Generative Moire Structures

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ABSTRACT. "GRAPHIC ON COMPUTER" – the work of the Czech Petar Milojevic, published in Titus Mocanu's book "THE MODERN ART'S MORPHOLOGY", in 1973, had great influence on me. I tried to discover the algorithm that generated this work. It wasn't so difficult to do and in a short time I was able to draw 12 such structures. In time, with interruptions, I have returned to this kind of works. In my personal exhibition "CYBERNETIC DESIGN" that took place at "Metopa" gallery of Pitesti, in march 1981, I have presented 8 such structures. To my joy, they had an impact on art lovers.

1. Introduction

Then I have limited my work to structures that were inscribed in TRIANGLE, SQUARE and HEXAGON, simple structures with a quite strong degree of symmetry. The works, 500x700 mm in size, have been realized on white paper, with lines in black China ink.

After this stage, I have done some works in witch I have introduced the ACHROMATIC degrade, and then I have introduced a COLOR system with 48 different chromatic tones from violet to blue-green, yellow, orange, red and back to violet.

This works have been also exhibited in different exhibitions on local level and group exhibitions.

But the most important stage is the one of September 2005, when. with the occasion of preparing my 8th personal exhibition, witch took place in the HELLIOS Gallery of Timisoara , I have returned to this subject, after 20 years.

This time, I could approach the moiré matter scientifically, by doing different studies of optics, symmetry and *combinatorica*...

Because the results seem to me interesting and because I haven't discovered in the domain literature a SYSTEMATICALLY approach. I propose you this material.

2. History

The word "MOIRE" comes from the Arabic language. It has been taken over in Europe by the English word MOHAIR meaning fabric with changing reflex. The fabric had been obtained with the help of a special calendar roll. The sphere of application can be extended to the objects that have a changing reflex with brilliancy or with changing reflex.

The principle comes from Asia and the technology was used for producing silk.

In 1784 an English physicist tries to find a scientific explanation of the phenomenon.

In 1963, the researchers GERALD OSTEE and YASUMORI MISHIGAMA, published in "SCIENTIFIC AMERICAN" magazine, in may, more illustrations. These illustrations, apart their scientific character, had plastic qualities also.

3. Op Aart

The movement appeared in 1960, in Europe and in USA.

The movement is based on optic illusions that are producing a sensation of movement. It is a movement of abstract art. It is based on the experiences of JOSEF ALBERS, made in 1920 at Bauhaus school in Germany.

The movement reaches an apogee with the exhibition "THE RESPONSIVE EYE". The exhibition took place in 1965, at the Modern Art Museum of New York. Then the movement is waning and becomes important in creating fabrics and decorative elements in architecture. We can remind several promoters of the movement: YAACOV AGAM, RICHARD ANUSKIEWICZ, LARRY POONS, BRIGET RILEY, JESUS-RAPHAEL SOTO, VICTOR VASARELY and JEAN PIERRE YVARAL.

4. Generation

In order to generate the configurations, regular polygons with 2 or 3 sides are used. Each edge of the polygons is divided in equal divisions. These divisions will be encoded with letters (block letters) and with numbers (roman numbers), in a trigonometric direction (from left to right), increasing complexity.

The interior radius will be encoded with small letters and numbers, with increasing numbers from the exterior to the center.

This encode help to recognize the configurations, being also the titles of the works. They will also eliminate the appearance of identical structures and gives us a double possibility to check from *the combinatoric* point of view the existence of all the possible configurations.

The points obtained by dividing the edges, were used as base for drawing some fascicles of straight lines uniting all the edges between them (outside, inside, outside-inside) and all the points of the marked divisions.

Table 1. *A number of 280 configurations resulted*

No	Polygon type	Numbers of flancks	Number of configurations
1	Triangle	3	14
2	Square	4	20
3	Pentagon	5	26
4	Hexagon	6	32
5	Heptagon	7	38
6	Octagon	8	44
7	Enneagon	9	50
8	Decagon	10	56
		TOTAL	**280**

I found that for each type of configurations (the ones that have as basis of generation the same polygon) it exists a number of identical configurations and a number of symmetrical configurations. Their number can be seen in the table 2.

