Optimum Vector Information Technologies Based on the Multi-dimensional Combinatorial Configurations

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Abstract: - Paper devoiced to optimum vector information technologies based on the multi-dimensional combinatorial configurations, such as Ideal Ring Bundles (IRBs). One-dimensional IRBs are ring ordered positive integers that form finite set of integers from 1 to *S* using both these numbers and all its consecutive terms. Two- and multi-dimensional IRBs make available to configure intelligent information and telecommunication systems providing generate the maximum number of distinct vector sums of consecutive terms in the combinatorial configuration. Applications profiting from optimum vector information technologies based on the multi-dimensional combinatorial theory provide for example data mining technologies and big vector data processing, data analysis and system security, signal compression and reconstruction, vector computing and telecommunications, and other branches of sciences and advanced information technologies.

Key-Words: - IRB, torus coordinate system, manifold, star- code, big data, optimum vector data coding system, encryption, security

Received: July 12, 2022. Revised: September 7, 2023. Accepted: October 11, 2023. Published: November 6, 2023.

1 Introduction

Combinatorial optimization is a subfield of mathematical optimization that relates finding optimal solutions of problems connected from sets that have finite number of elements, where the sets of feasible solutions are discrete. Classic combinatorial optimization problems are, for example, the travelling salesman problem, the knapsack proble, and the minimum spanning tree problem. Such problems, exhaustive search is not high-quality, and so directed on algorithms that quickly rule out large parts of the search space or estimate algorithms must be resorted to instead. Combinatorial optimization is related to algorithm theory, operations research, and computational complexity theory. It has significant applications in several fields, including artificial intelligence and machine learning, auction theory and software engineering, very large-scale integration (VLSI) and applied mathematics, big vector data processing and theoretical computer science, data mining technologies and big data, intelligent systems and data analysis, computational linguistics and computer-aided design (CAD), and other engineering areas. A number of research works consider combinatorial configurations using optimization of integer programming together with discrete optimization of big vector data coding and data mining technologies, which is composed with multidimensional combinatorial configurations. In turn, all of these topics have closely intertwined research literature. It time involves innovative combinatorial methodologies to efficiently allocate wherewithal for finding solutions of many mathematical problems.

A number of research works consider combinatorial optimization consisting integer programming together with discrete optimization of big vector data coding and data mining technologies, which is composed of many problems dealing with effective researches of intelligent multi-dimensional spatial combinatorial structures, using their remarkable propwrties. All of these topics have closely intertwined research literature. It time involves innovative combinatorial methodologies to efficiently allocate wherewithal for finding solutions to optimum vector information technologies based on the multi-dimensional combinatorial configurations.

2 Problem Formulation

The problem to be of very important for configure optimum vector information technologies and systems of information security with improved the quality indices of the system with respect to performance reliability, data protection, and speed transformation big information content.

Mathematical problem is reduced to establishing a mutually unambiguous display of vector binary code combinations sets according to vector data attribute-categories sets on the coordinate grid of the *t*-dimensional surface of the manifold. The task is to increase the number of code combinations of *t*- dimensional binary code for the formation of information parameters of signals by the number of attributes and categories in the basis of the outlined *t*- dimensional coordinate system. We require the code combinations enumerate fixed number of times both vector data attribute-categories sets and node points set of the coordinate grid with sizes $m_1 \times m_2 \times \ldots \times m_i \times \ldots \times m_t$, where m_i – number markers for referencing indexed categories on *i*-th axis, which corresponds to one of *t* attributes in the manifold coordinate system.

The main goal of modern intelligent systems engineering and big data mining technologies is expansion of advanced data processing for optimal solution of wide classes of problems, including big vector data information systems and data mining technologies focused on international academicians, scientists and practitioners to exchange new ideas for future collaboration.

