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Methods of increasing the power of interference-resistant barker-like codes

Abstract – It is known that the power of any multi-position interference-resistant sequence, in particular a Barker-like sequence, is determined by the number of its digits and increases accordingly with the increase in the length of the code sequence [4]. One of the well-known methods of increasing the power of barker-like interference-resistant sequences based on IRB is to use next to the combinations of the basic cyclic code of combinations, where all symbols in the corresponding digits are changed to the opposite.

Keywords – BCH code, ideal ring bundle, Barker code, barker-like code.

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The algorithm for the synthesis of barker-like interference-resistant code sequences based on high-power ideal ring bundle (IRB) involves the following actions:

- on the basis of the input data that characterize the given corrective capacity of the code sequence and its power, select a suitable family of IRBs with parameters that could satisfy the given requirements;
- a set of code sequences is built according to the selected family of IRBs, while using all the possibilities of IRB variants, in particular inverse code sequences;
- perform a pairwise check on a set of code sequences of their minimum code distances;
- from the set of constructed barker-like code sequences, a subset k of code sequences with minimum code distances that provide the desired corrective capacity of the code sequence are selected;
- if the generated barker-like code sequence satisfies the specified requirements for correction capacity and power, the calculation is completed.

If these requirements could not be met, the selected set of code sequences is supplemented with other numerical sequences based on the corresponding IRBs or their fragments, or a family of IRB options with a higher power is selected, after which they proceed to the operations according to clause 2. The calculations are continued until the desired result is obtained result.

Barker-like jamming-resistant code is built using the unique properties of "ideal ring bundles" (IRB) -of ordered integer sequences with a ring structure, all numbers of which, together with all sums of adjacent numbers, exhaust the natural series. To build a cyclic code with the length of code combinations S_N with the help of IRB, it is enough to highlight the line with S_N of the numbered positions of the one-dimensional array and fill with information units those positions of the code whose numbers coincide with the number x_j, which is found from the dependence

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$$x_j - 1 \equiv \sum_{i=1}^{j} k_i \left(\bmod S_N\right), j = 1, 2, ..., N, \tag{1}$$

$$S_N = N\left(N-1\right)/R + 1, \tag{2}$$

where k_i – i -th element of the selected IRB;

N, R – IRB parameters.

The rest of the cells are filled with informational zeros. The generated sequence of binary symbols is a creative combination of the code, by cyclic shifting of which the rest can be obtained $S_N - 1$ code combinations.

The minimum code distance for this code is determined by dependency

$$d_{\min} = 2(N-R) \tag{3}$$

The number of errors that can be corrected with this code depends on the parameters N and R:

$$t \leq \left(N - R - 1\right) \tag{4}$$

One of the indicators of the quality of interference-resistant coding is the ratio of the minimum code distance (3) and the length (2) of the allowed code combinations, which characterizes the effectiveness of the corrective ability of the K_e code:

$$K_e = d_{\min}/S_N\ . \tag{5}$$

However, Barker-like optimized codes make it possible to correct a greater number of errors with the same number of bits of the compared codes almost directly proportional to the bit rate, but not exceeding the level of 25% of the total number of bits of code combinations, while maintaining a fixed value of the power of the correction code.

It should be noted that the ratio between the lengths of code combinations and the efficiency indicators of barker-like codes built on the basis of IRB with different ratios of parameters ($N >> R$ and $N \approx 2R$), increases in direct proportion to the increase in the corrective capacity of the codes.

The main advantage of a Barker-like code with optimized parameters is the possibility of correcting up to 25% of errors at a stable level of efficiency of the

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code's corrective capacity with an arbitrarily large number of its digits, which favorably distinguishes this code from standard codes, in particular, BCH codes.

Conclusion. The corrective efficiency of barker-like codes built on the basis of multi-element IRBs with optimized parameters reaches the value of 0.5 with an arbitrarily large number of bits of code sequences. At the same time, the maximum possible number of corrected errors is 25% of the total number of code bits.

Research results can find practical application for the development of information technologies and systems with improved technical characteristics according to such indicators as ensuring the reliability of information, increasing the reliability, functional safety and survivability of information and information-management systems.

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Алгоритм генерації лабіринтів на основі моделі Амарі

Анотація – у даній роботі було проведено огляд та аналіз алгоритмів генерації лабіринтів, їхні особливості, переваги та недоліки. Визначені та проаналізовані основні інформаційні та програмні засоби необхідні для реалізації завдання. Досліджені параметри моделі Амарі, які впливають на процес генерації лабіринтів. Розроблений унікальний алгоритм генерації лабіринтів з використанням моделі Амарі. В основі даного алгоритму лежать теоретико-практичні знання з обчислювальної нейробіології.

Ключові слова – алгоритм, лабіринт, модель, нейрон, мережа.

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