Table 2.

No	Polygon type	Numbers of flancks	Number of configu-rations	Configurations			
				Differents	Identicals		Symme-tricals
1	Triangle	3	14	-	8	4	6
2	Square	4	20	2	14	8	4
3	Pentagon	5	26	-	18	10	8
4	Hexagon	6	32	2	24	16	6
5	Heptagon	7	38	-	34	18	4
6	Octagon	8	44	2	40	22	2
7	Enneagon	9	50	-	-	23	-
8	Decagon	10	56	2	-	27	-
		TOTAL	**280**	**8**	**138**	**128**	**30**

There is a large diversity of configurations and this makes it more difficult to put them into an order. This can be done only by imposing some new classification criteria. These can be the following:

- after the form of the base polygon
- after identical formulas
- after similar configurations

I have finished describing the GENERATIVE STRUCTURES.

A very important characteristic of these generative structures is the fact that their form is depending on two things:

- The type of relation that is established between the two edges that *are linked/ connected.* We can distinguish from 14 relations in the case of the triangle, to 56 relations in the case of the decagon (then side figure).
- The geometric form of the basis polygon where all the relations are possible. These go from the triangle to the decagon.

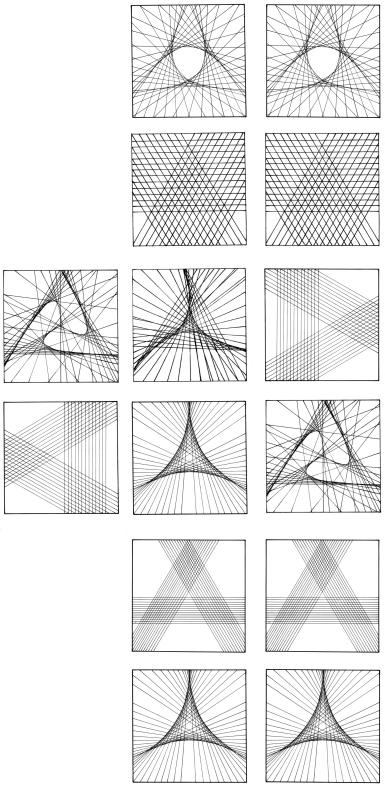

Fig. 1.

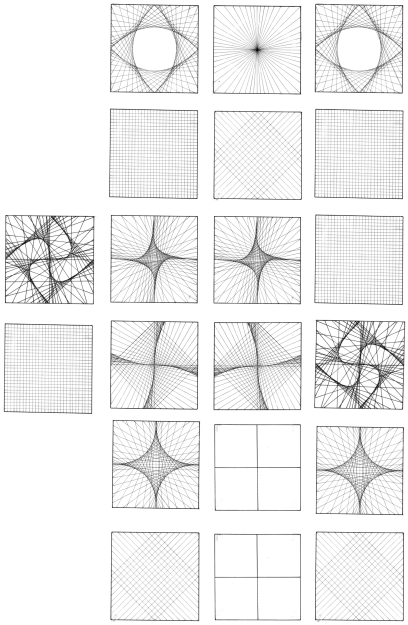

Fig. 2.

A very important conclusion is that in this type of structure, the form of configurations are depending 100% on these initially restrictions.

By this modality of generation the intrinsic geometric qualities of the each polygon are shown to advantage, the artistic intentions of the author are inexistent.

The *author has only the quality* to pick a repertoire of signs, to establish the basic rules and to find the patience to find, to draw and to order all the 280 possible variations.

