assume that each of these signals $S_j(t)$ $(j = 1,2)$ which have a finite energy

$$E_j = \int_{-\infty}^{\infty} S_j^2(t)dt < \infty. \quad (1)$$

When passing through the digital communication channel on the useful signal is superimposed additive disturbance $w(t)$ which is a stationary random process with a uniform (in the effective bandwidth where placed spectral signal components $S_1(t)$ and $S_2(t)$) with a power $G_w(w)$ density equal N_0. Then, each time at the receiver is $x(t) = S_1(t) + w(t)$ or $x(t) = S_2(t) + w(t)$ and a priori probabilities P_1 and P_2, respectively.

To do this, as synthesized signals, $S_1(t)$ and $S_2(t)$ set the operation of the receiver algorithm to automatically distinguish the situation of having at its input signal $S_1(t)$ or $S_2(t)$ the best way, ie a desired probability of correct reception P_{Π}. To do this, you must establish the criteria that will be evaluated through an optimal receiver. To do this, you must maximize the signal / noise ratio q_1 and q_2 transmission of signals, $S_1(t)$ and $S_2(t)$ in addition it is necessary to calculate the cross-correlation function between the signals $S_1(t)$, $S_2(t)$ and interference and conditional probabilities when there is no interference, and obstructions:

E_{11}; E_{22}; E_{12} and E_{21}; P_{11}; P_{22}; P_{12} and P_{21}.

Here E_{11} and E_{22} - energy signals; E_{12} and E_{21} - mutual energy (correlation) signals and P_{11} and P_{22} - the probability of correctly receiving signals, respectively $S_1(t)$ and $S_2(t)$; P_{12} and P_{21}- probability of erroneous reception signals S_2 instead of S_1 and S_1 instead of S_2 respectively [5]. Fig. 1 shows graphs of conditional probabilities, P_{11} and P_{12} when entering the receiver input signal $S_1(t)$.

Consider the optimization of the receiving-decision unit, subject to certain restrictions on the shape of the signals $S_1(t)$, $S_2(t)$ and their energy. At the same time, and we assume [2]. $E_1 = E_2 = E$ and $q_1 = q_2 = q$.

Minimize mutual energy $S_1(t)$ and $S_2(t)$ signals, ie, their mutual correlation, to obtain

$$N_0 e_{12} = -E = \int_{-\infty}^{\infty} S_1(t) S_2(t). \quad (2)$$

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The minimum e_{12} is reached at $S_1(t) = -S_2(t)$; $e_{12} = e_{21} = -q$; $U_1 = U_2 = 0$. for this situation

$$P_{12} = P_{21} = \int_0^{\infty} P_{12}(E)dE = \frac{1}{2}\left[1 - \mathrm{erf}(\sqrt{q/2})\right]; \quad (3)$$

$$P_{22} = P_{11} = \int_0^{\infty} P_{11}(E)dE = \frac{1}{2}\left[1 - \mathrm{erf}(\sqrt{q/2})\right]. \quad (4)$$

Thus $P_{12} = 1 - P_{11}$.

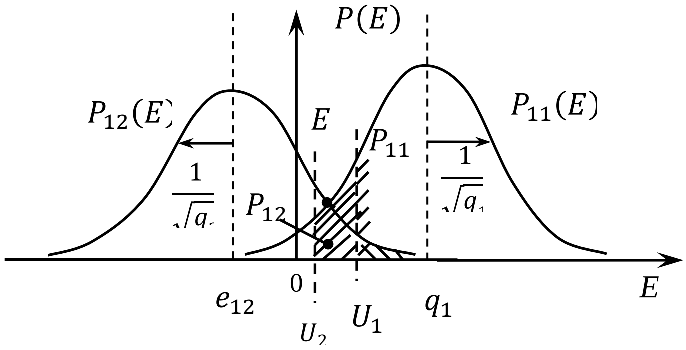

Fig. 1. Probability a priori probabilities of the signal energy

The reliability of binary channel leduyuschim determined by the expression:

$$\lambda = 1 + P_{11} log P_{11} + (1 - P_{11}) \log(1 - P_{11}). \quad (5)$$

The dependence of the reliability λ of a symmetric binary channel on the ratio of the interference/signal / 1/q is shown in Fig. 2.

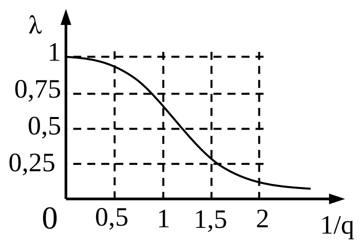

Fig. 2. Probability reliability of the relationship disturbance/signal

3.Conclusion

As a signal for maximum reliability, you can use phase-shift keyed signal $\Delta\varphi = \pm 180°$. In this case, as a result of the search and the detection output binary symmetric transmission channel discrete messages appear one of the following signals:

$S_1(t) = S(t) \cos \omega t$ (at φ = 0);

$S_2(t) = S(t) \cos(\omega t - \varphi) = -S(t) \cos \omega t$ (at φ = 180°).

The use of such signals in the main paths of mobile radio communication systems such as trunked communication ensures high reliability, which is necessary for its normal functioning.

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