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RESEARCH ARTICLE

ENCODING OF THE SIGNAL .TRITS OF INFORMATION . NUMERIC PRESENTATION OF A WAVE AS A CARRIER OF ENERGY

Ruslan Pozinkevych

Faculty of Informations Technologies and Mathematics, The Eastern European National University Ukraine,43021, Lutsk, Potapov str. 9
**Corresponding Author Email: galagut@protonmail.com*

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ARTICLE DETAILS

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ABSTRACT

Aims/ Objectives: The aim of the article is to provide the proof for use of trits in coding of the signal for Ternary processors The author substantiates the aforementioned use by formula and properties of Ternary Algebra In order to do so an analysis of the incoming signal is done and the wave is presented in the form of $f(x) = a\sin(\text{bx} + \text{C}) + \text{D}$ By converting this formula we obtain numeric value of the energy conveyed by the standing wave The same numeric value is the mathematical representation of a signal in the Ternary circuits (Pierce, 1973)

KEYWORDS

Sine Wave, Number Representation, Energy Conversion, Digital Signal, Trits of the Information

1. General Information

By the definition of a standard basis one can write coordinates of a given vector in the form of a: $a^1(1,0,\dots) + a^2(0,1,\dots) + \cdots a^n(0,0\dots1)$ where $(a^1, a^2 \dots a^n) \in R^n$ (Postnikov, 2009). In that view we can always present a vector in a R^3 as $(-1,0,1)\sum_{i=1}^{3} a^i$ This will be our base formula for further calculations in a 3D space (Dubovyk and Yuryk, 2011). Using binomial distribution we can write the same formula for pairs of numbers from the set of 3 : $(-1,0,1)$;

$$(-1,0,1)\sum_{i=1}^{3}\sum_{j=1}^{3}\binom{3}{2}\boldsymbol{a}_{ij} \quad (1)$$

($\boldsymbol{a}_{ij} \in (ixj)$: i = number of columns and j = rows)

This analysis of ours comes from the following statement: **Table: 1**

A	B	A ∗ B
T	T	T
F	F	F
$\bar{T}$	$\bar{T}$	T
T	F	F
F	T	F
$\bar{T}$	T	$\bar{T}$
$\bar{T}$	F	F
F	$\bar{T}$	F
T	$\bar{T}$	$\bar{T}$

As you might see from the entries, the literals in the last column are the resultants of multiplication of pairs which later can be presented as a single literal or a number (Pozinkevych, 2020; Pozinkevych, 2021).

2. Methodology

We now have to present our signal as Trits of info To do so I'd like to refer readers to the same authors publications namely to his Ternary Truth Tables In them we have three main entries (T, T, F) They must all be linearly independent if we were to substitute them into our main equation $f(x) =$
$a\sin(bx + C) + D$ (Pozinkevych, 2021; Strassen, 1969). The triangular augmented matrix of coeficients of the polynomial representing a signal is:

$$\begin{pmatrix}1 & 0 & -1\end{pmatrix}\begin{pmatrix}1 & 0 & 0\\ -x & 1 & 0\\ -y+xz & -z & 1\end{pmatrix}\begin{pmatrix}-1\\ -1\\ -1\end{pmatrix} \quad (2)$$

The solution of an equation $f(x) = a\sin(bx + C) + D$ with the three unknowns (x, y, z) will be numbers $(-1, -1, -1)$ which stand for the values of $x, y, z \mid x = t; y = f(x); z = C$ With C being a constant we have a function on $a(x, y, z)$ plane where $z = 0$, and C entries on the (x, y, z) plane where $z = (-1)$ (Kravchuk, 2013). Knowing the entries a, x, b, C the equation $f(x)$ has simple solution for the period of sin function $2\frac{\pi}{b}$ (Macbeath, 1964).All we need now is to write the above formula ($f(x) = a\sin(bx + C) + D$) in a vector form. Remember though that $\sin(3\pi/2) = (-1)$ which is our sought after z value. The rest is just a pure math

3. Materials and Methods

Before we begin the analysis of the materials and methods used I would like to deliver to your attention a few known facts about the properties of the series, namely the one regarding binomial coeficients (Boas, 1999)

Why this is an important issue First of all because every polynomial can be presented in its binomial form: $(a + b)^n$ if we put a = 1, b = x, and n = p then we can get an expansion of the following kind: $\binom{p}{2} = \frac{p(p-1)}{2!}$ That is the expansion of a coefficient of an infinite series Now remember that our trit coefficient was $\frac{3!}{2!} = 3$ Therefore for us to present a polynomial in the form of trits of numbers we must obviously divide our infinite series by that very coefficient,namely by 3; As a result of such a conversion our infinite series binomial coefficient for the trits of numbers will have a form: $\binom{p}{2} = \frac{p(p-1)}{6}$ What is missing in our binomial expansion formula is presenting of X in its vector form

