Nature as a Strategy for Pattern Formation in Art

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Abstract

Artists have responded intuitively and analytically to patterns in our world. My objective is to explore new ways of producing creative work that involves both linear and non-linear thinking. The linear process shows a logical progression towards a development of patterns. But the non-linear system can produce unpredictable patterns from a deterministic process. It crosses boundaries of prior cognitive knowledge and results in building new relationships as it gives new meaning to form. In the natural environment we find patterns that are generated by fundamental processes of growth. The formation of patterns is determined by intrinsic forces of an organizing process that also adapts to extrinsic factors as it evolves. I will discuss two processes of creating my paintings. Paintings that show how the cellular unit becomes a process of growth that is inspired by a mathematical formal order. This process of cellular growth can provide an integrative potential for a dynamic generative exploration of cellular automation and produce many variations of the original form. Why is this and important topic? This knowledge can be and has been adapted to many of today's innovations of the cellular growth in medicine, architecture and design. My other non-linear paintings show a departure from the deterministic process to that of an aesthetic decision-making approach based on multiple interactive variables of color and shape. These decisions result in interrelationships that add new information to prior knowledge. They become a manifestation of a poetic form. This paper will provide a historical overview of the evolution of man-made patterns throughout civilization and describe mathematical relationships that develop the form.

1-Introduction

My story began decades ago. From early childhood on, I had a love for nature. In later years, I began to draw natural forms

that I observed. This developed into a passion to understand the structures and patterns found in these forms, that I had recorded in my drawings. Why is the study of patterns important? How do we understand these patterns? Seeking an answer, took me on a journey in search of the ancient eye.

2-Evolution and Development of Man-made Patterns

Throughout the history of civilization, we find man-made patterns, that have a mathematical formal order. The pre-curser of patterns is found in early examples in the use of pebbles to cover the ground. These pebbles were arranged in certain designs. This practical application became a decorative floor pattern in later years. It developed into arranging cut stones to form geometric patterns, but it also tells a story of mankind.

It reveals the cultural window of social values and activities in which people have engaged and those depicting scenes from everyday life. In the Medieval town of Piazza Armerina, Sicily, I saw world famous mosaic tiled floors showing athletic prowess, the great hunt and fishing scenes. But the Cathedral of Monreale, Palermo, Sicily, adapted mosaic tiles “tesserae” to send a religious feeling of transcendence by enveloping the believer in a play of “unearthly” light. The reflecting silver and gold “tesserae” were adapted to achieve this goal. Churches and mosques incorporated tiling patterns to create an ambience of reverence and contemplation. The Blue Mosque in Istanbul, Turkey, a former Ottoman Empire, achieved this ideal. The patterns of blue tiles covered the ceilings, walls and floors. It felt like a mystical aura of blue. The Cathedral of St Vitale in Ravenna, Italy, was a former Byzantine Empire. Mosaic designs showed religious motifs and geometric patterns that covered columns and floors. There is a plethora of patterns in many parts of the world. Some were adapted for practical reasons, while others served as an educational tool and message of reflection and hope. The development of man-made patterns is an evolution from pebbles to pixels to algorithms.

Many new advances and innovations have been inspired by the natural world.

My interest is to understand patterns in natural forms and how they have adapted and evolved.

3-Formation of Patterns in Nature

Throughout the history of civilization, we find patterns that have evolved as a dynamic organizational process of cellular growth. The natural environment is an organizational system that is subject to intrinsic forces of stability and extrinsic factors of instability and adaptation of form. Nature creates patterns that use a minimal amount of energy and are determined by intrinsic forces. Patterns are complex observable systems that have a mathematical formal order. Patterns can have predictability but also uncertainty. Environmental factors may manifest unstable behavior that necessitates adaptation of the form that they become. There are many variations of patterns. D’Arcy Wentworth Thompson’s comprehensive book “On Growth and Form”, describes how cellular growth patterns develop and adapt in natural forms. Some have a logarithmic spiral, such as the Nautilus

seashell. In the Nautilus the radius of the equiangular spiral increases in distance from the central point. But the shape does not change. The sunflower head resembles two helical spirals of growth in opposite directions. It is comprised of separate florets that grow individually in a Fibonacci series of rows. There are other patterns that have a geometric progression, and those that have a branching pattern of trees. Snowflakes have hexagonal symmetry. But the structure of an individual snowflake changes due to variable environmental conditions to which they adapt.

Many new advances and innovations have been inspired by the natural world. The cellular tessellation structure of the honeycomb has been adapted to modular buildings and cubical spaces in office designs. Nature has provided us with examples of the efficient use of energy of minimal surfaces. This offers us a potential for harvesting heat, motion and vibration energy in solar panels, wind turbines and advancements in technology. As an artist and non-mathematician, I aim to bridge my understanding of the underlying mathematical concepts found in nature and to metaphorically represent them as an aesthetically creative work of art. My cognitive decisions of creating are not a random process. They are based on art aesthetics, physiology of vision, and mathematical concepts.

4-Geometric Patterns

The study of patterns having mathematical properties has been a relatively more recent development.

Grünbaum and Shephard 's comprehensive book "Tilings and Patterns" analyzes many different geometric patterns that have a mathematical structure. The process of tiling expansion is related to the cellular growth patterns in nature and how their variations are formed. Symmetrical arrangements of tessellation patterns can be formed through translation, reflection, rotation and glide. Patterns can be seen or hidden from view. Geometry is a clear and universal language. It is the vocabulary of nature and it revels the seen and hidden patterns and structures in our universe. Patterns in nature can have a predictable formal order but also adapt to external forces that result in a transformation of the form. Mathematics and art are related.

