Analysis of the Information Contained in Amplitudes of the Reflected Signals Received by Space Diversity Radars

Dmitriy Vasiliev

Abstract - In this paper crosscorrelation treatment of the narrow-band signals of two different frequencies of one band of lengths of events reflected from the radar target is examined. Thus the mathematical model of reflecting characteristics of radar target is used.

Keywords - Radar target, reflected signal, space diversity radars, envelope squares of amplitudes, reflecting elements.

I. INTRODUCTION

In the modern scientific and technical literature questions of the analysis of the information on geometrical characteristics of the radar targets contained in the reflected multifrequency signal are examined [1, 2]. These geometrical characteristics can be used as attributes of identification of various classes of the targets. Investigation character of the information received at joint treatment of signals received by system of space diversity radars workings on different frequencies of one wavelength band allows to shorten the count of in-use diversity radars workings on different frequencies of one space diversity radar. The analysis of the got information can be used as attributes of identification of various classes of radar targets [1, 2]. These geometrical characteristics are complex factors of reflection and n reflecting elements on frequency 1f (Radar 1); 1i, 2i are coordinates i and n reflecting elements on frequency 2f (Radar 2); x1i, x1n, x2i, x2n are coordinates i and n reflecting elements along line-of-sight Radar 1 and Radar 2 accordingly; φ1i, φ1n, φ2i, φ2n are phases of complex factors of reflection of reflecting elements of the target accordingly for Radar 1 and Radar 2.

As a result of the lead averagings and calculations we shall get expression for mutual time correlation function of envelope squares of amplitudes of the signals reflected from the radar target received to two examined radars as

\[ E_{12}(t, β) = 4 N^2 σ^4 + 4 N σ^2 + 4 σ^2 N(N - 1) \times \exp \left\{ -2 \left[ (2m_2 \cos β - 2 m_1)^2 σ^2 + (2m_2 \sin β)^2 σ^2 \right] \right\}. \] (3)

Expression for the rationed coefficient of correlation of envelope squares of amplitudes of the reflected signals received space diversity Radar 1 and Radar 2 workings on two different frequencies will look like

\[ R_{12}(t, β) = \frac{1}{N} + \frac{N - 1}{N} \times e^{-2 \left[ (2m_2 \cos β - 2 m_1)^2 σ^2 + (2m_2 \sin β)^2 σ^2 \right]}. \] (4)

The analysis of the got expression shows that coefficient of crosscorrelation depends on quantity of reflecting elements on the target, frequencies of probing signals, a corner of difference between radars and average on an interval of supervision longitudinal and transverse the sizes of the radar targets.

II. FUNDAMENTAL MATERIAL

Let the radar target is observed during some interval of time two diversity on a corner β radars here Radar 1 radiates and receives a narrow-band signal on frequency f1, and Radar 2 - on frequency f2 of the same wavelength band.

We shall calculate coefficient of crosscorrelation of envelope squares of amplitudes of the signals reflected from the radar target received by system two space diversity radars. All calculations we shall lead in view of mathematical model of reflecting characteristics of the radar target [1, 2].

We shall consider that quantity of reflecting elements on the target, their position and intensity does not change with change of frequency of a probing signal and receive-direction (the corner of diversity of radars β is small). For complex amplitudes of total field accepted accordingly on frequencies f1 and f2 it is possible to write down expressions as

\[ |E_{12}(t)|^2 = \sum_{i=1}^{N} |S_{1i}(t)|^2 + 2 \sum_{i=1}^{N} \sum_{l=n}^{N} |S_{1i}(t)||S_{1j}(t)| \times \cos \left\{ -2m_1[x_1i(t) - x_1j(t)] + [φ_{1i}(t) - φ_{1j}(t)] \right\}, \] (1)

where S1i(t), S1j(t) are complex factors of reflection i and n reflecting elements on frequency 1f (Radar 1); S12(t), S22(t) are complex factors of reflection i and n reflecting elements on frequency 2f (Radar 2); x1i, x1n, x2i, x2n are coordinates i and n reflecting elements along line-of-sight Radar 1 and Radar 2 accordingly; φ1i, φ1n, φ2i, φ2n are phases of complex factors of reflection of reflecting elements of the target accordingly for Radar 1 and Radar 2.

III. CONCLUSION

Measuring value of the rationed coefficient of crosscorrelation of envelope squares of amplitudes of the signals reflected from the observable radar target it is possible to define the supervision average on an interval its longitudinal and transverse sizes.

REFERENCES