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Optimum Vector Combinatorial Theory and Its Applications

Riznyk V*

Department of Computer Aided Control Systems, Lviv Polytechnic National University, Ukraine

***Corresponding author:** Volodymyr Riznyk, Department of Computer Aided Control Systems, Lviv Polytechnic National University, Stepan Bandera str., Lviv, 79013, Ukraine; Email: ikv.riznyk@gmail.com

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Abstract

Optimum vector combinatorial theory, namely the concept of Ideal Ring Bundles (IRBs), can be used for finding optimal solutions for wide classes of scientific and technological problems. IRBs are cyclic sequences of positive integers which form perfect partitions of a finite interval [1, s] of integers. The sums of connected sub-sequences of a numerical IRB enumerate the set of integers [1, s-1] exactly k-times. Example: The numerical IRB {1,3,2,7} containing four elements allows an enumeration of all numbers 1=1, 2=2, 3=3, 4=1+3, 5=3+2, 6=1+3+2, ...12= 3+2+7 exactly once.

Keywords: Ideal Ring Bundle; Rotational Symmetry; PDP; Torus Coordinate System; Combinatorial Optimization; Optimum Vector Monolithic Code

Abbreviations

IRBs: Ideal Ring Bundles; PDP: Perfect Distribution Phenomenon.

Introduction

Optimum Vector Coding Systems

Theory of optimum vector coding systems has its roots in originate of intelligent relationships “parts- whole” encoded into rotational symmetry [1] as two perfect complementary asymmetries [2]. An example of such relationship is *S*-fold (S=7) rotational symmetry ($S= n^2 - n + 1$) = 7, where set of all angular distances between of three (n = 3) blue lines emanating from centre of the symmetry enumerates a set of angular intervals [α, 6α] exactly once (R_1=1): α,2α,3α,...6α, while just twice between yellow ones (R_2=2). The visual presentation of the Perfect Distribution Phenomenon (PDP) originated from the 7-fold planar rotational symmetry is given below (Figure 1).

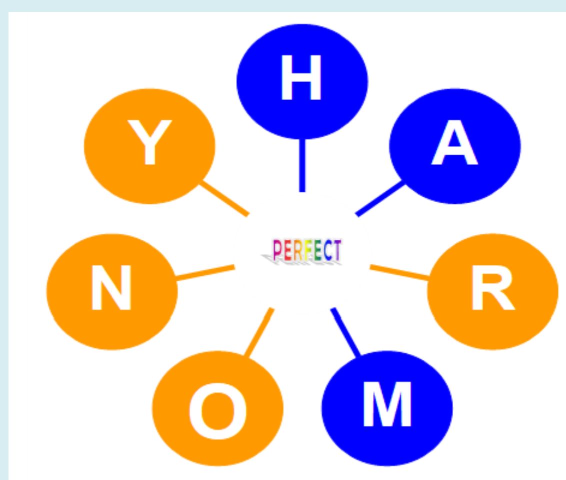

Figure 1: The visual presentation of the Perfect Distribution Phenomenon (PDP) originated from the 7-fold planar rotational symmetry.

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If we allow go round seven (S=7) lines {*H A R M O N Y*} moving clockwise, we can obtain a set of angular distances [α, 6α] between of distinct pairs of three (n_1=3) blue lines (*H A M*) as cyclic numerical relationship {1: 2: 4}, whereas between of distinct pairs of four (n_2=4) yellow ones (*R O N Y*) as cyclic link {2: 1: 1: 3}. The first of them allows optimal partition of a ring in three (n_1=3) parts for obtain the set of harmonious proportions from 1/7 to 6/7 by spatial interval α=360º/7 exactly once, while the second - as optimal partition of the ring in four (n_2=4) parts for finding the same proportions exactly twice. The idea of intelligent basis of t-dimensional rotational symmetry is useful in understanding cyclic n-sequence of t-stage integer-value sub-sequences of the sequence, where t-modular (m_1, m_2 , ..., m_t) sums of consecutive t-stage terms enumerate the set of t-dimensional manifold topology coordinate system. The principal property of the model is that ring n-sequence {K_1, K_2,... Kn} of t -stage its sub-sequences to be completed with non-negative integers allows on enumeration of all nodal points coordinates grid $m_1 \times m_2 \times \ldots \times m_t$ of the coordinate system.