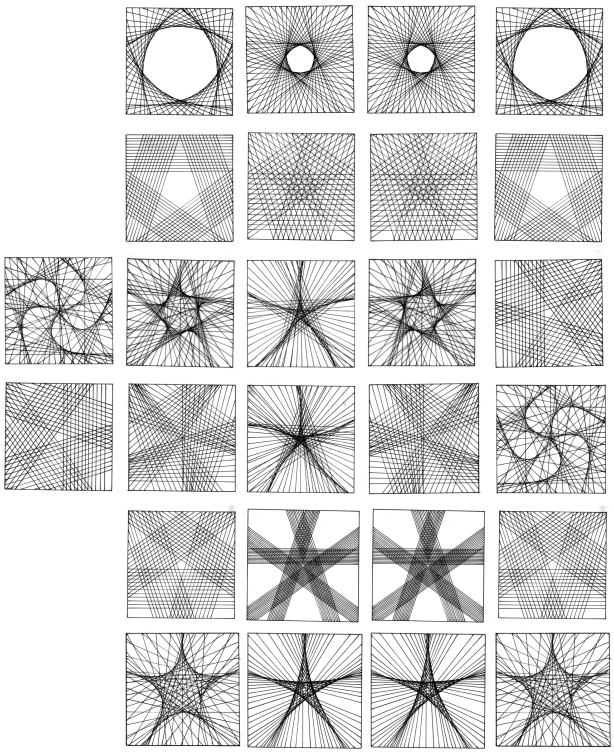

Fig. 3.

The graphic means and the dimensions of the works are various:

- The dimensions of the works: 100x100mm for all the found variants (280).They were drawn with black China ink on tracing paper.
- 200x200mm for the simple configurations (152) . They were drawn on black cardboard with silvery color for the odd structures (3,5,7,9) and golden color for the even structures(4,6,8,10) on black cardboard.

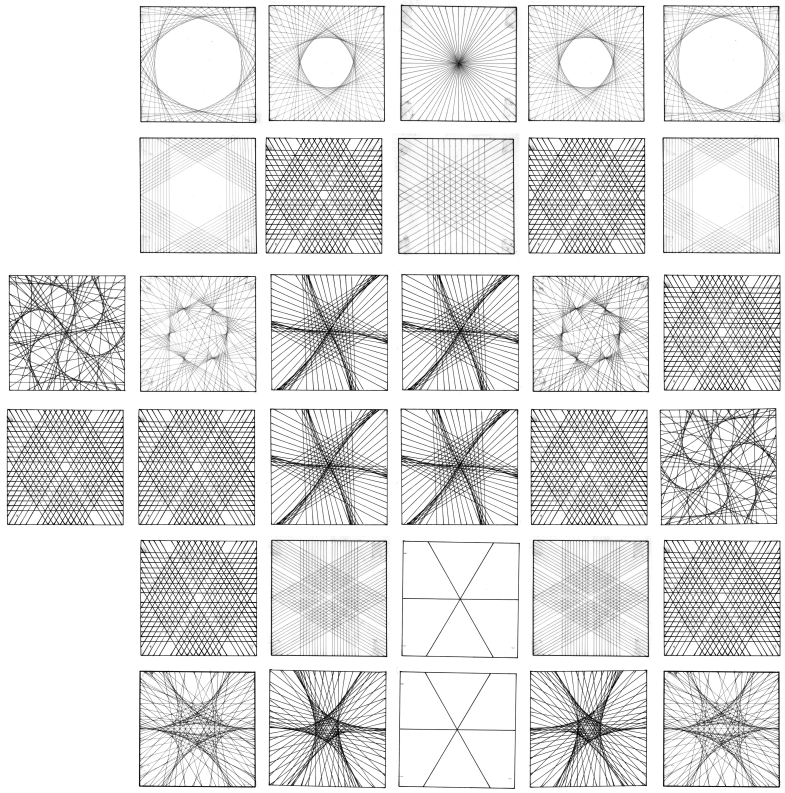

Fig. 4.