3 Rewiev of Literature

Big vector data information technology, is known, be able to defined as a softw are-utility that is designed to analysis process and extract the data from extremely complex and large data sets which the traditional data processing software could never deal with. In global review [1] presented big spatial vector data management. In this paper, autors discuss and itemize this topic from three aspects according to different information technical levels of big spatial vector data management. It aims to help interested readers to learn about the latest research advances and choose the most suitable big data technologies and approaches depending on their system architectures. To support them more fully, firstly, authors identify new concepts and ideas from numerous scholars about geographic information system to focus on big spatial vector data scope. They conclude systematically not only the most recent published literatures but also a global view of main spatial technologies of big spatial vector data, including data storage and organization, spatial index, processing methods, and spatial analysis. Finally, based on the above commentary and related work, several opportunities and challenges are listed as the future research interests and directions for reference. This review paper mainly focuses on big spatial vector data management in the era of big data. The big spatial data, data storage and organization, data processing, and spatial analysis are discussed, respectively. In the context of big spatial vector data management, this study categories the existing techniques and technologies, as well as highlighting the mainstream academic views to help the readers to better understand and handle the problems from big spatial vector data management efficiently. The existing work in big spatial vector data management has mostly emphasized on some characteristics (volume, variety, or velocity) of big spatial data, and solved certain problems in the technical level or applications. Although there already have several studies related to big spatial data. In addition, this review summarizes the characteristics and domains of big spatial data, and also overviews the big spatial vector data management. Moreover, a broad of literatures on the vector data model, data storage, spatial index, pre-processing, spatial query, visualization, and spatial analysis of big spatial vector data are provided and classified. Future research interests and directions are contributed as a guide for researchers. The key–value model is now the mainstream of the storage model in a large number of NoSQL databases. In the key–value model, each record consists of two parts, also known as "Key/Value Pair", which supports simple data operation. Driven by the wave of big data technology, big spatial vector data has been affected and changed, especially for the data management. This paper starts a ddiscussion for the existing work of big spatial vvector data (BSVD) management and summarizes three main aspects, namely big spatial data, data storage and organization, data processing, and analysis, which are carried out a detail description from the theoretical and technical levels. The overview of BSVD management is discussed firstly, and then, the big spatial vector data model, storage mode and spatial index are described in the layer of data storage and organization. Furthermore, authors discussed the data pre-processing, spatial query, visualization, and spatial analysis. Finally, three future research interests adirections are presented in the work.

In book [2] we can see a polynomial or a rational function (matrix), characterizing a single-input single-output (multi-input multi-output) system, has the coefficients for parameters. The number of such free parameters defines the dimension of the space and a system with fixed parameters may be represented by a point in parameter space. If at least configuration for the one coefficient varies about its nominal value, a region in parameter space is generated. This region characterizes a family of systems instead of one fixed system. When the coefficients vary independently of each other within specified compact intervals, an interval system is generated. A well explored case when the coefficients do not vary independently occurs when the region in parameter space is a bounded polyhedral set. A polyhedral set is formed from the intersection of a finite number of closed half-spaces and could be unbounded. A bounded polyhedral set is a convex polytope and vice versa. For an interval system, the polytope degenerates into a boxed domain or a hyper-rectangle. Extensive documentation of research results concerned with the extraction of information about the complete polytope from a very small subset of the polytope with respect to the property of stability for both continuous-time and discrete-time systems is available in several recent texts. The goal is to obtain tests for invariance of useful properties of sets of distinguished classes of functions from tests on a small subset of such functions.

Many number of original models, conceptions, parallel algorithms, platforms, applications and processing gears, relate to improve the assessment of big data technology [3 - 10]. The big data sets again have a lot of factors of infrastructure, including trade and industry, defense and economic and other indexes, which have many difficult problems. The papers [3-5] deal with forecast of big vector data for remote sensing. The techniques for create of a map procedure, which make filtering, sorting, reconstruction and a summary of big data operations presented at [6], at the IEEE International Conferences on Data Engineering. The paper [7] contains prompt vector data ensemble experimental method decomposition for the analysis of big spatial and temporal datasets.

From the work [8] we can see that geometric computing algorithms are time-consuming and very complex, which make big spatial data processing extremely slow. In the paper [9] a configuration for the parallel map projection of vector big spatial data which involves cloud and high-performance computing regarded. Large payer data amassed to explore big vector data for advancing information in nursing methodologies, clinical trials and lab research are described in [11]. The suggestion of torus topological coordinates for chemical structures is in concord with relating the physics of torus confined plasmas [12]. The research works provide spatial modeling of large-scale vector data under a common coordinate system. Still algorithmic complexity of the display projections represents pressing computational challenge.