Example: The vector IRB {(1,1), (0,1), (2,2), (2, 1)} containing four (n = 4) two-dimensional (t = 2) vectors generate ring vector-sums, taking complex modulo m_1 = 3, and m_2 = 4 as follows:

$$\left.\begin{aligned}
(1,1)+(0,1) &\equiv (1,2)\\
(0,1)+(2,2) &\equiv (2,3)\\
(2,2)+(2,1) &\equiv (1,3)\\
(2,1)+(1,1) &\equiv (0,2)\\
(1,1)+(0,1)+(2,2) &\equiv (0,0)\\
(0,1)+(2,2)+(2,1) &\equiv (1,0)\\
(2,1)+(1,1)+(2,2) &\equiv (2,0)\\
(1,1)+(0,1)+(2,1) &\equiv (1,3)
\end{aligned}\right\}\bmod 3, \bmod 4$$

So long as the vectors (1,1), (0,1), (2,2), (2,1) of the ring sequence themselves are 2D vector-sums too, the complete set of these vector sums: (0,0), (0,1), (0,2), (0,3), (1,0), (1,1), (1,2), (1,3), (2,0), (2,1), (2,2), (2,3).

The result of the calculation forms two-dimensional (t =2) grid over 2D torus surface of sizes 3 × 4, where 2D modular coordinates of each node of the grid occurs exactly once.

Here is schematic diagram of coordinate grid 3×4 based on the IRB {(1,1), (0,1), (2,2), (2, 1)} (Figure 2).

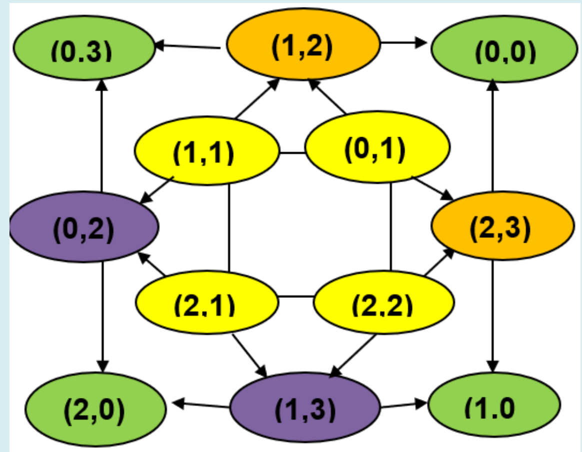

Figure 2: Schematic diagram of coordinate grid 3×4 based on the IRB {(1,1), (0,1), (2,2), (2,1)}.

Example of an optimum 2D vector data system processing at the same time in torus surface coordinate grid 3 × 4 displays the Table 1:

№	Vectors	2D datasets		Optimum vector monolithic 2D code			
		A	B	(1,1)	(0,1)	(2,2)	(2,1)
1	(0,0)	0	0	1	1	1	0
2	(0,1)	0	1	0	1	0	0
3	(0,2)	0	2	1	0	0	1
4	(0,3)	0	3	1	1	0	1
5	(1,0)	1	0	0	1	1	1
6	(1,1)	1	1	1	0	0	0
7	(1,2)	1	2	1	1	0	0
8	(1,3)	1	3	0	0	1	1
9	(2,0)	2	0	1	0	1	1
10	(2,1)	2	1	0	0	0	1
11	(2,2)	2	2	0	0	1	0
12	(2,3)	2	3	0	1	1	0

Table 1: Optimum 2D vector data system processing at the same time in torus surface coordinate grid 3 × 4 displays.

Table 1 contains n (n −1) =12 binary four- digit (n = 4) combinations for coding two-dimensional vectors (t = 2) in optimum torus coordinate system of sizes 3×4, where IRB {(1,1), (0,1), (2,2), (2,1)} is basis of the 2D vector encoding system. This system provides encoding the full set of 2D vectors from (0,0) to (2,3) in the torus coordinate grid by exactly one monolithic code combination, each of them is a

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ring sequence with no more of two solid packets of the same characters. The set of 2D code combinations one-to-one corresponds to set of torus coordinate grid 3×4.

Conclusion

The prospects for the development of optimum vector combinatorial theory are opened based on the minimization of the basic structure of multi-dimensional information flow processing systems and the functionality of vector computer systems is expanded. At last, optimum vector combinatorial systems theory discovers direct application of the underlying scientific approach for systems engineering design for development perspective R&S research in contemporary information technologies, computing, telecommunication, systems engineering, and education as an alternative to quantum ones.

References

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2. Riznyk V (2017) Multi-modular optimum coding systems based on remarkable geometric properties of space. Advances in Intelligent Systems and Computing 512: 129-148.