ISSN 0735-2727, Radioelectronics and Communications Systems, 2013, Vol. 56, No. 3, pp. 155–158. © Allerton Press, Inc., 2013.
Original Russian Text © V.K. Marigodov, E.F. Baburov, 2013, published in Izv. Vyssh. Uchebn. Zaved., Radioelektron., 2013, Vol. 56, No. 3, pp. 60–63.

Solution of Inverse Variation Problem in the Theory of Optimal Linear Filtering

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Received in final form January 10, 2013

Abstract—It is presented is the possibility to solve the inverse variation problem based on the determination of a primary functional by the results of minimum mean-square error in optimal linear filtering of the signal theory.

DOI: 10.3103/S0735272713030072

INTRODUCTION

The solution of variation problem is carried out for optimal linear predistortion and correction of the signals [1]. Here, it is also considered a possibility of definition of initial and boundary condition for solution of inverse and reverse problems. The lasts were solved on a basis of fixing the additive noise at the receiver input in case of increase of predistorted signals power at the input of communication channel, and also application of game-theory approach in a conflict situation of interaction of communication and radio masking systems operators. It is also used possibility of predistorting filter amplitude-frequency characteristics (AFC) optimization.

As researches show, the solution of reverse problem in a theory of optimal linear filtering, i.e. obtain of the initial functional on a basis of definite value of mean square error of filtering, does not result in desired result. In this connection stated problem should be solved by indirect method, namely by the method of inverse variational calculations separately for initial functional and filtering result. Further it is necessary to compare the relations obtained.

The purpose of the paper lies in obtain of initial functional in a theory of linear filtering on a basis of known value of meansquare error at the output optimal linear filter, which estimates the efficiency of signals processing on a background of additive noise in a communication channel.

GAME-THEORY ESTIMATION OF OPTIMAL LINEAR FILTERING RESULT

Minimal meansquare error $\overline{\varepsilon^2_{\min}}$ at the output of optimal linear filter in case of unsatisfying of condition of its physical possibility is obtained using condition [2]:

$$\overline{\varepsilon^2_{\min}} = \frac{1}{2\pi}\int_{-\infty}^{\infty} \frac{G(\omega)N(\omega)}{G(\omega)+N(\omega)}\,\mathrm{d}\omega, \tag{1}$$

where $G(\omega)$ and $N(\omega)$ are spectral power density of useful signal and additive noise, correspondingly.

In game-theory problem statement we should consider a conflict situation of antagonistic interaction of data transmission system (DTS) operator and radio noise system (RNS) operator, which in case of obtain of (1) and selection as pure spectra G and N strategies can be written in following form:

$$\min_N \max_G \overline{\varepsilon^2} \le \max_G \min_N \overline{\varepsilon^2}, \tag{2}$$

where G, N are mentioned pure strategies.