I have chosen from all these structures 4 series of similarly configurations (32 works). They measure 500x500mm and they are realized on white and black cardboard. The lines were drawn using drawing instruments and using different materials:
-black China ink
-silvery gel
-tempera, in 48 different tones of colors

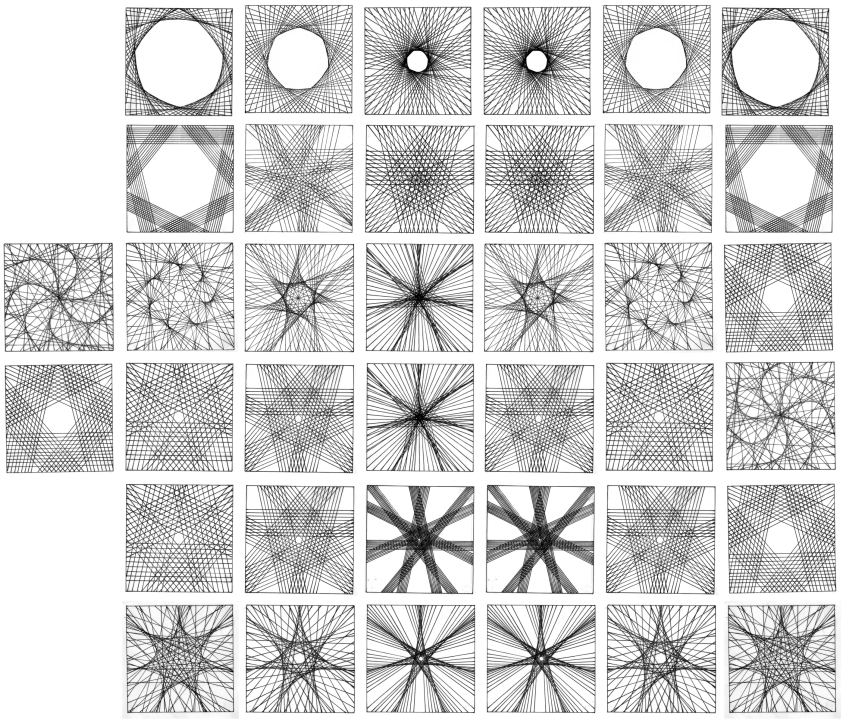

Fig. 5.

While doing these works, new directions of investigation in this family of forms emerged, generated on the basis of pre-established rules. Here are some of these directions:
-drawing the configurations for the next polygons (with 11 sides: 62 variations; with 12 sides: 68 variations)
-the form of the configurations to be drawn accordingly to the author's intentions (into the imposed structure)

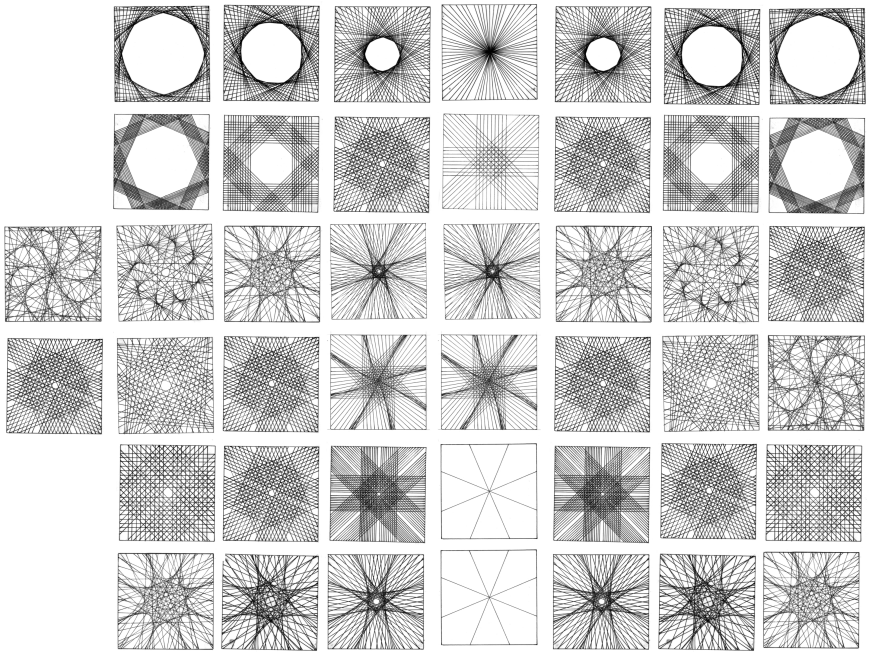

Fig. 6.

