ISSN 0735-2727, Radioelectronics and Communications Systems, 2013, Vol. 56, No. 5, pp. 260–264. © Allerton Press, Inc., 2013.
Original Russian Text © V.L. Seletkov, 2013, published in Izv. Vyssh. Uchebn. Zaved., Radioelektron., 2013, Vol. 56, No. 5, pp. 59–64.

Variants of Decoding of Unsystematic Cyclic Codes

V. L. Seletkov
Kyiv, Ukraine

Received in final form November 30, 2011

Abstract—It is considered two variants of syndrome decoding of unsystematic cyclic codes with decoding errors correction for output symbols of decoder, which is recursive or non-recursive filter of decoded coding symbols.

DOI: 10.3103/S0735272713050051

PROBLEM STATEMENT

Systematic binary cyclic codes are the most widely applied due to enough simple realization procedure of their syndrome decoding. After detection (regarding code error correction possibility) of an error of code word with the syndrome methods and the correction in systematic component of code word, the decoding problem is considered solved [1, 2].

But it is of definite interest considering the methods of syndrome decoding of binary unsystematic cyclic codes, since the procedures of their decoding are based on decoding of non-recursive convolution codes [1, 2]. Therefore we consider main variants of syndrome decoding of unsystematic binary cyclic codes.

MAIN PART

Methods of unsystematic cyclic encoding are based on polynomial description of information and code words using expanded Galois fields. For simplification of further analysis we assume the components of code $\mathbf{Y} = [y_i]$, $i = \overline{0, n-1}$ and information $\mathbf{X} = [x_j]$, $j = \overline{0, k-1}$ vector are members of Galois fields $GF(2^p)$. In case of unsystematic cyclic encoding the code polynomial $y(t) = \sum_{i=0}^{n-1} y_i t^i$ is represented in form of the product of corresponding generic $g(t) = \sum_{i=0}^{m} g_i t^i$ and information $x(t) = \sum_{i=0}^{k-1} x_i t^i$ polynomials:

$$y(t) = g(t)x(t) = \sum_{i=0}^{m} \sum_{j=0}^{n-m-1} g_i x_j t^{i+j}.$$

Generic $g(t)$ and checking $h(t)$ polynomials of cyclic code are always related with main expression [1, 2]

$$g(t)h(t) = t^n + 1.$$

In case of presence of errors in code word channel transmission, represented by correspondent error polynomial $\varepsilon(t)$, the polynomial of received code word $z(t)$ can be in following form

$$z(t) = y(t) + \varepsilon(t) = g(t)x(t) + \varepsilon(t). \quad (1)$$

Relation (1) allows to synthesize main algorithms of recursive and non-recursive convolution decoding of unsystematic cyclic code.

We write general analytic relations for recursive algorithm of syndrome decoding of unsystematic cyclic codes.