USE OF GEOMETRY AT CREATION OR THE ANALYSIS OF DESIGN AND ART OBJECTS

Iryna KUZNETSOVA
National Aviation University (Kiev), Ukraine

ABSTRACT: The article deals with the problem of geometry analysis when creating and using the objects of art and design. Currently, topical in the creation and research of art and design objects is the use of Euclidean, projective, differential, and fractal geometry, the theory of sets, the theory of probability, the theory of dilatation, and geometric transformations. Examples are provided. A simplified classification of geometrical models in industrial design is proposed.

Keywords: design; art; geometry.

1. INTRODUCTION

One of the essential objectives of research in industrial design has been to bring the design problems together within a system of strict and logically consistent scientifically founded knowledge.

2. INFORMATION

The majority of researches are carried out basing on Euclidean geometry, which is naturally accounted for by the character of the researchers' educational background, especially in the case of professional creators of design and art objects. Many existing researches can be extended on the basis of geometry branches that are not traditionally used by engineers and architects.

It is natural to begin with the simplest thing, the point. The perception of dynamic and static compositions of points was described, for example, by N. Yakovlev [5], where Euclidean geometry was made use of.

As an example of priority use of points, we may consider pointillism (from French *pointiller*, i.e. "mark with points")—the method of painting, in which separate distinct brushstrokes (shaped as points or small squares) are applied to the canvas to be optically mixed up in the viewer's eye. The formal and rationalistic character of pointillism, the fractionality of the piece surface, the locality and brightness of each separate color, did not prevent the use of pointillistic technique in the intensive landscapes by P. Signac with their contrast on colors, or in the canvases by G. Seurat that are full of delicate nuances, or in the portraits and space-and-volume genre compositions by T. van Rysselberghe, etc. A similar perception principle works in other art forms as well, where similar methods are employed based on optical intermixture of point sets, as in the Byzantian mosaic art.

In the course of analysing design and architecture products created by means of points, we here consider points to be indefinable space elements. The space presents itself as a logic form (or structure) providing a medium for implementing other forms. This medium is perceived as a set of objects—points—of any nature.

In geometry, axioms define some external interrelations of elements. Elements form unions of sets. The ways in which such unions are formed, as well as the operations, are structurally limited, in order to avoid paradoxes. Elements are primary to sets. One should note the uniformity of understanding images relative to the understanding of elements and sets. We can consider pointillism in retms of the theory of sets. The concept of

set is one of the broadest concepts in mathematics and in logic. Within the so-called "naive" set theory, the set is defined as an aggregate of any objects which are its constituents and have some characteristic property in common. One can consider sets of points either as an inventory—a list of elements; or as a rule, that defines a particular point's belonging to a particular image—for example, to a crown of this or that tree, or to the shimmering water surface, or the soft grass on by G. Seurat's *Sunday Afternoon on the Island of La Grande Jatte* (Figure 1).

The sum within the fuzzy set theory, as applied to the painting *Sunday Afternoon on the Island of La Grande Jatte* by G. Seurat

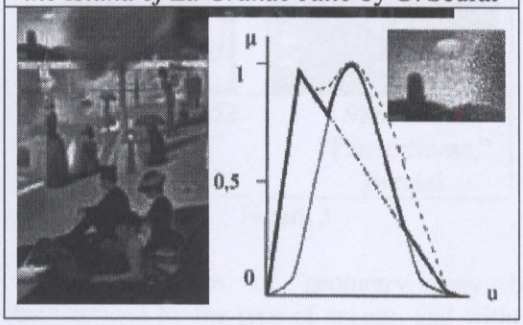


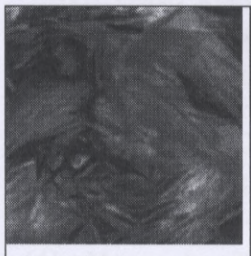
Figure 1

The fuzzy set apparatus appears to be the most acceptable for researching into pointillism.

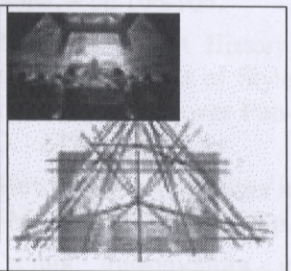
Following the analysis of point compositions, it is logical to describe the artistic technique of using straight lines in avant-garde painting. This technique is represented by the rayism of M. Larionov, which is considered to be one of the first forms of abstract art and one of the first manifestations of avant-gardism in painting, along with the suprematism of K. Malevich, the futurism of V. Tatlin, and the all-European cubism.

