

Quasi-Likelihood Estimation of the Time Parameters of Ultrawideband Signal Sequence of Unknown Shape under the Influence of Narrowband Interferences¹

A. P. Trifonov^{1*}, M. B. Bespalova¹, P. A. Trifonov^{2**}, and I. V. Gushchin²

¹*Voronezh State University, Voronezh, Russia*

²*Zhukovsky–Gagarin Air Force Academy, Voronezh, Russia*

**e-mail: trifonov@phys.vsu.ru*

***e-mail: bk_123@bk.ru*

Received in final form April 29, 2015

Abstract—In this article we investigate the characteristics of a quasi-likelihood estimation of the time of arrival and the repetition period of ultrawideband signal of unknown form, which is received on the background of narrowband interferences with unknown parameters and of Gaussian white noise.

DOI: 10.3103/S0735272716030031

Currently, the application of ultrawideband signals (UWBS) is the innovative and one of the most promising technologies [1–6], which is widely used in various radioelectronic systems, including military systems.

The physical basis of the expedience of implementation of ultrawideband signals is obvious, namely the amount of information, that is transmitted per unit time, is directly proportional to the frequency band utilized. An alternative to this is to increase the data transfer time, but in radiolocation the contact time with the target is always limited, thus there remains the problem of information capacity enhancement in the case of application of traditional approaches.

In many applied problems of radiolocation the radar receiver's objective is to measure the main time parameters of the reflected from the target UWBS sequence, namely the arrival time and repetition period. In [6] the authors considered the maximum likelihood estimation of these parameters under the influence of Gaussian white noise (GWN) only. In [3] the authors investigated the algorithms for the estimation of the time of arrival and repetition period of UWBS sequence on the background of noise, as the model of which they used Gaussian narrowband process (GNP) [7]. In that case the shape of UWBS was considered as known a priori.

Under real conditions the form of the received signal is unknown, because it changes after the reflection from the object (in the case of radiolocation), during the propagation in various media (navigation, communications), and in the process of radio monitoring the form of the signal is always unknown. In [5] the authors considered the problem of estimation of time parameters for the video pulses sequence (a special case of UWBS) of unknown shape, but the influence of interferences had not been taken into account. In this paper we consider the problem of estimation of the arrival time and repetition period for UWBS of unknown form on the background of the GNP and GWN. In this case the characteristics of GNP are also unknown.

The purpose of this investigation is to determine the deterioration in accuracy of measurement of the arrival time and the repetition period due to the differences in the form of expected and received UWBS, and also due to the influence of narrowband interferences.

Let us assume that on the time interval $t \in [0, T]$ we observe the realization of the following type:

$$x(t) = s_{0N}(t, \lambda_0, \theta_0) + n(t) + \xi(t),$$

¹ The investigation was carried out with the support of Russian Science Foundation (project No. 15-11-10022).