Present theory of combinatorial configurations are such spatial structures as perfect difference sets [13] algebraic constructions based on cyclic groups in extensions of Galois fields [14] manifolds [15], structures connecting algebra through geometry [16] In general case it was possible to take in consideration a new conceptual model of the data processing based on the laws of worldwide harmony, such as Golden ratio [17] and Perfect Distribution Phenomenon as relationships “parts-whole” of complementary asymmetries joined harmonically in the rotational symmetry, forming optimum *t*- dimensional coordinate system over closed manifold shape [18].

4 Problem Solution

Problem solution involves research into techniques for finding technologically optimum into the underlying mathematical principles relating to the optimal structural and information parameters of multi-dimensional combinatorial configurations for development optimum vector information technologies based on the configurations. These design techniques will make it possible to configure information technologies and systems with fewer structural elements and bonds than at present, while maintaining or improving on computer power, data protection and the other operating characteristics of the system, using optimum vector information technologies based on the multi-dimensional combinatorial configurations.

4.1 Two-dimensional Vector Ideal Ring Bundles

Two-dimensional Vector Ideal Ring Bundles (2D vector IRBs) follow from *n*-stage two-dimensional cyclic sequences of non-negative 2-stage (t=2) integer sub-sequences of the sequence. A set of all two-modular vector-sums (mod m_1, mod m_2) of the sub-sequences creates grid over surface of torus m_1

× m_2. A set of all node coordinates of the grid occurs exactly R-times, where m_1 and m_2 are ring reference axes.

From the underlying definition follows formula (1):

$$R\cdot(S-1) = n\cdot(n-1), \quad (1)$$

where S, n, R, and $m_1 \times m_2$ - parameters of two- dimensional

Example. Two-dimensional (t=2) vector IRB containing four (n=4) vectors {(0,2), (2,3), (0,1), (1,3)} with parameters S= 13, n = 4, R = 1, and m_1 = 3, m_2 = 4 depicted in Fig. 1.

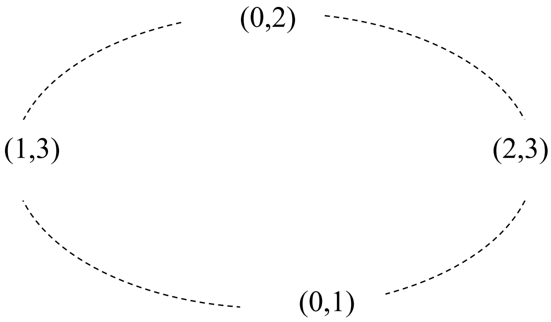

Fig. 1. Two-dimensional (t=2) vector IRB containing four (n=4) {(0,2), (2,3), (0,1), (1,3)} with parameters S= 13, n = 4, R = 1, and m_1 = 3, m_2 = 4

Creation of a torus coordinate system based on the Ideal Ring Bundle {(1,3), (0,2), (2,3), (0,1)} with parameters S =13, n = 4, R = 1, and m_1=3, m_2 = 4 showed in the Table 1.

Table 1
Node points of reference coordinate grid 3×4 created by modular vector sums (m_1=3, m_2=4) using 2D vector Ideal Ring Bundle {(1,3), (0,2), (2,3), (0,1)}

Node points	Modular vector sums (m_1=3, m_2=4)			
	(1,3)	(0,2)	(2,3)	(0,1)
(0,0)	(1,3)	(0,2)	(2,3)	-
(0,1)	-	-	-	(0,1)
(0,2)	-	(0,2)	-	-
(0,3)	(1,3)	-	(2,3)	(0,1)
(1,0)	(1,3)	-	-	(0,1)
(1,1)	(1,3)	(0,2)	-	-
(1,2)	(1,3)	(0,2)	-	(0,1)
(1,3)	(1,3)	-	-	-
(2,0)	-	-	(2,3)	(0,1)
(2,1)	-	(0,2)	(2,3)	-
(2,2)	-	(0,2)	(2,3)	(0,1)
(2,3)	-	-	(2,3)	-

Table 1 contains $n\cdot(n-1)$=12 node points of reference coordinate grid created by modular vector sums (m_1=3, m_2=4) using 2D Ideal Ring Bundle {(1,3), (0,2), (2,3), (0,1)}.