Figure 2 represents an illustration from M. Larionov's book *The Donkey's Tail and The Target* and his picture *The Radiant Rooster*. M. Larionov provided the theory of the new artistic trend (1912—1914). Larionov commented on the "fourth dimension" in art—the radiant and energetic dimension—particularly emphasized by rayism. The idea of multidimensional perception was voiced by many artists, but the multidimensional geometry apparatus appears too complicated to be used for studying art perception.

We may assume though that rayism is based on the apparatus of projective geometry. This geometrical apparatus was also used by other authors of design and art objects. For instance, the whole composition of the *Lord's Supper* by S. Dali is built on the bunches of projective geometry sheaves.



The Radiant Rooster, M. Larionov



The *Lord's Supper* by S. Dali and the analysis of the picture made by the author of this article, based on sheaves of lines

Figure 2

The author of this article has proposed a system of differential equations [1], the first one describing the rotation of the styles' cyclic recurrence ("linearity" vs "painterliness," in terms of H. Wöllflin [2]), and the second one reflecting the longitudinal motion of information.

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 design,

decorative, applied, and graphic arts objects based on the Hausdorff dimension in order to provide a practical solution to the problem of predicting changes in their visual perception.

The second half of the 20th century is characterized by the growing interest in fractal geometry. Fractals are objects with the topological dimension that is smaller than the Housedorff dimension. In art, there exists a fractal ratio known as the Golden Section.

1.8814323652 "Linearity," Michelangelo	1.9865897112 "Painterliness," Bernini

Figure 3

Many branches of geometry may be characterised by the type of spaces, and within these spaces, by the type of objects that represent the subject of research.

A number of researches may be pointed out in industrial design, that are connected with explicit or inexplicit use of various sections of geometry.

3. CONCLUSION

At the current stage, the basic techniques of geometrical modeling in creating and studying the objects of design imply the use of

1. Euclidean geometry
2. theory of sets
3. probability theory
1. differential geometry
4. projective geometry
5. fractal geometry
6. dilatation theory
7. geometric transformations.

REFERENCES

[1] Kuznetsova I. Creating a Set of Differential Equations to Predict Changes of Visual Perception of Design Objects // Proceedings of the 2nd International Conference on Engineering Graphics and Design, June 7-10 2007, Galati, Romania.—pp.106-108.

[2] H. Wölfflin, Principles of Art History. The Problem of the Development of Style in Later Art. New York, USA: Dover Publication, Inc., 1950. - 237 p.

[3] Голицин Г.А., Петров В.М. Гармония и алгебра живого. -М.: Знание,1990. -128 р.

[4] Моль А. Теория информации и эстетическое восприятие. - М.: Мир, 1966. - 678 р.

[5] Яковлев М.І. Геометричні принципи художнього формоутворення: Дис. д-ра техн. наук: 05.01.03 / КНУБА. - К., 1999.- 352 р.

ABOUT THE AUTHOR

Kuznetsova Iryna, Dokt.Sc., National Aviation University, Prof. of the Department of Interjer Design in Kiev, Ukraine. Her research interest is forecasting, features of perception, formation of the design and art objects form. She can be reached by e-mail: iakuz56@mail.ru

CONFERENCE SERIES

Hans-Peter Schröcker, Manfred Husty (eds.)

Proceedings of the 16th International Conference on Geometry and Graphics

Innsbruck, August 4-8, 2014

innsbruck university press

Hans-Peter Schröcker, Manfred Husty
Faculty of Engineering Science, Unit Geometry and CAD, Universität Innsbruck

Universität Innsbruck
1st edition

www.uibk.ac.at/iup
ISBN 978-3-902936-46-2

Contents

The 16th International Conference on Geometry and Graphics (ICGG 2014)

Program and Abstracts

edited by Hans-Peter Schröcker and Manfred Husty
Unit for Geometry and CAD, University of Innsbruck

Innsbruck, Austria

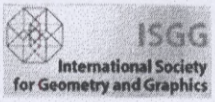
August 4–8, 2014

Program and Abstract of ICGG 2014, The 16th International Conference on Geometry and Graphics, Innsbruck, Austria, August 4–8, 2014.

