ISSN 0735-2727, Radioelectronics and Communications Systems, 2008, Vol. 51, No. 8, pp. 421–425. © Allerton Press, Inc., 2008.
Original Russian Text © A.A. Popov, 2008, published in Izv. Vyssh. Uchebn. Zaved., Radioelektron., 2008, Vol. 51, No. 8, pp. 25–32.

Possibilities of Processing of Signals with Completely Defined Parameters against a Background of Interferences (Noises) in a Signal Space with Algebraic Lattice Properties

A. A. Popov
National Academy of Defence, Kyiv, Ukraine

Received in final form 5 April, 2007

Abstract—It is shown, that processing of signals with completely defined parameters against a background of interferences (noises) in a space with algebraic lattice properties, we can achieve better processing parameters, than in linear algebraic space.

DOI: 10.3103/S0735272708080037

The most known papers consider problems of signals against interferences (noises) processing in terms of linear signal £ space; in this case interaction result x of signal s and noise n is described by addition operation of commutative group: $x = s + n$ [1–7]. But a number of authors suppose signal processing problem with regard to signal and interference (noise) interaction [8].

An object of further consideration of this paper is analysis of possibilities of signals with completely known parameters against interferences (noises) processing in signal space with algebraic lattice properties and obtained results comparison with existent result for additive interaction of useful and interfering signals in linear signal space. Algebraic lattices are widely known, researched and described in many papers. As a signal space we consider distributive lattice $L(\vee,\wedge)$ with operations of upper and lower limit correspondingly: $a \vee b = \sup_L\{a,b\}$, $a \wedge b = \inf_L\{a,b\}$ [9, 10]. At that, elements a, b of lattice $L(\vee,\wedge)$ can be elements of n-dimensional vector space ($a = [a_1, a_2, \ldots, a_n]$, $b = [b_1, b_2, \ldots, b_n]$) or functions (determinate or random), defined in several set T ($a = a(t)$, $b = b(t)$, $t \in T$).

The signal $s_i(t)$ with completely defined parameters from the ensemble $\{s_k(t)\} \equiv \{s_k\}$ ($k = 0, 1, \ldots, K$) is represented in form of

$$s_i(t) = s_i(t, \boldsymbol{\lambda}_i, \boldsymbol{\mu}_i) = s_i(t, \boldsymbol{\mu}_i),$$

where $\boldsymbol{\lambda}_i$ is information parameters vector ($\boldsymbol{\lambda}_i \equiv 0$); $\boldsymbol{\mu}_i$ is non-information parameters vector; where information parameters are absent ($\boldsymbol{\lambda}_i \equiv 0$), among non-information parameters $\boldsymbol{\mu}_i$ there are absent unknown and random parameters.

Field of application of such signals is restricted by theoretical analysis, whose results can be applied for comparison with the other algorithms of signal processing. Model of interaction of signal s_i from ensemble $\{s_k\}$ ($k = 0, 1, \ldots, K$) and noise n in signal space with algebraic lattice properties is described by relation:

$$x = s_i \vee n, \tag{1}$$

where $s_0 = \text{O}$, O is zero element of the lattice $L(\vee,\wedge)$.

Cross-linking function of optimal signal processing algorithm in this case is

$$y = \hat{s} \wedge x, \tag{2}$$

where signal estimation is