UDC 004.032.26

Yu. Khanas, A. Golovatyy, K. Kaganovych
Lviv Polytechnic National University, DCAD

COMBINED NUMERICAL MATRIX BALANCE TYPES

The article proposes a new method for balancing matrices, which is based on a combination of several previously developed methods. This method will have several variations of application, which will be demonstrated in the article.

Key words: centripetal balancing, centrifugal balancing, balancing with the star, individual balancing.

КОМБІНОВАНІ ТИПИ ЗБАЛАНСУВАННЯ ЧИСЛОВИХ МАТРИЦЬ

Запропоновано новий метод збалансування матриць, оснований на комбінації кількох розроблених раніше методів. Кілька варіацій застосування методу продемонстровано у статті.

Ключові слова: доцентрове збалансування, відцентрове збалансування, збалансування зіркою, одиничне збалансування.

Introduction

Simultaneous application of several balancing algorithms in the form of a combined method enables to increase the efficiency of encryption of data or messages. The method of transformation of numerical matrices does not exclude the alternate application of various algorithms of transformation and the formation of an encryption key. Balancing methods belong to a number of new methods for converting numeric matrices, and encryption is only one of the areas of application of these methods and algorithms.

1. Types of matrices to balance the star

Like all previously developed and proposed algorithms, the method of applying a star balance will depend on the type of the matrix itself. Among the characteristics of the matrix, one of the most important tools for their transformation is the size of the matrix, namely the number of columns and rows.

For example, matrices with different ratios of rows and columns will be given.

5	4	7	9	0	
3	1	9	1	2	
5	5	5	0	8	
4	6	4	1	3	
5	6	8	9	3	
0	7	5	3	2	

a

1	2	4	3	9	8	
5	4	7	0	0	0	
8	1	9	4	6	5	
9	7	3	2	0	9	
5	7	4	2	4	0	

b

4	8	6	9	0	
2	1	1	1	4	
4	5	9	0	9	
7	8	5	6	7	
1	3	5	3	2	

c

3	2	4	2	5	5	
5	2	2	5	6	7	
0	9	8	3	2	9	
0	2	4	1	3	7	
6	6	6	6	4	2	
1	2	3	1	5	8	

d

Fig. 1. Matrix of the main proportions of the columns and rows

- a is a matrix with an odd number of columns and a pair of rows,
- b is a matrix with a pair of columns and an odd number of rows,
- c is a matrix with an odd number of columns and an odd number of rows,
- d is a matrix with a pair of columns and a pair of rows.

For each of the four types of matrices, the algorithm for balancing the star is applied differently.

2. Algorithms used in combination of star balance

Three top priority algorithms that were applied:

- horizontal balancing
- vertical balancing,
- Diagonal balancing.

Actually, due to these three algorithms, emphasis was placed on the importance of matrix size, since one of these algorithms is used depending on the size of the matrix.

Horizontal balancing is applied to matrices with a type on rice. 1a,

Vertical balancing is used for matrices of type in rice. 1b,

Diagonal balancing is used for two types of matrices, namely types in rice. 1c and 1d.

When horizontal equilibrium, the number of columns is odd, so the central column separates the matrix into adjacent parts. These parts are compared with each other already in rows and, accordingly, the balancing is already horizontal, depending on which part is larger and less. Balancing occurs on all lines of the matrix, and the central column remains unchanged.

When vertically balancing everything with the exact opposite. Odd number of rows, so the central line separates the matrix, comparing and balancing occur in columns, that is, vertically.

Diagonal balancing is applied for an equal line and column ratio. If the number of rows and columns is the same and either pair or odd. Then the comparison and balancing takes place on two diagonals of the matrix.

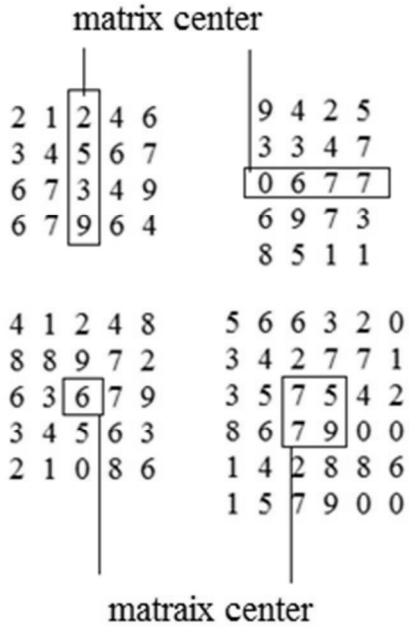

Fig. 2. Determination of the center of the matrix depending on its size for further balancing with the determined algorithm

In addition to the basic algorithms, you can add a range with the combination.

This method is based on three basic balancing algorithms, but is improved and also consists of several algorithms:

Single balancing – the balancing occurs only on “1”, that is, the parts of the matrix increase or decrease only and only on one.