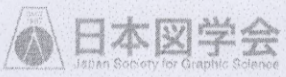
Edited by Hans-Peter Schröcker and Manfred L. Husty, Unit for Geometry and CAD, University of Innsbruck, Austria.

Published on behalf of the International Society for Geometry and Graphics (ISGG).

We gratefully acknowledge the support of our sponsors.



International Society for Geometry and Graphics
http://isgg.net



Japan Society for Graphic Science
http://www.graphicscience.jp/

Robert McNeel & Associates
http://www.rhino3d.com/

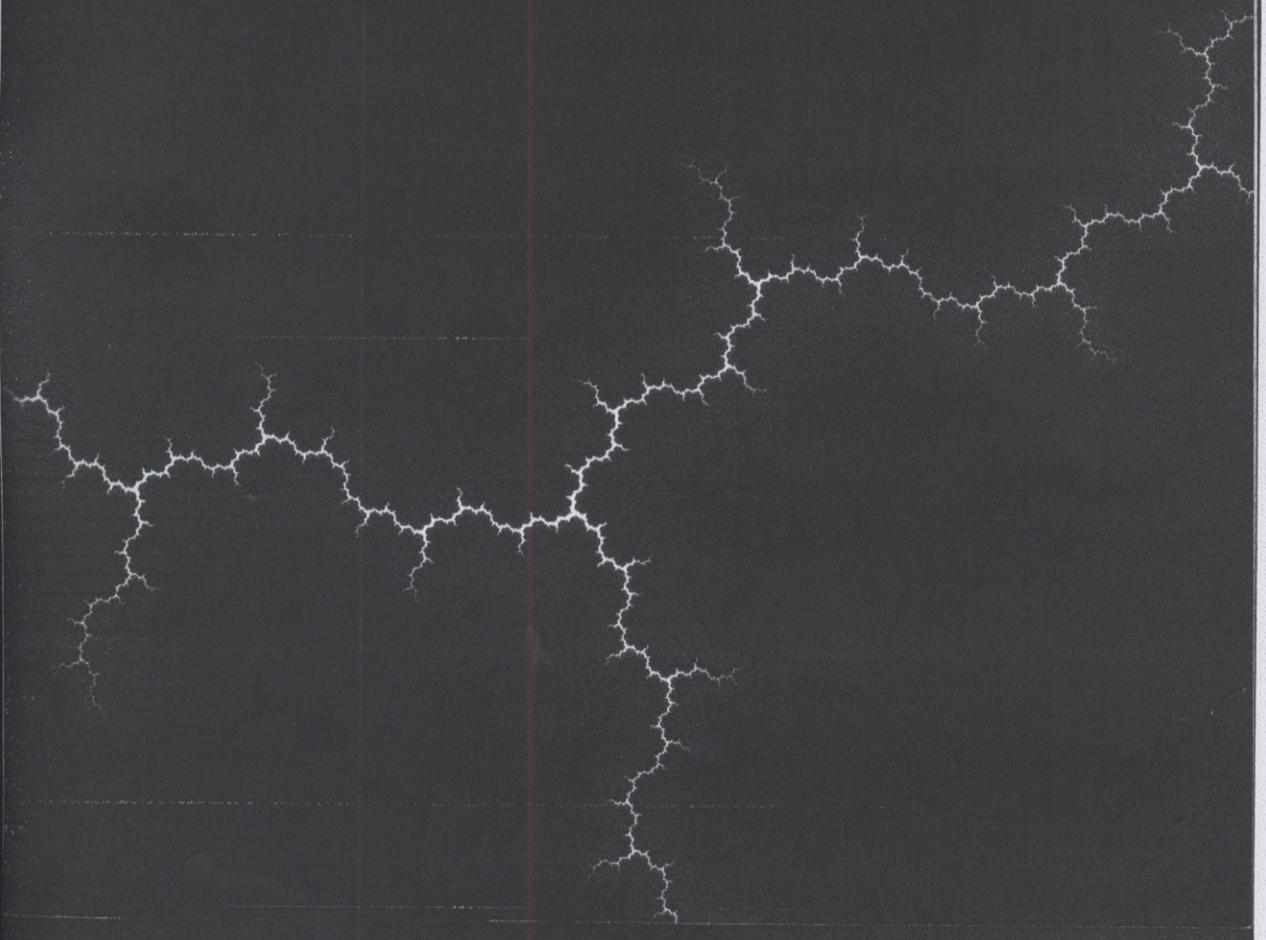
University of Innsbruck
http://www.uibk.ac.at/