Remember:

$$(a+b)^n = \sum_{k=0}^{n} \binom{n}{k}(a^n b^{n-k}) \tag{3}$$

This formula will serve as a base for our further expansion Let's return to where we started from namely $f(x) = a\sin(bx + C) + D$; Solution to this equation, which by the way is a formula of a plane is $a\sin(bx + C) + D = 0$ It can well be presented as a 3 component vector The components are x = t; y = f(x);and z = C; The most difficult part here is actually z which is a constant lt's, as we mentioned before , is equal $\sin(3\pi/2) = (-1)$

Now if we know the value of all those three we can get a solution for D as well $f(x) = a\sin(bx + C) + D$; $a\sin(bx + C) + D = 0$; $a\sin(bx + C) = (-D)$; Let's see if everything is "cooked well" metaphorically speaking We have a function $f(x) = \sin(x) \equiv \sin(t): x = t$; We have a constant C = z = (−1); We also have a binomial coefficient, which is equal $\binom{p}{2} = \frac{p(p-1)}{6} \equiv$ a, b = 2pi/b
Now we are ready : Let's write our formula in the form of a matrix multiplied by a vector (Dolciani, 1967).

$$\frac{p(p-1)}{6} \sum_{i=1}^{3} \sum_{j=1}^{3} a_{ij} \begin{pmatrix} x \\ f(x) \\ z \end{pmatrix} \tag{4}$$

This will be our main formula for the analysis and discussion

4. Results and Discussion

The reader might be perplexed by the presentation of the formula and all variables and constants found in it Especially if we are talking to the professionals whose background is not mathematics In that view a few points must be cleared. The formula (4) represents the general approach towards digital presentation of the wave in a digital form To "connect all the dots" let's remind ourselves of some basic rules of matrix algebra By multiplying a matrix by a vector we will obtain a vector on condition that the dimension of the both are corresponding We choose to present our signal in the form of trits e.g by 3×3 matrix which is our $\sum_{i=1}^{3} \sum_{j=1}^{3} \boldsymbol{a}_{ij}$ part So it is essentially a matrix of a 3×3 or a trit Now the coefficient in front of the matrix is the number of entries or trits One might ask what does p stand for in the formula $\frac{p(p-1)}{6}$. It's a very good question the answer to which is $p = x = t$ so if you substitute p by t you will get the answer to it as well. Now the last but not the final part, that is a vector $(x, f(x), z)$ As mentioned previously x = t, $z = (-1)$ therefore our vector here is $(t, f(t), -1)$;

$$\frac{p(p-1)}{6} \sum_{i=1}^{3} \sum_{j=1}^{3} a_{ij} \begin{pmatrix} x \\ f(x) \\ Z \end{pmatrix} \equiv \mathrm{f(x) = asin\,(bx + C) + D} \tag{5}$$

Let's not forget though that the aim of our investigation was to obtain a numeric value of the energy conveyed by a wave. This will be our final stage of the signal analysis.

5. Conclusions

Our research aims at presenting of the information or encoding the signal in the form of the so-called "Trits" The importance of the principle lies in the fact that trits represent also physical characteristics of the system presenting them The two are inseparable. The meaning of this statement can be understood if we look at the things from the perspective of comparing the newly presented system with an old one Namely if we compare Binary approach to Ternary Binary principle has been manifested in semiconductor device and bits of information (Grau, 1947; Hoshino, 1989). The Ternary approach requires the 3 D placement of logical elements meaning that the wave vector or any of its characteristics must be presented using at least three parameters (for example a vector in space). Vectors are easy to deal with using principles of vector algebra We can present them as matrices or plain numbers or we can leave them as vectors on the plane or in the space. For example our current research deals with wave representation on the plane (Look at the formula $f(x) = a\sin(bx + C) + D$). In essence our initial analogue representation of a signal is the analysis of the sine on the plane The fact is though that the plane is in the 3 D space making it perfectly suitable for Ternary Maths. What about energy? Thus far energy has been studied by various branches of physics chemistry and other natural science Depending on the type of energy we can talk about various modifications of Ternary machines or devices utilizing that principle In our case the goal was to present a signal in the numeric form and the number will be a symbolic representative of the quants of energy We call them trits. This publication is not an attempt to analyze physical characteristics of the wave. We only mention the fact that the wave is a carrier of the energy and that energy can have a numeric value. Trits are not a numeric value If we multiply a (3 x 3) matrix by a (1×3) vector we can obtain a (3 x 1) matrix. The last and final part is to obtain a dot product of two vectors (Cantor, 1952) One is a row vector $(1,0,-1)$ and another is our resultant (3×1) column vector By doing so we will get a numeric representation of a signal which is a numeric wave representation as a carrier of energy. I'd sincerely ask the readers to do a simple maths for themselves. The use of Ternary Machines will have wide applications in all spheres of human activity The hardware and software of those can be used as a next step in electronics and software programming (Kuphaldt, 2006; Li et al., 2006).

Competing Interests

Author has declared that no competing interests exist.

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From an indifferent perspective

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