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# THE PRINCIPLE OF RANDOMNESS IN COMPUTER ART

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## **Abstract**

The article discusses the principle of randomness in traditional and computer visual art. It addresses the question of the manifestation of chance in the works of Leonardo da Vinci. The article reveals the characteristic features of chance in the works of the Dadaists. The author focuses on the work of Marcel Duchamp. The author also carries out a detailed analyzes of randomness in computer art focusing on the generation of random numbers in computer art. The author analyzes the concepts of chance, generation of random numbers, and the work of the computer artists of the 60-70s, such as C. Ksuri and W. Kolomyjec. The author describes the algorithmic method, i.e. the method of creation of images in the style of op art with the use of the FORTRAN program.

*Keywords:* fractal, graphics, random numbers

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## **1. Introduction**

The importance of research of accident in the subject framework of Art philosophy is caused by the feature and the equipment of the post-modernist stage development of the philosophy of Science. On the basis of the review of scientific and philosophical literature it is possible to draw the conclusion that the principle of accident thoroughly fell within the scope of the history of Philosophy, synergetic within the sphere of researches of social and cultural communication and art.

Notions of chance originated in ancient times together with the very first attempts of man's awareness of his existence, his relationship to the world, and to himself. This process shows that chance can be compared with the need - another extreme form of correlation in the world.

Chance as philosophical category denotes such connections between phenomena of the real world, which can be realized under certain conditions, while under others cannot. Chance is a problem and a mystery of Philosophy since the interpretation of the principle of determinism, which is in fact since the advent of the most rational philosophy [1].

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Various manifestations of chance in the creative work attracted artists since the time of the Renaissance. Leonardo da Vinci, for example, discoursed upon artistic improvisation of nature that was able to create its own 'pictures' and the whole 'scenic' worlds in random spots on the old walls. All sorts of random effects and impressions often gave impetus for the artists' fantasies [2].

## **2. Main part**

One more version of special language casual is connected with the development by some artists of the stylistics of automatism as spontaneous, underlined by corporal, organic gesture. In similar works, the casual splashes of spots on paints which are chaotically running up on a leaf (L. Bruni a series of the drawings 'Negatives' 1921) or the involuntary, not counted expressional gesture stroke (V. Stepanova a series of pointless drawings of 1919) can be imitated. Unlike a freak of chance, in these works it is possible to speak about the organic version of stylistics casual, based on unconscious mechanics of the body.

Interfering on the art territory, accident raises a question of borders, limits of expressive opportunities of language. Whether art language is capable, remaining language, to refuse linear logic and relationships of cause and effect? Whether it is capable to catch what is in the inconceivable area and magic causality? All versions of stylistics casual in the Russian art are to some extent connected with the solution of this problem.

Accident in any work of art has to be seen and realized aesthetically. Only then it appears in art space. In other words, the artist has to create a special method of exhibiting of the freak of chance in the work, allocate it from the general stream of vital accidents, i.e. make it available to perception. However as soon as the case becomes a method, i.e. a system of repeating techniques, it is a matter of fact loses in the accident. The artist working with 'the principle casual' has to create the special language, capable to balance at the border of language space. In creation of such language of art one of the most painful and insoluble tasks also consists in use 'the principle casual'.

The aesthetics casual to which many artists and writers address, is connected with the special line in modernist art. It first of all washes away the rigid style of thinking, the rigid limits of the most modernist project of culture. The case becomes the instrument of search of new mechanisms of generating the sense, the new technician of creating works of art, giving the chance to see volume. More exactly, is a multidimensional reality in which are works not only rigid determinist mechanics, but also magic causality, the magic world of compliances, an irrational arbitrariness of a case.

