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Constructive Synthesis Methods of Binary Error Correcting Code of Length 32 for MC-CDMA Technology

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Abstract—The article proposes the constructive synthesis methods of binary error correcting code of length $N = 32$ with the optimal value of peak-to-average power ratio of Walsh–Hadamard spectrum for MC-CDMA technology. The authors have developed three constructive methods for the synthesis of codewords of correcting code: in the time domain, in the Walsh–Hadamard transform domain, and in the Reed–Muller transform domain. The parameters of the built code correspond to the best-known codes in McWilliams table.

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One of the most promising technologies of multiple access in the broadband wireless networks of new generation is the MC-CDMA (Multi-Code Code-Division Multiple Access). MC-CDMA is a simple solution that supports a flexible trade-off between data transfer speed and the number of users in the communication system. Thus, a user who wants to transmit data at a higher speed can be assigned an additional orthogonal data channel and, conversely, the number of users of the system can be increased by reducing the number of orthogonal channels assigned to each user [1].

The signals used in the communication system based on the MC-CDMA technology are generated using the sums of the N-th number of discrete Walsh–Hadamard transforms, where N is the number of orthogonal channels of the system.

The binary data vector $b = \{b_i\}, i = \overline{0, N-1}$ undergoes the orthogonal transformation in the MC-CDMA system. In the case when each data bit b_i changes the sign of one of the N orthogonal functions of discrete time $h_i(t)$, and the output is the sum of these N modulated functions, then the transmitted signal is the Walsh–Hadamard spectrum of the sequence b

$$S_b(t) = \sum_{i=0}^{N-1} b_i h_i(t). \tag{1}$$

We also note that this method of signal generation has found its numerous applications today in information transmission systems with VLC (Visible Light Communication) technology [2].

Obviously, the signals generated using Walsh–Hadamard transform coefficients lead to the high Peak-to-Average Power Ratio (PAPR) in the system that is a significant drawback

$$\kappa = \frac{P_{\max}}{P_{\text{avr}}} = \frac{1}{N} \max_t \{|S_b(t)|^2\}, \tag{2}$$

where $P_{\max}$ is the peak power of the signal $S_b(t)$, P_{avr} is the mean power of the signal $S_b(t)$, N is the length of the sequence.

The most promising approach to reducing the peak factor κ is coding the original messages d_j with such codewords c_i so that the Walsh–Hadamard spectrum would have the smallest peak factor κ, in other words, building the optimal C-code in terms of the peak factor (Fig. 1).

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ADDITIONAL INFORMATION

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