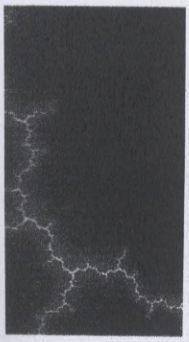
H.-P. Schröcker, M. Husty (editors)

The 16th International Conference on Geometry and Graphics

Innsbruck, August 4–8, 2014

Program and Abstracts





Contents

1 Welco

Welcome A

It has become a f
ternational Societ
to hold a biannial
has also become a
is hosted in term
great regions: A
America/South A
/Africa. The last
were organized in
treal (Canada 20
ence in 2014 we
them with a clea
It took some car
Innsbruck to be t

Let us recall t
started with a fe
our flourishing c
encreasing numb
teaching expertis

Theoretical re
Applications i
Education.

The different s
modern media ar
The oral present
ations, experien
inspire further re
be scientific excl

On this confe
lectures from se
ICGG2014 and

Organizing su
qualified and m
what they have a

TU-3-H1 Room: H1	TU-3-S6 Room: S6	TU-3-S7 Room: S7	TU-3-MS Room: MS	TU-3-KL Room: KL
04:20–04:40 p. 126 *S. Chiarenza* Geometry and Graphic Design	04:20–04:40 p. 73 *Y. Ma, Y. Fu, S. Li et al.* The Development of Modeling Tools for Pin-by-Pin Precise Reactor Simulations	04:20–04:40 p. 189 *V. Cardone and B. Messina* A New Condition of Perpendicularity in Isometrical Cavalier Projection	04:20–04:40 p. 170 *A. Mollicone* Logic (Systematic) Vs. Automation (Mechanisms)	04:20–04:40 p. 99 *S. Mick and G. Weiß* Fibonacci Triangles and Circle Chains and a Golden Bi-Arc Spiral in...
04:45–05:05 p. 279 *I. Kuznetsova* Use of Geometry at Creation or the Analysis of Design and Art Objects	04:45–05:05 p. 135 *S. Enghardt, J. Bauch, and F. Henschel* On the Geometry of Pseudo-Kossel and Bremsstrahlung Interferences	04:45–05:05 p. 98 *J. Correia, M. Costa, A. Guerreiro et al.* Eyesight Cartographies – Unfolding the Visual Sphere	04:45–05:05 p. 79 *I. Honma and K. Kuwabara* An Educational Trial on Drawing for True Shape by Using Auxiliary View Method...	04:45–05:05 p. 130 *Z. Kolar-Begović, R. Kolar-Šuper, and V. Volenec* Geometry of ARH-Quasigroups
05:10–05:30 p. 159 *G. Barczik* Intruiging Intersections and Useful Unfoldings	05:10–05:30 p. 285 *H. Jankowski and L. Stanberry* Visualising Variability: Confidence Regions in Level Set Estimation	05:10–05:30 p. 106 *A. Brailov* The General Approach to the Solution of Typical Engineering Geometrical Problems	05:10–05:30 p. 72 *M. Ilić and M. Stavrić* Developing Spatial Ability for Quality Engineering Education	05:10–05:30 p. 68 *M. Katić Žlepalo* Curves of Centres of Conic Pencils in Pseudo-Euclidean Plane
—	05:35–05:55 p. 80 *W. Liu, C. Kong, Q. Niu et al.* An Effectual Offset Algorithm for 3D Curve in Engineering Application	05:35–05:55 p. 218 *J. Dzwierzynska* The Representation on the Cylindrical Rotary Surface – Inverse Panorama	—	05:35–05:55 p. 92 *S. Vidak* Existence and Uniqueness of Centers of Regular Polygons in Some Subclasses of...

WE-1-H1 Room: H1	WE-1-S6 Room: S6	WE-1-S7 Room: S7	WE-1-MS Room: MS	WE-1-KL Room: KL
10:15–10:35 p. 204 *G. Amoruso, A. Sdegno, and S. Masserano* Perspectival Geometries	10:15–10:35 p. 52 *D. Velichová* Classification of Manifolds Resulting as	10:15–10:35 p. 246 *A. Tan, F. Croft Jr., and F. Tan* Simulating the	10:15–10:35 p. 116 *B. Blaschitz* Geometric Optimization in Minkowski Space	10:15–10:35 p. 224 *B. Han, Y. He, B. Tong et al.* The Research on Graph