The 19<sup>th</sup> century demonstrates many examples of the use of randomness in the creative practice of artists. In the late 10s of the 20<sup>th</sup> century chance became a crucial element in the work of the Dadaists. As H. Richter stated: "Chance became our trademark. We followed it like a compass." [3] Marcel Duchamp also used the principle of chance in the creation of art works. Chance had a

central place in the work of the Surrealists in such techniques as frottage and decalcomania. In 1925, Max Ernst invented the technique of 'frottage', i.e. 'rubbing' (according to his stories, he discovered the potential of this technology while considering the roughness and texture of the old wooden floor). Ernst was engaged with the development of other elements of randomness, which served the same purpose, namely grattage (scratching) and decalcomania (getting unpredictable configurations with the use of two or more surfaces coated with liquid pigments).

Frottage, grattage, dripping and decalcomania allowed the enthusiasts (primarily M. Ernst) to get closer to the visual effect of hallucinations. They allow achieving a kind of natural effects. Thus, these techniques are able to reinforce the convention of cultural vision and 'educated' drawing that reproduces the reality reliably. In fact, the reproduced reality does not exist in human experience. The artist appeals to the eye habits to the conventions of European culture with the purpose to deceive the eyes and to 'sell' under the guise of the painting, which is depicting something interesting, alluring and endowed with emotional meaning, some configurations that occur without any mind control. Degree of chance in such works has always been an object of discussion: pigments of paint or pencil strokes did not accidentally fall on the paper or canvas, as they were intended, directed by the artist's hand. On the other hand, the level of unpredictability of the result in this case was much higher than by the strokes of expressionists. The random factor was evident particularly for the Dadaists: the artists threw paints and other materials into the canvas or walls. To legitimize these strange actions, which did not look like the old methods of artists, they invented the myths about the artist as an unconscious medium of the world forces and energies [4].

Later, randomness could be found in performance and happening art, in abstract expressionism, in the works of John Cage, in the activities of Fluxus. These examples demonstrate a great importance of chance in the modification of art, in the change of the usual relationship between a work of art, life, and the work of the artist.

As Richter commented: "chance appeared to us as a magical procedure by which, one could transcend the barriers of causality and of conscious volition, and by which, the inner eye and ear became more acute. Adoption of chance had another purpose, a secret one. That was to restore to the work of art its primeval magic power and to find a way back to immediacy... Referring directly to the unconscious, which is a part of chance, we sought to restore in the work of art something supernatural, whose conductor art has been since time immemorial. Absolute acceptance of chance has led us into the realm of magic, incantations, oracles, and the predictions on the entrails of the lambs and birds." [3]

Chance introduces a special principle of creativity in art that helps to develop the imagination of the artist in the process of creation of unusual images. One of the examples of such random creation of unusual images is drawing in a period of deep thought. In one of his articles, Paul Valery gave a description of this method: "feather ... on its own started sketching out bizarre

figures, ugly fish, octopuses, bristling with too shaky and weightless curls ... As a result a strange, absurd creation was born, incongruous with the flow of life, powerful and frightening, with no beginning, and no ending, no limit.” [5]

This description accurately emphasizes the special principle of creativity in creating of absurd images, which are not subject to human consciousness, where an important role is played by accident.

With the introduction of the latest scientific research, which is closely connected with the theory of chaos, fractal geometry and computer graphics, the manifestation of chance in the works is defined in a special way; together with creation of a new reality. This model departs from reality and rationality of established methods and techniques in the creation of works of art. The model of virtual reality has become one of the permanent components in computer art. Origin computer arts began in industrially developed countries where the defensive and technical industry dominated. Computer art was closely related to Mathematics, based on Plato’s doctrine of numbers and harmony. The American mathematician and the artist Ben Laposky broke borders between art and Science. It was the first who managed to receive a graphic representation, having applied for this purpose the analogue computer. Ben Laposky was an example for future scientists and programmers in creation of artistic images by technical means. In the 1952 Ben Laposki created by means of a tube of an oscillograph the first compositions ‘Electronic abstractions’. In the 1980s, computer was described as a gateway to the unseen and unknown worlds of digital abstraction. For many people, computer was an ‘infinite machine’, which provides access to a vast metaphysical border opening the universe of visual forms. Encouraged by the new paradigm of the techno-science, computer became micro universes ready for boundless creativity and creation of new worlds. The artists’ appeal to computer as a creative tool was primarily associated with the ability to create new visual worlds through algorithms and computation. The first computer artists have been fascinated by computer capabilities to create new forms and images. Charles Csuri believed that the ability to change and distort the simple vector objects on computer by using a random number generation helped to create fantasy images and worlds.

