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IDENTIFICATION AND ANALYSIS OF A PARABOLIC SURFACE BALYUBY (PSB)

Formulation of the problem

Application of the surface type "Magnifier" for modeling, empirical baseline data, topographic surfaces and complex multifactorial process caused the need to identify, clarify their place among many other surfaces, identify the properties that they are inherent. Awareness of the way of their formation and properties that they are inherent, will enable more informed of their application in particular cases. Therefore, the analysis of parabolic surfaces of the "Magnifier" to identify ways their construction, installation limitations and inherent properties, is relevant. Figuring appointed topical issues on the surfaces of parabolic type "Magnifier" and dedicated to this article.

Literature review

The equation of the parabola in dotted-shape that passes through the predetermined three and one quasi real terms, it proposed of Balyuba I.G. [1]. With its use has developed a way to "Magnifier" [2] to build on empirical data cover parabolic surface that passes through the actual nine points, edges equation which is the point of parabolas. Examples of ways to "Magnifier" and its further development are witnessing in [3, 4]. However, in none of scientific papers on theoretical analysis method "Magnifier" mentioned. This analysis can be done only by examining some of the theory of functions, which influenced the development of research A. Gilbert, N.K. Bari, D.E. Menshov, A. Lebesgue [6], A.N. Kolmogorov [7]. In further studies will need the concept of complex function. The complex function [5], a feature that is a composition of several simple functions. If the set values Y_i of functions f_i fits plural definition X_{i+1} functions f_{i+1}: $f_i : X_i \to Y_i \subset X_{i+1}$, for $i=1,\ n-1$, the function $f_n\circ f_{n-1}\circ \ldots \circ f_1$, for $n\geq 2$, determined equality: $(f_n\circ f_{n-1}\circ \ldots \circ f_1)(x) = f_n(f_{n-1}(\ldots f_1(x)\ldots))$, for $x \in X$, called a complex function or $(n-1)$ - a multiple composition functions $f_1, f_2, \ldots, f_n$. Complex functions remain property features a composition they have.

Any sorts rational function of any number of variables is a composition of four arithmetic operations, function composition is $x+y,\ x-y,\ x\cdot y,\ x/y$.

Simple function called measured function $g: X \to R^1$, $g(x)=y_n$, $y_n \neq y_k$ at $n \neq k$, if $x \in X_n$, $U_{n-1}^{\infty} x_n = x$.

A simple function g called so attached when the series $\sum_{n=1}^{\infty} y_n \mu x_n$ absolutely identical; the sum of this series is Lebesgue integral: $\int g d\mu$.

It is known [5], if the integrated amount $\sigma = \sum_{i=1}^{n} \eta_i \mu(M_i)$, in the sense of Lebesgue, when approaching zero from the maximum difference y_i-y_{i-1}, ie when there is a number I, and that any $\varepsilon > 0$ find $\delta > 0$ is that the only condition $max(y_i$-$y_{i-1})<\delta$ will meet inequality $|\sigma - I| < \varepsilon$. This specified limit I is called the definite integral of Lebesgue function *f(x)* on the interval *[a, b]*. In other words, *I*-Lebesgue integral is the area between the curve and the integrand *y* axis within interval *[a, b]*. Instead interval *[a, b]* in integral Lebesgue considered arbitrary set, measured relative to some positive full of countable additive measure by which we should understand the function sets λ some set X on the class of subsets ε, when $\lambda(U_{i=1}^{n} E_i) = \sum_{i=1}^{n} \lambda(E_i)$, where $E_i \in \varepsilon, U_{i=1}^{n} E \in \varepsilon, E_i \cap E_j = \varnothing$ for $i \neq j$ respectively, if $n=2$, n - any final $n < \infty$.

Let's consider (Figure 1) a geometric diagram for creating a point arc equation of parabola through the points A, C_∞, C, B:

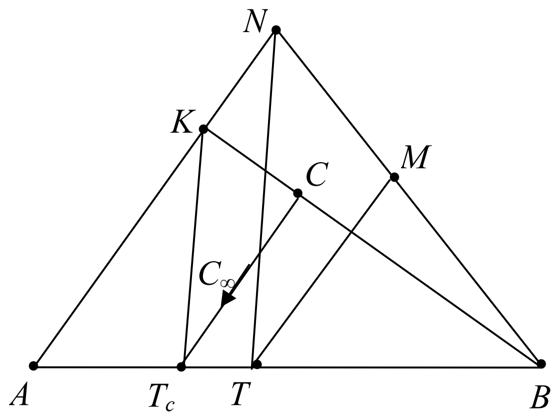

Figure 1 - Diagram of variable point M of the parabola

Here C_∞ point is improper and determines the direction of the branches of the parabola [8], the arc of a parabola of the second order on AB segment in point form, it will be the point equation:

$$M = A\frac{\bar{t}(t_c - t)}{t_c} + B\frac{t(t - t_c)}{\overline{t_c}} + C\frac{t\bar{t}}{t_c\overline{t_c}}, \qquad (1)$$

where $0 \le t \le 1$ - the parameter that defines the arc of a parabola;

$\bar{t} = 1 - t$ - addition the parameter t to the unit;

t_c - important parameter that determines quasi point arc of a parabola;

$\overline{t_c} = 1 - t_c$ - addition the parameter t_c to the unit.

However, neither in this work [8] or other [1, 2, 3, 4], which refers to such a parabola and the surface of the "Magnifier" that are built using similar parabolas of the second order, not provided identification, analysis and parabolas and surface properties of the "Magnifier".

The purpose and objectives of Article

To formulate the definitions for the "Magnifier" surface and analyze their properties.

Main part

Let asked nine of valid points $X_{11}, \ldots, X_{33}$ (Figure 2).

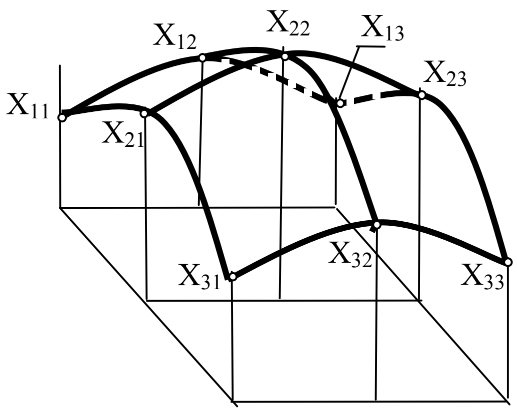

Figure 2 – the parabolic surface

By analogy with (1) we introduce the notation:

$$a_1 = \frac{\bar{v}(v_c - v)}{v_c};\; a_2 = \frac{v\bar{v}}{v_c\overline{v_c}};\; a_3 = \frac{v(v - v_c)}{\overline{v_c}};\; b_1 = \frac{\bar{u}(u_c - u)}{u_c};\; b_2 = \frac{u\bar{u}}{u_c\overline{u_c}};\; b_3 = \frac{u(u - u_c)}{\overline{u_c}};$$

Then

$$a_{11}=a_1b_1;\; a_{21}=a_2b_1;\; a_{31}=a_3b_1;\; a_{12}=a_1b_2;\; a_{22}=a_2b_2;$$

$$a_{32}=a_3b_2;\; a_{13}=a_1b_3;\; a_{23}=a_2b_3;\; a_{33}=a_3b_3 \qquad (2)$$

The functions a_i, b_j, a_{ij} - are functions of the operations of addition, difference, multiplication and division are simple and positive functions. If we consider a fold function that formed the amount a_{ij}, then we obtain a complex function $f(a_{ij}) = \sum_{i,j=1}^{3} a_{ij}$, that will superposition of simple functions a_{ij}. As a point of BN-counting the measurement happens through relationship of homogeneous geometric shapes, all parameters must be within $0 \le v, u, \bar{v}, \bar{u}, v_c, u_c \bar{v}_c, \bar{u}_c \le 1$. Fix the direction of the axis of the parabola and take $v_c = u_c = \bar{v}_c = \bar{u}_c = 0{,}5$, and calculate a_{ij} functions for different values of their parameters u and v. The calculation results are summarized in Table 1.

Table 1

The calculation results of a_{ij} functions for various parameters u and v.

	u, v						
a_{ij}	0	0,2	0,4	0,5	0,6	0,8	1
a_{11}	1	0,2304	0,0144	0	0,0064	0,0144	0
a_{21}	0	0,3072	0,1152	0	-0,0768	-0,0768	0
a_{31}	0	-0,0576	-0,0096	0	-0,0096	-0,0576	0
a_{12}	0	0,3072	0,1152	0	-0,0768	-0,0768	0
a_{22}	0	0,4096	0,9216	1	0,9216	0,4096	0
a_{32}	0	-0,0768	-0,0768	0	0,1152	0,3072	0
a_{13}	0	-0,0576	-0,0096	0	-0,0096	-0,0576	0
a_{23}	0	-0,0768	-0,0768	0	0,1152	0,3072	0
a_{33}	0	0,0144	0,0064	0	0,0144	0,2304	1

The charts of the simple functions from the Table 1 depicted in Figure 3.