The sequence of the basic vectors {(1,3), (0,2), (2,3), (0,1)} form two-dimensional (t =2) grid over torus surface grid 3 × 4.

In the Fig. 2 we can see a symbolic presentation of two (t =2) annular axes over surface of usual torus with coordinate grid $m_1 \times m_2$ = 3 × 4 and reference point (0,0).

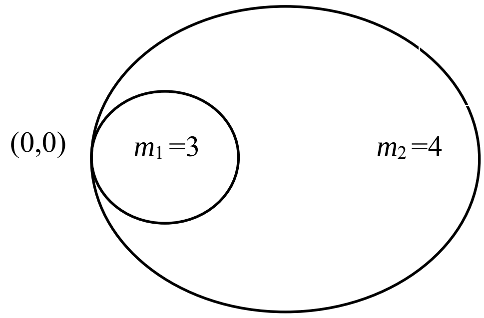

Fig.2. Symbolic presentation of two (t =2) annular axes over surface of usual torus with grid $m_1 \times m_2$ = coordinate $m_1 \times m_2$ = 3 × 4 and reference point (0,0)

Symbolic presentation of torus coordinate system is the simplest and well useful presentation of combinatorial optimization of vector data coding and processing based on remarkable properties of two-dimensional IRBs.

Binary 2D vector code based on the IRB {(1,3), (0,2), (2,3), (0,1)} in torus coordinate system $m_1 \times m_2$=3×4 presented in Table 2.

Table 2
Binary 2D vector code based on the IRB {(1,3), (0,2), (2,3), (0,1)} in torus coordinate system $m_1 \times m_2$=3×4

Node points	Digit weights			
	(1,3)	(0,2)	(2,3)	(0,1)
(0,0)	1	1	1	0
(0,1)	0	0	0	1
(0,2)	0	1	0	0
(0,3)	1	0	1	1
(1,0)	1	0	0	1
(1,1)	1	1	0	0

Node points	Digit weights			
	(1,3)	(0,2)	(2,3)	(0,1)
(1,2)	1	1	0	1
(1,3)	1	0	0	0
(2,0)	0	0	1	1
(2,1)	0	1	1	0
(2,2)	0	1	1	1
(2,3)	0	0	1	0

Table 2 contains $n \cdot (n-1)$ =12 binary four- digit (n = 4) combinations for coding two categories (t = 2) with three (m_1 = 3) attributes of the first, and four (m_2 = 4) – the second category. Each of the combinations allows coding two (t=2) indexed data simultaneously.

4.2 Optimum Vector Codes

We can extend set of categories and increase number of data code size, using optimum star-codes. The optimum vector star-codes follow from the self named "Gloria to Ukraine Stars" codes [18]. The optimum vector star-codes may be separating as self-correcting (redundant vector codes), and the non-redundant optimum codes with merits and limitations for each of them.

For example, two-dimensional (t=2) self-correcting optimum vector code with digit weights {(1,3), (0,2), (2,3), (0,1)} forms encoding design in torus coordinate system $m_1 \times m_2$=3×4 the maximum number P_{max}= $m_1 \times m_2$=12 allowed vector code words, each of them is no more one block of the same binary symbol. We identify this class of star-codes as the optimum vector annular monolithic-group self-correcting codes (Table 2).

The non-redundant optimum vector star-code with digit weights {(1,2),(2,4),(1,3),(2,1)} forms encoding design in torus coordinate system $m_1 \times m_2$=3×5. Unlike self-correcting star-codes, the non-redundant vector star-code provides growing code size for the same number of code positions. maximum number P_{max}= $m_1 \times m_2$=12 allowed vector code words, each of them is no more one block of the same binary symbol. We identify this class of the optimum vector star-codes as the non-redundant optimum vector codes (Table 3).

The code size of n- digit binary code cannot be greater than the number of nonzero binary code combinations formed by it.