With use of computer technologies the artist will improve equipment of a collage, using various special effects of computer graphics. Opportunity to create means to computer graphics in the collage image fantasy and at the same time absolutely real, even the household world made one of the most attractive characteristics of this equipment.

The term ‘collage’ in its modern interpretation is also used for designation of reception of creation of the whole image from some other images or their separate fragments, as a rule by means of computer programs, such as Adobe Photoshop and other graphic editors. At the heart of creation of a digital collage it is the work with layers. In the course of creation of collage, various types of imposing, mixing and transparency can be applied. In spite of the fact that in most part of cases the term ‘photomontage’ would be more pertinent, borders of these two concepts at manipulation with images by means of computer

programs, are practically erased. Thanks to computer technologies has given the opportunity of creating considerably extended collages using graphic programs for processing of images. Creation of computer collages brings first of all the ability to work with layers, and the competent application of art special effects.

Chance in traditional art has been determined only by artist's imagination and inspiration, and in computer art the creative dialogue is complimented with equipment, computer software, and random number generation, which created the first works of computer art and fractal graphics. Generating of random numbers in computer art defines a specific principle of creativity, stimulating the artist to create fantasy images far from human rationality. Randomness in computer art was considered by many artists, primarily as a mechanism for creating something new, as an effective way to achieve what you cannot achieve in a rational way. Random combination of individual fragments of objects made in the technique of collage or installation techniques creates not only one but many meanings. Randomness in the art develops associative memory. The interpretation of such works of art is not unique as each viewer has the own association [6].

Computerization of fine art is closely related to the generation of random numbers. Random number generation is an algorithm that generates a sequence of numbers, the elements of which are almost independent of each other and are subject to a given distribution. The first computer works were created by a random number generator - new images and art works were created by chance [J.D. Golic. *New paradigms for digital generation and post-processing of random data*, Technical report, Cryptology ePrint Archive, Report 2004/254, 2004, <http://eprint.iacr.org/2004/254.ps>]. According to the statement of Frank Herbert, the founder of computer art: "with the advent of the computer it is not necessarily to possess the academic drawing skills to create works of art. It is sufficient to apply a random number generator." [7]

For example, the works of one of the first computer artist, C. Ksuri, are based on randomness like the drawings 'Time', 'Accidental War' and 'Departure'. In 'Time' Ksuri depicted the movement of flies, which symbolize the passage of time. The computer program generated random numbers that determined the distribution of a certain number of flies in the range of 1-inch concentric rings. Random number also solves the orientation and size of each fly in the range. The figure 'Accidental War' was created from a toy soldier that became the data set for the future composition. The computer program used the random number generator. Random numbers determined the distribution and location of four hundred soldiers on the battlefield. The transformation of objects was used to change the distribution and inclination of each soldier. One side was called 'Red' and the other 'Black' and the names of real people were given by the program. Another program designated military and army ranks. The figure 'Departure' was carried out with the help of computer programs. The distribution of flies was based on a combination of random numbers, which were located in the area of the triangle, and then another area of the semicircle was converted.

By the end of the 1960s, the use of computer technology in the fine art aesthetic research is common: more and more artists are not only using computer in their practice, but also trying to understand the role of computer technology in the visual arts.

W. Kolomyjec used two methods to create art works that are opposed to each other - constructive, based on a scientific, rational thinking, and the random number generation.

The image 'Banana-Cone' was created in two phases: two figures were created with the help of precise mathematical calculations, a banana and a cone, then the artist has made 40 copies of each image using random numbers generation. As a result, a banana and a cone were transformed into an ice cream with the help of a linear interpolation of the digital image.

