Radioelectronics and Communications Systems
Vol. 49, No. 9, pp. 29–35, 2006

Izvestiya VUZ. Radioelektronika
Vol. 49, No. 9, pp. 44–53, 2006
UDC 621.391.1

A METHOD FOR GENERATION OF THE FULL CLASS OF PERFECT BINARY ARRAYS OF THE ORDER $N = 2^k$

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The paper presents a new constructive method for generation of the full class of perfect binary arrays of the type $N = 2^k$ of arbitrary dimension, with exact estimation of its power.

Considerable recent attention has been focused on generation and inquiries in the structural and correlative properties of perfect binary arrays (PBA) and of their rarified (sparse) matrices. But the known methods of synthesis of PBA — $H(N)$ cannot synthesize full classes of PBA for a prescribed order (dimension) in N: $N = 2^k$, or $N = 3 \cdot 2^k$, for an arbitrary integer k. Moreover, at the present time we do not know the power of full classes of PBA for many orders ($N_1 \times N_2$). For example, in [1] the estimate of the power of the full class of PBA of order $N = 3 \cdot 2^1 = 6$ was established. In [2], based on the spectral approach, and then in [3], with the use of the time (correlative) approach, the estimate of the power of the full class of PBA of order $N = 2^k$ was obtained:

$$W(N) = W(2^k) = \begin{cases} 3^{k/2} 2^{2^{k+1}-1}, & \text{for even } k, \\ 3^{(k-1)/2} 2^{2^{k+1}-1}, & \text{for odd } k, \end{cases} \tag{1}$$

and several algorithms for their construction were suggested.

Further investigation of structural and correlative properties of PBA and of their sparse matrices permitted to define all available structures of the sparse matrices and to introduce a new estimation of power of the full class of PBA of the order $N = 2^3 = 8$ [4], which exceeds the estimate (1) by a factor of 7.

The purpose of this paper is development of a constructive method for generation of the full class of PBA of square shape for any order $N = 2^k$. The method is based on general structural and correlative properties of PBA and their sparse matrices. Another purpose consists in exact estimation of power of a PBA of any prescribed order.

It is known [2–4] that an arbitrary PBA of order $N = 2^k$, obtained by rarifying along spatial coordinates, can always be represented as an alternation of four sparse matrices for all possible (4! = 24) rules of their permutations [4]. The reverse rule is true as well: if we know four structures of sparse matrices constituting a PBA, then, by all possible permutations, we can build 4! = 24 different PBA.

In order to build the full class of PBA $H(N)$ with a preset order N, it is necessary to use the full class of PBA of a less order — $N/4$, and the sparse matrices $B(N/2)$, $C(N/2)$, and $D(N/2)$ of order $N/4$.

It has been shown in [4] that in order to generate PBA of order $N > 4$, we must use one of the following combinations of sparse matrices:

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7 February 2006