Superposition function-parameters a_{ij} always be equal to unit: $\sum_{i,j=1}^{3} a_{ij} = 1$. Let's prove it, making the table:

$$
\begin{array}{ccc|c}
a_1 & a_2 & a_3 & b_1 \\
a_1 & a_2 & a_3 & b_2 \\
a_1 & a_2 & a_3 & b_3
\end{array}
$$

Each a_i line corresponds to the first, the second and the third parabolas that are built on the original data x_{ij}. As we know from [1, 2, 3, 4, 8], the sum a_1+a_2+a_3=1, according to the rules and b_1+b_2+b_3=1, where the sum of products a_1b_1+a_2b_1+a_3b_1=b_1.

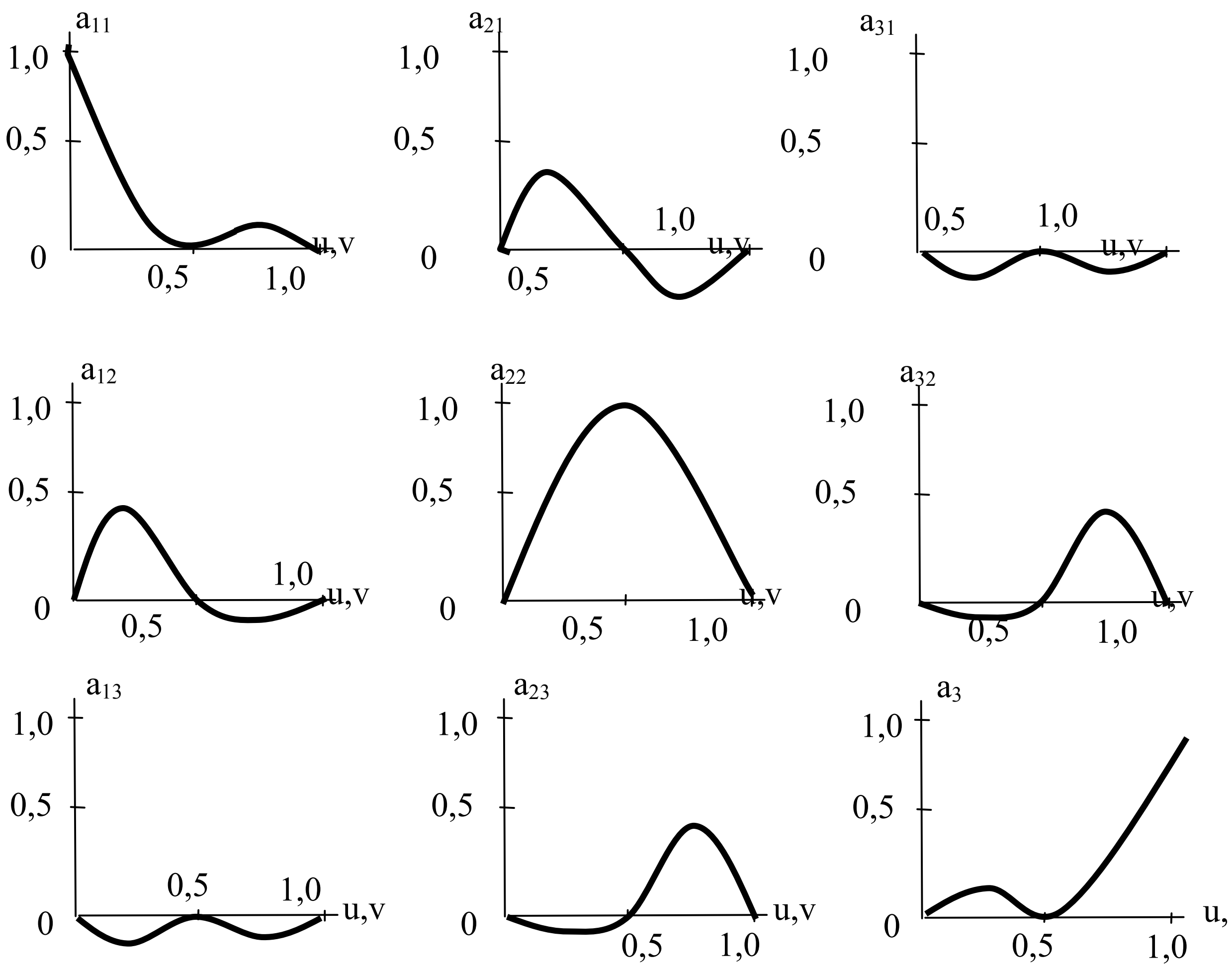

Figure 3 - Graphs of the functions a_{ij}

Similarly, $a_1b_2+a_2b_2+a_3b_2=b_2$ and $a_1b_3+a_2b_3+a_3b_3=b_3$. Putting these three equations, make the appropriate substitutions we obtain:

$$a_1b_1+a_2b_1+a_3b_1+a_1b_2+a_2b_2+a_3b_2+a_1b_3+a_2b_3+a_3b_3=b_1+b_2+b_3;$$

$$a_{11}+a_{21}+a_{31}+a_{12}+a_{22}+a_{32}+a_{13}+a_{23}+a_{33}=1 \qquad (1)$$

From the graphic point of view, the left part (3) means a superposition of all graphs (Figure 3) and will look like (Figure 4). Functions-parameters a_{ij} (2) are based on the parabola (1), so for all values of u, v they are always the