Table 3 illustrates forming binary 4-digit 2D optimum vector star-code {(1,2),(2,4),(1,3),(2,1)} in torus coordinate system $m_1 \times m_2$=3× 5.

Table 3
Binary 4-digit 2D optimum vector star-code {(1,2), (2,4),(1,3),(2,1)} in torus coordinate system $m_1 \times m_2$=3×5

Node points	Digit weights			
	(1,2)	(2,4)	(1,3)	(2,1)
(0,0)	1	1	1	1
(0,1)	1	1	0	0
(0,2)	0	1	1	0
(0,3)	1	0	0	1
(0,4)	0	0	1	1
(1,0)	0	1	0	1
(1,1)	1	0	1	1
(1,2)	1	0	0	0
(1,3)	0	0	1	0
(1,4)	1	1	1	0
(2,0)	1	0	1	0
(2,1)	0	0	0	1
(2,2)	1	1	0	1
(2,3)	0	1	1	1
(2,4)	0	1	0	0

Table 3 consists 4-digit (n=4) binary 2D (t=2) star-code {(1,2),(2,4),(1,3),(2,1)} as non-redundant code with parameters n=4, R=1, and code size P (n) = 15.

Theorem. The power of the method of converting the form of information with t–measurable optimum star- code is greater than in classical binary codes.

Proof. With the increase in the number of t measurements of vector weight digits of the star-code, the total number of transformations on the set of basic vectors of weight digits as multiplicative groups increases accordingly, supplemented by options for mutual rearrangements of digits in the structure of "stellar" ensembles and corresponding permutations of numbers within the base vectors, which makes it possible to obtain more invariants of code combinations than standard code.

Theorem is proved.

A more general model of the t-dimensional toroidal coordinate system for vector data coding and processing made from multidimensional combinatorial configurations that provide an ability to reproduce the maximum number of vectors in the system [18], [19].

5. Vector Data Processing in Spatial Coordinate Systems

The basic ideas of vector data processing in spatial coordinate system are as following:
- determine sizes of intelligent spatial coordinate system and its dimensionality accordingly to category- attribute of vector data list;
- make digital indexing category- attribute list in the intelligent coordinate system;
- fetch from an information base applicable vector code with respect to computer power and processing program;
- make vector data processing in the intelligent coordinate system.

The underlying methods provide opportunities to apply them to configure suitable relation big vector data models, using arbitrary number of characteristics, and its associations.

For example, vector data coding by two (t = 2) categories of three (n=3) attributes under torus coordinate system with reference grid $m_1 \times m_2 = 2 \times 3$ based on the 2D Ideal Ring Bundle {(1,0), (0,1), (0,2)} presented in Table 4.

Table 4
Vector data coding by two (t=2) categories of three (n=3) attributes under torus coordinate system with reference grid $m_1 \times m_2 = 2 \times 3$ based on the 2D Ideal Ring Bundle {(1,0), (0,1), (0,2)}

Index of category	Index of attribute	Digit weights		
		(1,0)	(0,1)	(0,2)
1	1	1	1	0
0	1	0	1	0
1	2	1	0	1
0	2	0	0	1
1	0	1	0	0
0	0	0	1	1

Table 4 contains a set of six ($m_1 \times m_2 = 2 \times 3 = 6$) 3-digit ($n$=3) binary code words for data processing (storage, encryption, transmission etc.), each of them have information about two (t = 2) indexed data. For example, category with digital index “1” and attribute with index “1” respond to code word “1 1 0”, because {(1,0) + (0,1)} ≡ {1,1}(mod m_1,mod m_2), where m_1 = 2, m_2 = 3; attribute with digital index “0” and category with index “1” - to code word “0 1 0”.
Category with digital index “1” and attribute with index “2” respond to code word “1 0 1” , because {(1,0) + (0,2)} ≡ {1,2}(mod m_1,mod m_2). Category with digital index “0” and attribute with index “2” respond to code word “0 0 1”; category with digital index “1” and attribute with index “0” - to code word “1 0 0” or “111”. Finally, category with digital index “0” and attribute with index “0” respond to code word “0 1 1”. So, vector code based on the IRB {(1,0), (0,1), (0,2)} make it possible to organize vector information technology for data processing over combinatory two-digital sets of indexed arbitrary categories and attributes, taking in account two (t = 2) categories and three (n=3) attributes. Such technique provides storage, sorting, and translation two indexed information categories of the vector data concurrently. At the same manner provides encoding big datasets of arbitrary content at any level of indexing by a priory infinitely large number of the datasets providing big data processing without parallel computing. .

