OBJECTIVE ANALISIS OF DESIGN, DECORATIVE, APPLIED AND GRAPHIC ART OBJECTS

Iryna KUZNETSOVA
Sevastopol National Technical University Ukraine

ABSTRACT: The thesis is devoted to developing the prediction model for the cyclicity of design, decorative, applied and graphic art (DDAGA) objects visual perception. A system of differential equations is developed for predicting the cyclicity of percepting elements in DDAGA objects, based on Solar activity (SA) and geofluctuations. For an objective analysis of design, decorative, applied and graphic art objects, the Hausdorff dimension is used.

Keywords: qualitative and mathematical model; visual perception; object of design, decorative, applied and graphic arts, Hausdorff dimension.

1. INTRODUCTION

To create a mathematical model of visual perception cyclicity of (DDAGA), a qualitative analysis was carried out [1].

2. INFORMATION

The qualitative analysis of design, decorative, applied and graphic art (DDAGA) objects cyclicity prediction is made on the basis of Solar activity (SA). The asymmetry / symmetry cyclicity in DDAGA objects at different SA stages is investigated. The phase space is proposed as a basis for predicting the cyclicity of elements in DDAGA objects. Based on the visual-graphic interpretations of existing cultural cycle theories and considering the particulars of their authors' perception, a general theory of sociocultural dynamics is proposed. The given analysis is described in [2] in more detail.

The phase space of perception cyclicity of art and design objects may be seen as placed within a trihedron formed by three axes: $D, \dot{D}$, and $\dot{I}$. The minimum potential energy E correlates with the maximum speed of information $\dot{I}$.

It is necessary to define what basic movements will occur in the proposed perception model. We know, that solar spots are electric vortices, the essence of magnetism is reduced to rotation, and a rapid rotation causes a charged electric body to produce a magnetic field. Thus, the formula for predicting style changes in design and art objects depending on the natural phenomena should include a trigonometric function, that is a torque. Proceeding from the definition, we obtain the sine or cosine function.

The phase space of perception cyclicity of art and design objects correlation is shown on Fig. 1.

The disturbing moment consists of restoring, decay (damping) moments, and the moment of inertia. Thus, the components may look as follows:

$$M_B + M_D + M_i = M_A \quad . \tag{1}$$

The Kolmogorov entropy shows the speed of losing information about the condition of a system:

$$\frac{d^2D}{dt^2} = f\left(D, \frac{dD}{dt}\right). \tag{2}$$

It has been known since the Poincaré's times that a singular point is a point where $\frac{d^2D}{dt^2} = 0$ and $\frac{dD}{dt} = 0$ simultaneously,

which provides a basis for the construction of separatris surface.

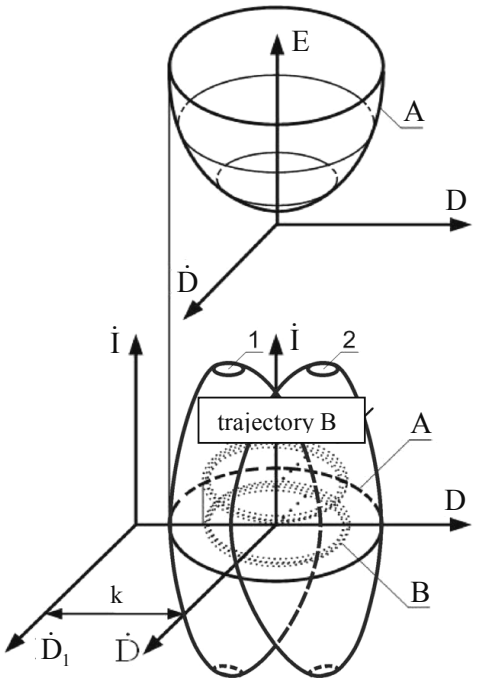


Figure 1: Phase Space of Perception Cyclicity of Art and Design Objects Correlation.

To indicate the harmonicity of perception, the golden section (GS) is generally used. Among the papers discussing the phase space, E. Shuster's remark [9] about the character of separatris surface being defined by the golden section deserves special attention. The potential ambiguity of image perception will be visually reflected in the projections (1, 2) of the separatris surface on Fig. 1.

Basing on our previous researches we have to consider the following coefficients in deriving the formulae:

Ultimately a theoretical model of the cyclicity of DDAGA objects' perception based on the Space activity is proposed in the form of a set of two equations:

I. The rotary movement of style changes ("analytical"—"synthetic" in terms of Y. Maslov [3], or "linear"—"picturesque" in terms of H. Wollflin [4]) is described by the formula:

$$I_n\left(\frac{d^2D}{dt^2}\right)+A\left(\frac{dD}{dt}\right)+f_2(D,t)=M_A, \qquad (3)$$

where M_A is the disturbing moment:

$$M_A=(F_GZ_G+F_{SA}Z_{SA})\cos D+M_K\left(\frac{d^2I}{dt^2}\right). \qquad (4)$$

where F_{SA} is the force of Solar activity; it may be defined by Volf's numbers, and the prognosis curve may be built by the astronomers' prognosis curve; F_G is the force of geofluctuations (GF); a prognosis similar to that proposed on the basis of Volf's numbers may be developed; M_K is the moment of unexpected influences in the Space.

The moment of inertia is defined as:

$$M_I=I_n\left(\frac{d^2D}{dt^2}\right), \qquad (5)$$

where I_n is the mass of all design objects multiplied by *r*.