same as shown in Figure 3. For the other point equation similarly to (1), the (2) will be ther as well. As you can see (Figure 3), regarding a_{22}, inside, a_{11} *is* symmetrical to a_{33}, (Figure 5) with respect to the line u,v=1.

The other six options are equal in pairs: $a_{13}= a_{31}$; $a_{12}= a_{21}$; $a_{23}= a_{32}$. But, a_{21} is symmetrical to a_{32} with respect to the line u,v=0,5 (Figure 5); a_{12} - is symmetrical to a_{23} with respect to the line u,v=0,5 (Figure 5).

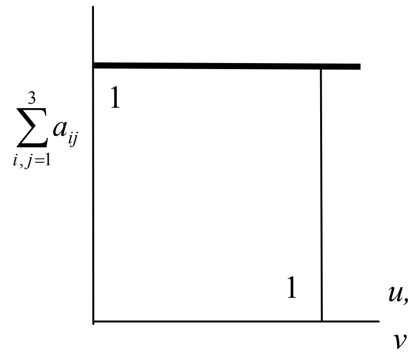

Figure 4 - The image of superposition (3)

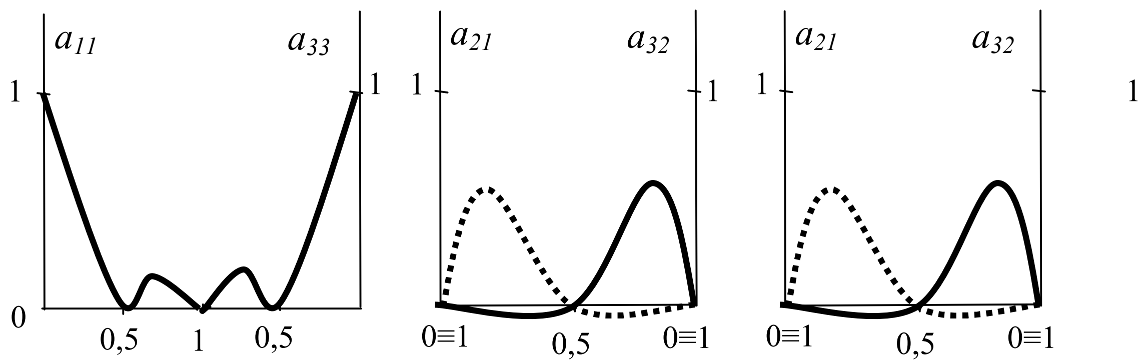

Figure 5 - The symmetry of the parameters

Because $a_{12}= a_{21}$, $a_{23}= a_{32}$, then their image in Figure 5 are the same, and if they lay one on one, they coincide.

This symmetry is due to the fact that a_1 and b_1 are the same in structure of writing, but are designed for different parameters (2) $a_1(u)$, $b_1(v)$. Similarly $a_2(u)$, $b_2(v)$ and $a_3(u)$, $b_3(v)$. However, when writing patterns a_1 and b_1, a_2 and b_2, a_3 and b_3 are different, the graphics functions, parameters a_{ij} are not symmetrical.