Information encoded in vector signals with a limited number of transient energy levels helps to reduce energy costs and increases the level of protection against external interference. In addition, it is possible to encrypt the processed data, for example, by periodic renaming of coordinate axis numbers, rearranging vector weight digits of the loop code, etc. Surface topology is superior to geometry relating manifold as “perfect” shape that useful to visualize objects as mathematical model of multidimensional systems for big vector data processing under manifold reference systems based on suitable IRB combinatorial configurations. The underlying techniques can be used for easy-to-grasp representation of big vector data processing under the systems. Remarkable combinatorial properties and structural perfection of the combinatorial configurations provide high performance vector computing technologies for effective big vector data processing. Advanced big vector data information technologies based on concept of IRB combinatorial configurations provide competitive advantages of the information technologies with respect to processing speed and storage capacity due to vector coding of compound attributes for two and more their categories simultaneously. Theoretically, there are infinitely many intelligent IRB ensembles with increasing bit depth and dimension of optimized t-dimensional vector codes, which can be processed and sent by communication channels for the same period of time a greater amount of information compared to the capabilities of classical analogues.

Vector IRB- and star-codes open up new prospects for the use of combinatorial methods of optimized encoding of multidimensional signals for big data revolution in data storage and processing, information and communication technologies and vector computer engineering.

As it evident, combinatorial optimization of big data processing under manifold coordinate systems based on the concept of Ideal Ring Bundles (IRB)s can be used for finding optimal solutions for wide classes of problems related to intelligent systems, including optimum vector data coding and decoding design, data content transformation, storage and security. One of them presents mutually unambiguous compliance with a set of indexed data “category-attributes” of a set of binary vector code combinations formed by this database have been achieved in the system. In turn, it was possible due to reducing the natural redundancy in the system.

6 Discussion

As it evident, the Table 2 demonstrates the advantages of two- dimensional (t=2) binary vector data coding in the minimized 3- digit (n = 3) 2D database of the torus coordinate system a reference grid with sizes $m_1 \times m_2 = 3 \times 4$. The mutually unambiguous compliance with a set of indexed data “category-attribute” of a set of binary vector code combinations formed by this database have been achieved in the system. The optimal t-dimensional codes are based on the encoding of t–measurable signals by annular monolithic-group code, where any allowed ring code combination allows the presence of no more than one block of characters of the same name. This allows you to instantly detect false combinations on the basis of group distribution, and the code acquires self-corrective properties. As it evident, the Table 3 demonstrates the advantages of binary vector data coding in the minimized 4- digit (n = 4) 2D database of the toroid coordinate system a reference grid with sizes $m_1 \times m_2 = 3 \times 5$. The mutually unambiguous compliance with a set of indexed data “category- attribute” of a set of binary vector code combinations formed by this database have been achieved in the system. In turn, it was possible due to reducing the information redundancy in the system.

Reasoning along similarly, Table 4 shows method of vector data coding design in the minimized database of the torus coordinate system a reference grid with sizes $m_1 \times m_2 = 2 \times 3$.

