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JOINT PROBABILITY DENSITIES OF ENVELOPES AND PHASES IN SIGNAL-NOISE MIXTURE IN THE RECEPTION CHANNEL OF A SURVEILLANCE MONOPULSE RADAR SYSTEM

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To check the hypothesis about independence of probability densities (PD) of envelopes and phases in the mixture of a determinate harmonic signal and quasiharmonic noise in the summation (Σ) and difference (Δ) channel of the reception part of the surveillance monopulse radar, expressions are derived for joint PD of these values in the form of products of single-dimensional PD in the Σ- and Δ-channels.

The problem of creation of three-coordinate surveillance radar systems (able to measure target's range, azimuth, and elevation angle) has a whole number of alternative solutions. One of them consists in using the monopulse (MP) method of direction finding in the measuring channel of target's elevation.

The main task of any measurer is to provide the required accuracy of measurement (estimation) of the parameter under interest. The analytical description of a design version, and statistical analysis of accuracy of the channel of target's elevation measurement, as a part of a surveillance MP radar with amplitude direction finding and summation-difference processing of signal, are presented in [1]. In the work cited, for determination of the mean value of the module of ratio between the envelopes in the addition (Σ) and difference (Δ) channel we used the assumption about independence of probability densities (PD) of the envelopes and phases of the mixture of a determinate harmonic signal, and quasiharmonic noise in the Σ- and Δ-channels of the reception part of the surveillance MP radar. The purpose of this paper consists in checking this hypothesis provided the noises in the channels are independent.

For simulation of quasiharmonic noise in the channels of the signal processing system in the surveillance MP radar it is expedient to use the models of independent narrow-band random processes with symmetric spectral density. It is well known [2] that the latter give the most comprehensive description of noise characteristics of radar reception system. These processes are well studied [2, 3], and in what follows we shall employ only the results of their analysis.

Represent an additive mixture of a determinate harmonic signal and of quasiharmonic noise in the Σ- and Δ-channels of the reception part of a MP radar in the form

$$\xi_{\Sigma(\Delta)} = s_{\Sigma(\Delta)}(t) + n_{\Sigma(\Delta)}(t) = X_{\Sigma(\Delta)}(t)\cos(\omega_0 t + \varphi_{\Sigma(\Delta)}(t)),$$
$$X_{\Sigma(\Delta)}(t) \geq 0,\; -\pi \leq \varphi_{\Sigma(\Delta)}(t) \leq \pi, \tag{1}$$

where $s_\Sigma = A_0 \cos \omega_0 t$; $s_\Delta = kA_0 \cos(\omega_0 t + \psi)$; A_0 is a priori unknown amplitude of a determinate harmonic signal; ω_0 is the carrier (intermediate) frequency of the signal in the reception path; k is a coefficient characterizing the attenuation of the signal in the Δ-channel; ψ is the phase of the Δ-signal, equal to 0 or π; $X_{\Sigma(\Delta)}(t)$ are the envelopes of the signal-noise

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