The drawing 'Birds' was created on the base of the data bases of imagery, which was formed in advance. The artist painted a bird, transformed it in different angles, and then placed it in the data bases. With the help of the graphics program FORTRAN and random number generation the artist generated the images in a single composition of chaotically flying birds.

Other examples of using data bases of imagery and random number generation are 'Bird Curves' and 'Creature Tune'. These are some good examples of using repetitive operations on a computer. The program used the same images with some slight modifications to create a composition. This program used the random number generator when selecting images and placing them in the space [7].

W. Kolomyjec created his works using the algorithmic method, or the method of creating an image in the FORTRAN program that lets you to create the images relating to optical art. 'Random Concentric Squares' contains an algorithm that divides the individual squares into large arrays consisting of squares of different sizes, creating the illusion of surround tunnel. The figure was created on 'organic illusion'. The artist used the same idea of a large array of squares, the basis of which was a square. With the use of transformation and generation of random numbers he transformed the squares into ellipses, irregularly shaped and connected with each other by broken lines, deformed in places. Many digital artists have interpreted the works of avant-garde artists, such as the drawing of W. Kolomyjec 'Moire'. It does not only illustrate the logic of many of the algorithms used in computer science, but it can be also related to the optical art. W. Kolomyjec created an optical illusion using the deformation of the model of a rectangle into rays decreasing and increasing, and simulating the movement. If we look at the works of 'Op'-artists, in particular Bridget Riley and Victor Vasarely, we can see a striking similarity with computer images.

W. Kolomyjec was apparently inspired by the works of Maurits C. Escher. The artist showed interest in clarity, methodical and algorithmic of the Escher's works. Some of Escher's techniques have been used for computer images by W. Kolomyjec. The American artist and programmer Sen Lee offered his own algorithm for constructing artistic tiling of the plane (the plane coated with a set

of repeating shapes without gaps between them) in the spirit of the works of Maurits Cornelis Escher. The algorithm in this case is not only applicable to regular tilings, which Escher worked with, but also to the Penrose tilings and fractals [8]. Due to the fact that the method of Lee can be used for the fixed-area, his theory can be applied, for example, to build art fractals. Fractals are geometric objects that have a certain degree of self-similarity (there is not any strictly mathematical definition of this concept). In addition, the Lee method is applicable to non-periodic tilings, which are not moving in a shear (like Penrose tilings).

Mathematicians, scientists, as well as digital artists got carried away by the study of fractal geometry. They were surprised and amazed by the unpredictability of results in the process of creating images and patterns by means of fractal graphics.

F. Kenton Musgrave, a programmer from Yale University, was the first to apply fractal geometry of Benoit Mandelbrot in visual arts. By using fractals he created coastlines, sea and mountains. Later on the artists began to use random fractal actions to create scenery in computer graphics. The discovery of fractals was the discovery of a new aesthetic of art, Science and Mathematics, as well as the revolution in human perception of the world.

### **3. Conclusions**

Computer simulation of the random element is based on two basic principles:

1. the similarity between the original random element and its model is the coincidence (affinity) of probabilistic distribution laws or numerical characteristics;
2. every random element is defined as a function of simple random elements, so-called basic random variables (BRV).

The basis sequence of random numbers, which is used to generate random elements on computers of different nature and with different laws of distribution, is a set of random numbers with uniform distribution law [9].

Based on the above stated, we can come to the conclusion that the phenomenon of randomness in art gives new opportunities for creativity, for both traditional and digital artists. Moreover, randomness in the visual arts is extremely attractive and interesting for art historians and researchers.

Random factors include random interval time between the requirements in the flow of requirements to operation; random length of operation in the system; selection of the traffic direction in accordance with the requirements of specified probabilistic characteristics. The imitation object can be not only random variables but also occasional events, vectors, processes, fields, sets, i.e. arbitrary random elements [10].

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