A series of such works can be seen in the above images. They have been encoded as it follows: Aa-aB-bC. I estimate that these works, over a hundred, that are practically unlimited, could be realized in the next period.

Another possible investigation could be the search of the three-dimensional area. Pyramids with 3,4, n., could be realized. We can also study the archimedical polyhedrons: the tetrahedron, the octahedron, the hexahedron, the icosahedron and the dodecahedron.

Given the complexity of these SPATIAL STRUCTURES (thousand of variations), we intent to use informational technology and eventually animation. These structures could be realized in 3 D space and could receive new dimensions: LIGHT, COLOR, DYNAMISM, SOUND and, why not, realize a MULTIMEDIA program.

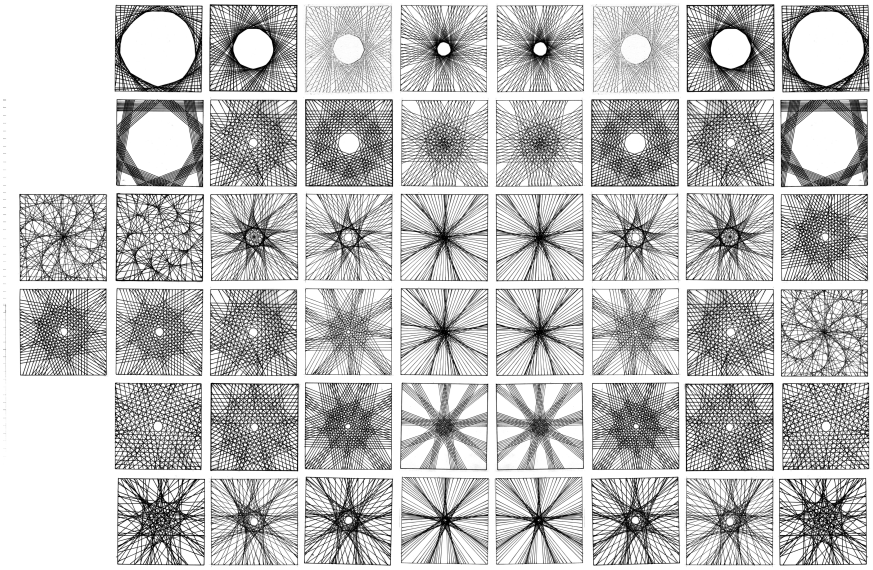

Fig. 7.

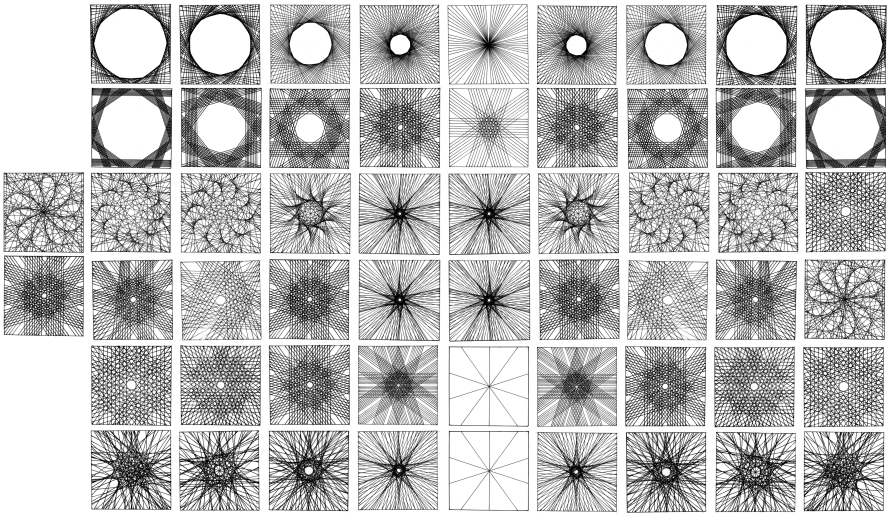

Fig. 8.

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