In the formula (1), the underlying rule displayed by the number R of methods of covering all node points of t- dimensional outlined toroid coordinate system for encoding of indexed vector data “category- attribute” sets with t categories and appropriated number of attributes in the set. Besides, using n- digit base reconstruction of t-dimensional binary vector code we provide the rule: repetition is a loss of information in order to increase so-many times’ security of vector data coding under the coordinate system. Increasing the number of allowed code combinations of the coding method and improving the characteristics of vector data coding and processing by performance and interference, as well as the star-code information capacity increases faster than code size of the code with growing dimensionality and number of its binary digits. Growing vector code combination by one bit doubles the code size of the encoding method in the outlined toroid coordinate system with the corresponding dimensions and dimensions. The number of indexed attributes and categories in the form of any long a priori of integer t- tuple allows one code word to encode, forward and process in the basis of the system simultaneously as many signs of vector data as symbols contained in the t- tuples without parallel computing. It respectively provides increasing the performance of the system at t times, where t is the number of annular axes of the t –dimensional coordinate system. Formalization allows you to reach a balanced compromise on contradictory goals related to the power and reliability of the information method. It outlines theoretically a large- scale information model of harmoniously built of multidimensional geometric space as a hypothetical system of a perfectly structured source of information as t-dimensional locked spheres. This system has a priori infinitely large number of sets of coordinate sub- systems of quantum "density", generated by a minimized basis of t- dimensional binary n- bit code with compression coefficient value approaching to $2^n/n$.

7 Conclusion

The essence of the proposed project technology is processing multidimensional data in the database without loss of information, processing data arrays in streaming mode by lists of attribute sets at the same time, ability to change the number of categories and attributes when processing information. Application profiting from optimized vector information technologies under the torus coordinate systems are the ability to update completed tables with indexing of names, packages, procedures, etc. These design techniques provides optimum vector information technologies based on the underlying combinatorial configurations, using formalization of interdependence between information parameters of vector data coding systems on a single mathematical platform. It reflects the essence of the proposed concept of converting multidimensional form of information with binary code in a structured field of toroid coordinate systems of corresponding dimensions and dimensionalities for provide optimum coding and processing vector data arrays with numbering categories and attributes under minimized basis of outlined *t*- dimensional toroid coordinate system, using the underlying formalization (1), (2).

The scientific novelty of obtained results is the formalization of interdependence between information parameters of vector data coding systems on a single mathematical platform. This approach allows forming the outlined *t*– dimensional toroidal coordinate system, using smaller as all number of coordinates set basis of *t*-tuples. This, in turn, provides optimum coding and processing vector data arrays with numbering attributes and categories under minimized basis of outlined *t*- dimensional toroidal coordinate system by holding criterion and limitations to achieve a favorable compromise between contradictory goals in changing of computational values within of theoretically defined by formulas (1) and (2) boundaries. The upper limit of the information capacity encoding method for given optimum vector code size with numbering categories and attributes of vector data sets, as well as *R* of various ways of coding the same "category-attribute" sets defined.

Physical results - a better understanding the role of geometric structure in the behavior of natural and man-made objects. The existence of an a priori of an infinitely large number of minimized bases, which give rise to numerous varieties of multidimensional "star" coordinate systems, opens up new possibilities for solving a wide range of mathematical and applied problems of computer science, cybernetics, and management on the platform of system mathematics. We take into account the developments of modern theory of systems as a set of philosophical, methodological and scientific, and applied problems of analysis and synthesis of multidimensional systems. offering ample scope for progress in systems engineering, cybernetics, and industrial informatics.

Prospect for further research are the development of new direction in multidimensional information technologies, computing, telecommunications and systems engineering for improving such quality indices as information capacity, reliability, transmission speed, positioning precision, resolving and ability to reproduce the maximum number of combinatorial varieties in the system with a limited number of elements and bonds, using remarkable properties and structural perfection of the underlying multidimensional combinatorial configurations.

The experimental results allow recommending the proposed methodology for direct applications to information and computational technologies, telecommunications, radio- and electronic engineering, radio- physics, and other engineering areas, as well as in education. These design techniques allows configure optimum two- and multidimensional vector data coding system, using innovative methods based on the underlying combinatorial structures, offering ample scope for progress in systems engineering, cybernetics, and industrial informatics.

Urgent problem of optimum vector information technologies and processing large data content based on the multidimensional combinatorial configurations solved.

Acknowledgement:
The basic results of the research presented in completed work on the R&S project “Designing Software for Vector Data Processing and Information Protection Based on Combinatorial Optimization” (State registration 0113U001360). State account number 0218U000988.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

The author contributed in the present research, at all stages from the formulation of the problem to the final findings and solution.

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself

No funding was received for conducting this study.

Conflict of Interest

The author has no conflict of interest to declare that is relevant to the content of this article.