A COMPARATIVE ESTIMATE OF THE QUALITY OF RADAR-SIGNAL DETECTORS ON A BACKGROUND OF NOISE OF VARIABLE INTENSITY

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For practical purposes the need arises to classify possible practical detection devices and to make a comparative estimate of their efficiency (quality). Below we consider mainly detectors of incoherent narrow-band signals, accompanied by additive Gaussian noise with varying intensity (i.e., nonstationary noise) [1] of the form

$$N_0(t) = \eta(t)\langle N_0\rangle, \tag{1}$$

where $N_0(t)$ is the current value of the spectral noise density, and $\eta(t)$ is a sample of a certain stationary random process with a one-dimensional probability density $p(\eta)$ and unit mean, where $\eta(t)>0$; $\langle N_0\rangle$ is the expectation value of the spectral density of the noise.

The class of detectors in question is shown in Fig. 1. The regulated transfer factor K(t) of the detector is formed using a special device for measuring the spectral density of the noise [2,3]. We will assume that it is a power function of the intensity $N_0(t)$ with exponent

$$K(t) \sim N_0^{\nu}(t). \tag{2}$$

The control of the detection threshold (Fig. 1), required in general, may be achieved using a variable voltage $U_0(t)$ applied to the decision device [3,4]. We will assume that after a time equal to the duration of the pulse signal, the change in the process can be neglected, and, consequently, the matched filter does not appreciably change the nonstationarity parameters of the process. We will also assume that the resultant process after summation can be taken as Gaussian, while the pulses at the input are weak. Hence, we have the necessary prerequisites for analyzing the efficiency in the asymptotic sense.

A natural indicator of the quality of detectors for Gaussian noise is the output signal/noise ratio, which is related monotonically to the detection probability [1,2,4].

If the detector (Fig. 1) is a square-law detector, then, according to [5], and taking into account the controlled transfer constant (2), we can write the output signal/noise ratio q_q in the form

$$q_q = \sum_{i=1}^{n}\langle E_i\rangle\left(\sum_{i=1}^{n}\langle N_i^2(t)\rangle\right)^{-0.5} = n^{0.5}\langle E_{in}N_0^{2\nu}(t)\rangle\langle N_0^{4\nu+2}(t)\rangle^{-0.5}, \tag{3}$$

where E_i and $N_i(t)$ is the power of the pulse and the spectral density of the noise, respectively, at the output of the attenuator in the i-th probing period, E_{in} is the power

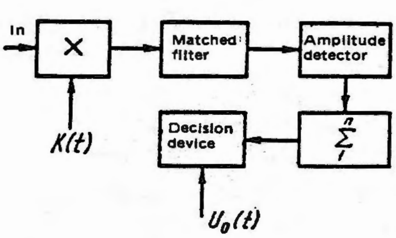

Fig. 1

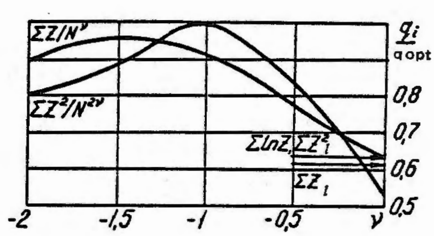

Fig. 2

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