Center-centric balancing – the range of balancing begins with “1” and gradually increases by one in the direction towards the definite center of the matrix.

Centrifugal balancing – the range also begins with “1” and increases by one in the opposite direction of the center.

These algorithms allow more radically to change the content of the matrix depending on its size, respectively, the larger the matrix, the greater the range of balancing.

3. Combined method of balancing the star

This algorithm is based on the simultaneous application of all balancing directions (vertical, horizontal, and two diagonals). For the most illustrative example, the matrix of rice will fit. 1c

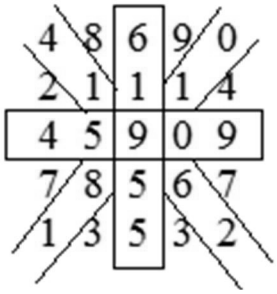

Fig. 3. This matrix defines a central part of “9” that will not change, as well as eight parts that will be compared and balanced. The scheme of parts of the matrix resembles a star in its form

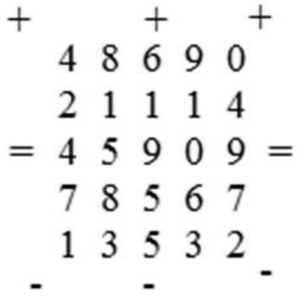

Fig. 4. Determination of the balancing for each part of the matrix

The plus sign means a part to increase, a minus to decrease, and the sign of equality means that both parts are equal and there is an opportunity to choose. For demonstration, the use of both approaches for equal parts will be demonstrated.

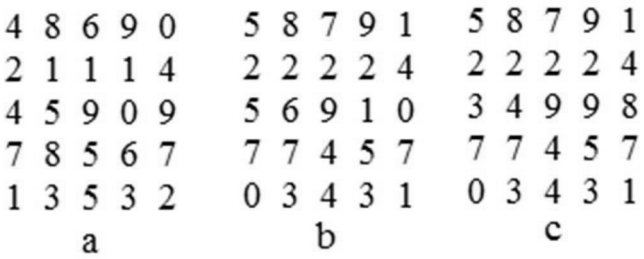

Fig. 5. Implementation of one iteration of balancing

- a – matrix of initial appearance,
- b is a balanced matrix with an increase in equal parts,
- c is a balanced matrix with a decrease in equal parts.

Comparing the initial and balanced matrices, one can see that the transformation was successful. However, only one iteration of balancing is not a limit, it is possible to determine and hold a relatively optimal number of iteration balancing stars. In addition to balancing, other transformation algorithms can also be involved.

If you take an example of a matrix of rice. 1d, the result will be as follows:

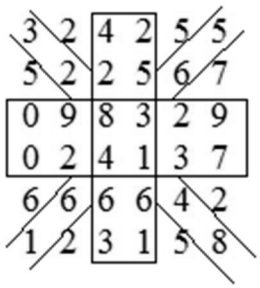

Fig. 6. Separation of the matrix into parts

As can be seen from the figure, two columns and strings were chosen for balancing, since for a matrix of this size it was impossible to select only one central one.

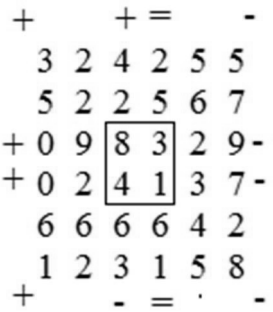

Fig. 7. Definition of balancing for parts of the matrix and allocation of the center, which will not change

The given circuit will have a given number of iteration balances.

Balancing algorithms can be combined with each other as well as with other matrix transformation algorithms, but one should not forget about the specifics of the application of each of the algorithms and methods. Since separate groups of algorithms were developed for data compression, their modifications and new groups were developed for other tasks, for example, for encryption, for application in the theory of graphs, for the construction of digital lattices, for encoding images.

Conclusions

This article shows and describes a combination of methods for balancing the matrix in one algorithm. New methods and algorithms for matrix transformation were developed due to modification, improvement and combination of older analogs and prototypes. Methods of this class are designed in such a way that in the future they can be combined for the accomplished tasks. This approach allows us to develop adaptive algorithms for virtually any area of their application.

1. Lobur M. V., Ivantsev R. D., Kolesnik K. K., Kanas Yu. Yu. Development of algorithm for matrix reduction, depending on their size and content // Scientific and Technical Journal "Technology of Instrument Making", No. 2, 2015, Kharkiv, Ukraine. – 2016. – C. 29–31. 2. Khan Y., Ivantsiv R. Finding methods and means of optimizing algorithms of transformation of numerical matrices // Bulletin of the Lviv Polytechnic National University. Series: Computer Systems Designing Theory and Practice: [op. sciences etc.] / Ministry of Education and Science of Ukraine; chairman of the editor-in-chief. for N. I. Chukraj; [rep. Ed. M.V. Cabbage head]. – 2016. – No. 859. – P. 31–35.