METHOD OF CALCULATING THE CHARACTERISTICS OF DETECTING A BURST OF COHERENT PULSES AGAINST THE BACKGROUND OF GAUSSIAN IMPULSE NOISE

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Izvestiya VUZ. Radioelektronika,
Vol. 35, No. 11, pp. 55-59, 1992

UDC 621.391.01

Works are known, for example, [1, 2], which give expressions for calculating the qualitative indices (characteristics) of detecting a burst of coherent signals against the background of stationary Gaussian noise. However, in practice it is often necessary to deal with a situation when noise is a random pulse flow of Gaussian noise pulses [4-6]. There are no methods of calculating the characteristics of detecting signals for these conditions, which determines the urgency of their development.

The purpose of the present work was to determine the qualitative indices (probability of correct detection D and false alarm F) of the detector of a burst M of coherent pulses of a given power σ_s^2 against the background of a stationary stochastic flow of rectangular mutually nonoverlapping radio noise pulses of constant power σ_{in}^2 with a Gaussian distribution of the voltage amplitudes within the pulse. The values of the pulse duration τ_{in} and spacing T_{in} of impulse noise (IN) satisfy the conditions:

$$\tau_s \le \tau_{in} \le T_{in} \le M\,T_s, \Delta f_s - \Delta f_{in},$$

where τ_s, T_s are the values of the pulse duration and spacing of the desired signal, respectively; Δf_s, Δf_{in} are the half-power width of the signal and noise spectrum, respectively.

For the given conditions the probability density function of the random voltage u normalized to the variance of the internal noise σ_n^2 at the output of the coherent integrator can be represented in the form [1, 2]

$$f(u) = \exp\left\{-(u-q)^2 / [2(1+\nu^2)]\right\} / \sqrt{2\pi(1+\nu^2)}$$

- in the presence of the desired signal

$$g(u) = \exp\left\{-u^2 / [2(1+\nu^2)]\right\} / \sqrt{2\pi(1+\nu^2)}$$

- in its absence, where $q^2 = \sigma_s^2/\sigma_n^2$, $\nu_2 = \sigma_{in}^2/\sigma_n^2$ are values of the pulse power of the signal and IN at the detector input normalized to the variance of the internal noise.

At the output of the coherent integrator the amplitude of the random voltage $u_s = \sum_{n=1}^{M} u_n$, being a linear combination of normally distributed quantities u_n, also obeys the normal distribution law. Therefore, the probability density function of the voltage amplitude, which depends on the number of noise pulses j arriving during the time of integration of the signal, will have the form

$$f(u_s, j) = \exp\left\{-(u_s - M\,q)^2 / [2(M + j\nu^2)]\right\} / \sqrt{2\pi(M + j\nu^2)}$$

-in the presence of the desired signal;

$$g(u_s, j) = \exp\left\{-(u_s^2 / [2(M + j\nu^2)]\right\} / \sqrt{2\pi(M + j\nu^2)}$$

REFERENCES

1. B. R. Levin, Theoretical Basis of Statistical Radio Engineering [in Russian], Radio i Svyaz, Moscow, 1989.
2. Ya. D. Shirman and V. N. Manzhos, Theory and Techniques of Processing Radar Information Against a Noise Background [in Russian], Sov. Radio, Moscow, 1981.
3. N. M. Sedyakin, Elements of the Theory of Random Pulse Flows [in Russian], Sov. Radio, Moscow, 1965.
4. B. Leroy, Van Brant, Applied Electronics Countermeasures-EW, Engineering Inc., USA, vol. 3, 1982.
5. G. P. Tartakovskii (editor), Problems of Statistical Radar Theory [in Russian], Sov. Radio, Moscow, vol. 1, 1965.
6. M. V. Maksimov (editor), Protection from Radio Interference [in Russian], Sov. Radio, Moscow, 1965.

29 January 1992