MEASUREMENT OF THE PHASE OF A QUASI-HARMONIC SIGNAL
ON A BACKGROUND OF INTERFERENCE WITH A NONSYMMETRICAL SPECTRUM

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We will consider the estimate of the accuracy of phase measurements on a background of interference with a nonsymmetrical spectrum, which occurs when the frequency of the received signal does not coincide exactly with the frequency of the linear filters of the phase-measuring device. In this case we measure the phase of a quasi-harmonic signal

\[ x(t) = A(t) \cos(\omega t + \theta), \quad 0 \leq t \leq T \]

(1)
on a background of nonstationary Gaussian interference \( n(t) \) with correlation function

\[ B(t, u) = b_1(t, u) \cos(\omega(t - u)) - b_2(t, u) \sin(\omega(t - u)), \]

(2)
corresponding, in the stationary case, to a nonsymmetrical interference spectrum.

The functional of the likelihood ratio for this case [1] can be written in the form

\[ L[x(t) | \theta] = \exp \left\{ -\frac{1}{2} \int_0^T A(t) f_1(t) dt \right\} \exp \left\{ 2 \cos \theta \int_0^T x(t) v_2(t) dt + \right. \]

\[ + 2 \sin \theta \int_0^T x(t) v_1(t) dt, \]

where

\[ x(t) = z(t) + n(t); \quad v_1(t) = f_1(t) \cos \omega t + f_2(t) \sin \omega t; \]

\[ v_2(t) = f_1(t) \cos \omega t - f_2(t) \sin \omega t. \]

Here \( f_1(t), f_2(t) \) are the solutions of the integral equations:

\[ \int_0^T b_1(t, u) f_1(u) du = A(t); \]

(3)

\[ \int_0^T b_2(t, u) f_2(u) du = \int_0^T b_2(t, u) f_1(u) du. \]

(4)

In this case the maximum-likelihood estimate of the signal phase is

\[ \theta^* = \arctg(Y/X) + \pi n, \]

(5)

where

\[ X = \int_0^T x(t) v_1(t) dt; \quad Y = \int_0^T x(t) v_2(t) dt; \]

\[ n = \begin{cases} 0, & X > 0; \\ 1, & X < 0. \end{cases} \]

The random quantities \( X \) and \( Y \) are normal, since they were obtained as a result of linear operations on the normal random process \( x(t) \). For average values of the variance of the random quantities \( X \) and \( Y \) and of the correlation coefficient between them, the following expressions hold:

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REFERENCES


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