They seek to understand structural order based on natural laws, but they use a different non-verbal language.

5- Paintings
"Stretching the Space" (Series)

My geometric paintings bear a relation to structures and patterns found in natural forms.

The paintings show two different types of patterns. The initial condition of the pattern in both paintings is based on a formal order. Both types of paintings begin with a geometric conception on a two-dimensional plane. The module serves as a unifying element and consists of a sum of multiples of these units that become an interlocking pattern and are distributed over a field.

Linear Formal Order. Fig.1,2,

show the mathematical concepts of symmetry of four quadrants. Tessellation of modules form patterns. But the central core consists of rotated, overlapping, interlocking patterns that result in fragmentation. Fig.3, shows a linear process but also a transition. It is especially evident in the second example

of paintings. Fig.4 and Fig.5 that show a transformation.

Fig.5.1-"Rotation & Stripes"
The painting is composed of empty individual sections with zig-zag patterns. Oher sections are solid shapes with stripes. Superposed colors cover the underlying, interlocking pattern. Rotation shows the mapping from top left to right, down and across. It is similar to rotation of the hands of a clock about a point. The interior core is composed of overlapping patterns that become fragmented shapes.

Fig.5.2-"Blue Triangles & Stripes"
Superposed colors are on top of the underlying, interlocking pattern. Blue triangles no longer show the interlocking pattern. Superposed colors cover these triangles. Rotation is from the top left, to top right, down and across. The central core of overlapping patterns becomes fragmented. Blue and red shapes in the core relate to the stripe patterns.

Fig.1- 36"x36"x1.5", oil paint, canvas, ink markings, Irene Rousseau artist

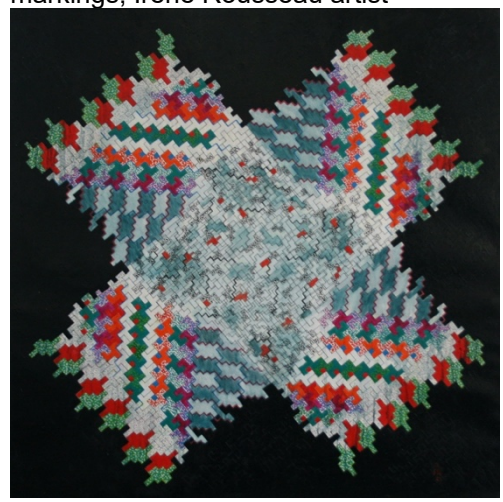

Fig.2- 39"x39"x1.5", oil paint, canvas, ink markings, Irene Rousseau artist

Transition

Fig.5.3- "Visual Symphony 1"
Although it is a linear process, a transition has taken place in Fig.3. There are individual, empty sections with faint traces of interlocking patterns. Stripes of superposed colors on top of the underlying pattern reveal and conceal. Some of the colored zig-zag patterns relate to those in the quadrants and background. The central core consists of rotated interlocking patterns that cut across and overlap contours and subdivided space that result in fragmentation.

Transformation

Fig.5.4- "Layered Space"
Superposed merging colors of red, blue, green and yellow form new shapes. Markings on top of colors add an additional layer.
The painting seems veiled in mystery. Linear partitions of boundaries cannot be determined. A faint hint of a central core is only implied, but not defined. The

painting is visually dimensional. The red, warm colored shapes advance and the cool blue and green colors retreat. Our eyes guide us in a movement from the top blue left border to the right, and then down and across. The initial interlocking pattern has been transformed.

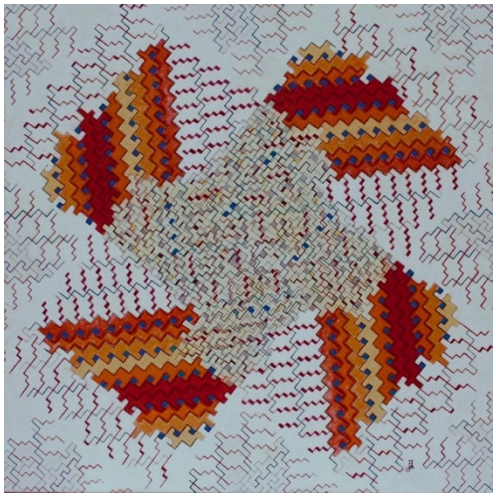

Fig. 3- 36”x36”x1.5”, “Visual Symphony” oil paint, canvas, ink markings, Irene Rousseau, artist

Fig.4- 39”x39”1.5”, “Layered Space”, oil paint, canvas, Irene Rousseau, artist

Fig.5. 5 -“Complexity

A transformation is also seen in this painting. The central core no longer exists. Color partitions become stripes. There is a break in the underlying pattern. There are merging clusters of colors that form new units. Superposition of colors are layered on top of the underlying, interlocking pattern within each bounded column.

New connections are made but there are many related factors that remain in their complex relationships to the whole. A transformational process has taken place.

6.Discussion

1.How could the human artistic intent be assigned to the computer?

2.How will machine autonamy and idependence assigned to the computer affect an aesthetic response by society?

3-What is the role of authorship and ownership in automated technology?

Machine learning simulates the human brain. It recognizes patterns and their relationships and makes predictions.

It has been a revolutionary process from patterns using pebbles to pixels to algorithms.

Fig.5- 39”x39”x1.5”, “Complexity”, oil paint, canvas, Irene Rousseau, artist

7-Key concepts: superposition, linear, pattens, overlapping, symmetry, rotation, tessellation, color, complexity.

8-References

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