ISSN 0735-2727, Radioelectronics and Communications Systems, 2010, Vol. 53, No. 1, pp. 20–24. © Allerton Press, Inc., 2010.
Original Russian Text © A.A. Shpylka, S.Ya. Zhuk, 2010, published in Izv. Vyssh. Uchebn. Zaved., Radioelektron., 2010, Vol. 53, No. 1, pp. 25–30.

Joint Interpolation of Data and Parameter Filtration of a Multibeam Communications Channel

A. A. Shpylka and S. Ya. Zhuk
National Technical University of Ukraine "Kyiv Polytechnic Institute", Kyiv, Ukraine
Received in final form September 1, 2009

Abstract—The optimal and quasi-optimal algorithms of joint data interpolation and parameter filtration of a multibeam communications channel have been synthesized by using the tools of mixed Markov processes in discrete time. The analysis of the quasi-optimal algorithm and its comparison with an adaptive filter based on the training sequence were carried out by using the computer statistic simulation for a model example.

DOI: 10.3103/S0735272710010048

Adaptive equalizers using training sequence have found wide application for the compensation of distortions in multibeam communications channels [1]. However, there are a number of applications, such as multiuser communications networks, where it is desirable to perform the distortion compensation without the use of training sequence. That is why a topical problem emerging during the data transmission over a multibeam communications channel with unknown parameters is the synthesis of adaptive algorithms making it possible to adjust the equalizer coefficients without transmission of a test sequence blindly [1]. One of the promising directions implies joint estimation of channel parameters and data. In order to solve this problem, the apparatus of mixed Markov processes in discrete time was utilized that is adequate to computer.

Without restrictions of generality and also for the purpose of reducing the volume of this paper we shall apply a real practical model of the multibeam communications channel, which is in common use nowadays [2]:

$$y(k) = \sum_{l=0}^{\Delta-1} s_j(k-l)c_l + \upsilon(k), \tag{1}$$

where $y(k)$ is the value measured at the output of multibeam communications channel; $s_j(k)$, $j=\overline{1,m}$ is the transmitted information symbol; m is the modulation size; c_l, $l=\overline{0,\Delta-1}$ are coefficients describing parameters of a multibeam channel; $\upsilon(k)$ is the uncorrelated Gaussian sequence with zero mathematical expectation and dispersion $R(k)$; Δ is the number of beams of multibeam communications channel.

The results obtained can be extended to the case of a complex model of multibeam communications channel by using the technique presented in paper [3].

The vector-matrix model of a multibeam communications channel in the state space equivalent to model (1) is described by the following expressions:

$$\mathbf{x}(k) = \mathbf{x}(k-1), \tag{2}$$

$$y(k) = \mathbf{H}(k)\mathbf{x}(k) + \upsilon(k), \tag{3}$$

where $\mathbf{x}(k) = |c_0, c_1, \ldots, c_{\Delta-1}|^{\mathrm{T}}$ is the vector containing unknown parameters of a multibeam communications channel; $\mathbf{H}(k) = |s_j(k), s_i(k-1), \ldots, s_\beta(k-\Delta+1)|$ is the row matrix containing information symbols $j, i, \beta = \overline{1,m}$.

Expression (2) takes into account that coefficients c_l remain invariable on the observation interval.