If the a_{ij} parameters of (3) multiplied by the appropriate starting coordinates x_{ij}, we obtain the equation parabolic surface M:

$$M=x_{11}a_{11}+x_{21}a_{21}+x_{31}a_{31}+x_{12}a_{12}+x_{22}a_{22}+x_{32}a_{32}+x_{13}a_{13}+x_{23}a_{23}+x_{33}a_{33} \tag{4}$$

Since the idea of a surface (4) was proposed by Professor I.G. Balyuba, the authors suggest further call them Balyuby parabolic surfaces instead of the previously used their name "Magnifier surface type."

Statement: If a point equation (4) $M=\sum_{i,j=1}^{3} x_{ij}a_{ij}$ is superposition function-parameters $\sum_{i,j=1}^{3} a_{ij}=1,$ then the point equation M is the BPS (Balyuby parabolic surface).

Above it was found that the left side of (3) is a superposition of the nine-parameter functions a_{ij}, which is, by definition, composition. However, the identity (3), in general, is a combination because of a change in any of the nine a_{ij} will change all others. By definition [5], the combination is mutually caused mergering of homogeneous components caused by a combination of elements in a complex deterministic form in which a change in one element entails a change in all the others. Composition (left side of (3)) was turned to combination (3) because it equated to unity. At the same time, any combination can be turned into a composition.

It is known [5], the composition is the result of assembling mutually independent elements in order to obtain certain decisions, while changing any of the elements of the composition does not entail other changes. For example, consider a point BPS equation (4), which coordinates x_{ij} is the baseline that are selected from the domain. Each of them arbitrarily choose and their values are independent of each other, so the amount of products on their respective functions-parameters $\sum_{i,j=1}^{3} x_{ij}a_{ij}$ violates combination (3) and converted into the composition (4), through which the determined variability point M. Each element a_{ij} is a function of the parameters u,v: $a_{ij}(u,v)$, $0\le u,\ v\le 1$. By changing u and v in the aforementioned range, with forward a_{ij} (2), which is part of the unit (3). Then M_{ij} is a composition of parts of each unit of base points x_{ij}.

Statement: the value of any variable point M_{ij} of the parabolic surface Balyuby lodged by point equation $M=\sum_{i,j=1}^{3} x_{ij}a_{ij}$ corresponds to one and only one initial composition of products x_{ij} basical coordinates and corresponding elements a_{ij} identity $\sum_{i,j=1}^{3} a_{ij}=1$.

In this regard, setting the initial data hij certain way, we can create parts such that the surface of the MFP degenerate into a plane or a curved line, or a straight and even the point.

Based on the above, point equation parabola (1) should be seen not merely as a parabola, but as a way to establish mutually predefined combinations of settings (combination) to perform identity (3) and changing her point of M_i can also be represented as a set of parts from one point *A, B, C*. This parabola can also degenerate into direct line or point.

This property BPS degeneration is the basis method of deployment-clotting of cells [9]. It also allows not perform the initial analysis of empirical data, which greatly simplifies their application.

In our opinion, the theoretical terms BPS should be attributed to a specific group of composite surfaces.

Conclusions and future research directions

The research outlined in this article, was obtained by the authors the first time and is a scientific novelty. Definition formulated and analyzed, it was found and studied the properties and characteristics of creating parabolic surface Balyuby (BPS). These studies substantiate the validity opportunities deployment method-clotting cells, which in the future will be laid in the foundation multifactor modeling processes, including management solutions supporting systems in energy efficiency area.

LITERATURE

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The article studied the application of surfaces "Magnifier" type for modelling of complex multifactorial processes. In particular, introduced the term "parabolic surface Balyuby - PSB," which is based on empirical data, it carried out an analysis and determined its properties and characteristics that explain the possibility of PSB conversion into a plane, line, point. It is proved that PSB is a composition of the starting points as well as possibilities of its application in the process of unfolding-folding cells. These researches substantiate the possibility of applying the method of folding-unfolding of the cells for modeling of the multifactorial processes. This method, in the future, will form the basis of the mathematical apparatus in the information systems for support management decisions in the implementation of energy-saving-projects.

Ref. 8, pic. 5, tab. 1.