The damping forces moment is calculated by the formula:

$$M_D=A\left(\frac{dD}{dt}\right). \qquad (6)$$

The restoring moment

$$M_B=f_2(D,t)=Q\cdot\cos[\sigma_Kt-\varepsilon(t)], \qquad (7)$$

where Q is the volume of design and art objects V, multiplied by coefficient ρ. M_B also includes the arm of statistical stability as function of D: $l(D)$ is the arm of statistical stability, $\Delta l(D,t)$ is the harmoniously changing increase caused by SA and GF, σ_K is frequency, and $\varepsilon(t)$ is random phase. Thus,

$$M_B=Q\{l(D)+\Delta l(D)\cos[\sigma_Kt-\varepsilon(t)]\} \qquad (8)$$

II. The longitudinal movement of information (the increase of its speed along the axis):

$$V\left(\frac{d^2I}{dt^2}\right)=F_G+F_{SA} \qquad (9)$$

where V is the volume of design and art objects.

As the quantity of details cannot be a negative value, the beginning of coordinates shifts by the value of K. Then:

$$D_1=D+k. \qquad (10)$$

The above summarizing yields:
$\exp T_p, R, \Sigma P_i$ are the coefficients of the rotary movement formula (3),
$\Sigma J_i, \Sigma B_i, M$ are the coefficients of the movement formula (9).
The resulting set of equations:

$$\begin{cases} \left\{ \exp T_p R \Sigma P_i \left\{ I_n \left(\frac{d^2 D}{dt^2} \right) + A \left(\frac{dD}{dt} \right) + Q\{l(D) + \right. \right. \\ \left. \left. + \Delta l(D) \cos[\sigma_i t - \varepsilon(t)] \right\} \right\} = \\ = (F_G Z_G + F_{SA} Z_{SA}) \cos D + M_K \left(\frac{d^2 I}{dt^2} \right), \\ \Sigma J_i \Sigma B_i M V \left(\frac{d^2 l}{dt^2} \right) = F_G + F_{SA}. \end{cases} \quad (11)$$

A generalized model of predicting art and design perception cyclicity should be, firstly, laconic and simple, and secondly, general and universal. The model should correspond to similar regularities observed in reality. The cyclicity of perception involves and considers natural changes occurring over the time.
To create a mathematical model within the framework of a qualitative model of predicting the perception of the objects under study, the author introduces the quantity of details and information parameters. *D* stands for quantity of details. A rate of change of details (the first-order time derivative of *D*) is taken into account in the formula to predict the art and design perception cyclicity.
Significant is the effect of the information parameter *I* on the perception rate of any events that are of importance for human survival. The formula involves the parameter of information perception rate (the first-order time derivative of *I*). Throughout the process of personal development, the information perception rate (a constant, which is of relevance for the research at the present stage) keeps growing gradually.
In the general case of a differentiated dynamic system, a phase space is a differentiated manifold which, in turn, is a locally Euclidean space possessing a differential structure. To define a locally Euclidean space we need to correlate it with a Hausdorff topological space. At this stage of research, the author proposes to carry out a comparative analysis of DDAGA objects (design, decorative, applied, and graphic arts) based on the Hausdorff dimension in order to provide a practical solution to the problem of predicting changes in their visual perception.

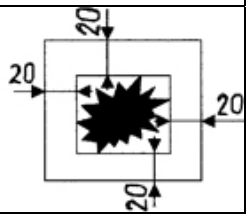
Hausdorff dimension	Boundary value
$\dim_H = \lim_{r \to 0} \frac{\ln N(r)}{\ln \frac{1}{r}}$, where *r* is cell size	

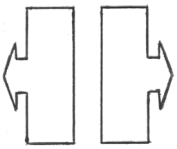
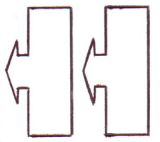
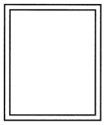
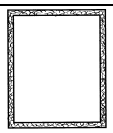
Figure 2: Hausdorff dimension

The Hausdorff dimension of more painterly (according to Heinrich Wolfflin) design and art objects is larger compared with that of linear objects. The objects' asymmetry lessens the Hausdorff dimension.
Here is an example of a computer calculation of Hausdorff dimension made by the author of the article:
Various compositions of elementary combinations of points, straight lines and curves have been investigated by the author which part is submitted in table 1.

Table 2: Compositions of Elementary Combinations.

1,6951883438	1,6335325689
1,4574529349	1,4642670947

Table 3: Complex compositions

	
1,4376263788	1,3840922593
	
1,3057141202	1,5160004295
	
1,4593064415	1,4243126817
	
1,6275106228	1,6947971854
	
1,8814323652	1,9865897112
	
1,6168911225	1,9694316884

Close analysis performed by the author shows that there is a possibility for marketing departments to study monochromatic versions of design, decorative, applied, and graphic arts objects at the sketch design stage and to predict the advisability of their production at a given moment.

CONCLUSION

The mathematical model of predicting the cyclicity of DDAGA objects' perception has been created, based on synergy influenced by Space cyclicity (SA and GF). The model is "rigid" and requires further research oriented toward either its "loosening," or more precise definition of coefficients.

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ABOUT THE AUTHOR

Kuznetsova Iryna, Prof., Dokt.Sc., Sevastopol National Technical University, Department of Descriptive Geometry and Graphics in Sevastopol, Ukraine. Her research interest is forecasting. She can be reached by e-mail: iakuz56@mail.ru or through postal address: Kuznetsova Iryna, 11 Nadezhda Ostrovskaja apt. 7 Sevastopol 99028, Crimea, Ukraine