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Artworks: **An experience of Generative Painting**

Topic: Generative Painting

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References:
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Abstract:

The aim of the installation is to illustrate an experience in creating works of generative painting devoted to the link between art and science.

The author has developed a non-commercial software that allows to create, manage and display shapes (hyperstructures) defined in spaces with an arbitrary number of dimensions (nD hyperspaces). Over time, he gradually refined and enriched the software, with the management of sounds and chromo-evolutionary structures, orienting it to become an instrument for the creation of works that can be placed in the context of generative art.

Author's generative painting works are the result of a frozen "chromatic trace" starting from a geometric (*Fig. 1*), functional (*Fig. 2*) or table-arranged mathematical structure in predetermined or random motion within a nD hyperspace. The typical result is a bitmap file that is reproduced on canvas, plexiglass or other medium.

The generative software is able to manage hyperstructures covering several physic-mathematical topics (oscillating systems, polytopes, multivalue logics, ...) and is integrated with author's special routines that permit to work with arbitrary-length integers for scientific or artistic purposes. In addition, the software allows a complete and accurate chromatic control of the creation governed by the definition of the initial conditions.

The end result is a generative painting with deterministic or non-deterministic character. Sight-worthy are the artworks showing 2D dynamic-optical effects on matte canvas which are generally visible only in 3D installation with overlay surfaces (*Fig. 3*).

Fig. 1: 4D Hypersphere

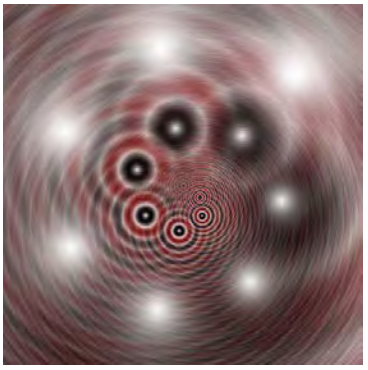

Fig.2: 2D Oscillating system

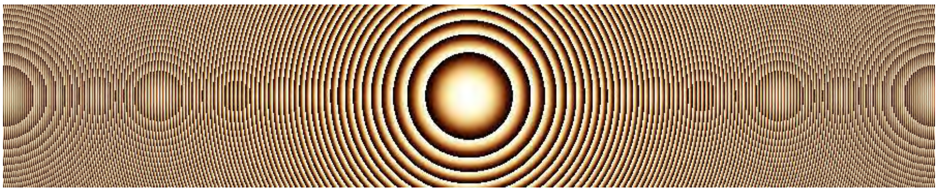

Fig. 3: Particular of a 2D dynamic-optical modulation

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Keywords:
generative painting, hyperspace, hyperstructures, hypersphere, oscillating systems, dynamic-optical effects

An experience of Generative Painting

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Abstract

Fig. 1 - Chromatic trace

The aim of the paper is to illustrate the potential of the software developed by the author in creating generative painting artworks . The creations can be deterministic or non-deterministic and are essentially pictorial images defined in multidimensional spaces. The development of the paper provides a brief description of the basic elements of the generation technique with notes on software's capability to create sounds and react to external inputs.

Introduction

The main feature of the software is the ability to create, manage and display shapes (*hyperstructures*) defined in spaces with an arbitrary number of dimensions (*hyperspaces*). The hyperstructures can have mathematical or table-arranged origin and are free to move within the hyperspace according to functional or random-perturbative inputs. The major elements of the hyperstructure are associated with colour-dynamical components responsible for generating an image (*chromatic trace*) that can be frozen in any state (*Fig. 1*). Optionally, you can establish a link between the colour component and a sound component that is uniquely dependent on the geometric and dynamic properties of the hyperstructure. The typical generative action results in the creation of BMP, WAV and AVI files.

General aspects

Conceptual elements and techniques used to achieve the above results have a number of features inspired by elements of physics and mathematics.

Chromatic field and sonorities

In analogy with the physical concepts of scalar or vector field, a *chromatic field* is a region of the hyperspace where point-by-point is defined a colour. Within the field, the point of a hyperstructure that occupies a given position necessarily assumes a given univocal colour. Introducing an appropriate mathematical law, as well as you can associate a colour to a point so you can associate a sound to a colour and therefore associate a sound to a point. As a result of the limitations imposed by the representations of colours and sounds (RGB, MIDI, ...), the correspondences between points, colours and sounds are not necessarily bijective.

Primary chromatism

If you simply consider the one-dimensional space, the set of chromatically definable positions can be represented by the set of points of a straight line. Four points of the line are remarkable: *origin*, *antiorigin* (or point at infinity assumed unique), *unity* and *antiunity*. Once arbitrarily assigned colours to the remarkable points, the introduction of an appropriate functional law allows you to assign a univocal colour to all points of the straight line (*Fig. 2*). By extending these criteria to the hyperspace, the chromatic field is defined as soon as, for each dimension, you assign the colours to unity and antiunity and choose the two colours for origin and antiorigin. Once you have completed the chromatic initialization, each point (*vertex*) of the hyperstructure can be linked to a univocal colour (*primary chromatism*) that depends exclusively on vertex position.

Fig. 2 - Primary chromatism

Secondary chromatism

Under the constraints of the primary chromatism, you can also handle the aspect of other interstructural elements (*edges*, *surfaces*, ...). This process is accomplished by introducing functional laws capable of constructing combined colour effects between vertices, edges and surfaces (*secondary chromatism*). The results may have evolutionary character thanks to integrated support codes based on physics and mathematics (wave effects from oscillating systems, compositional effects from multivalue logics, ...). The set of previous choices completely define all the preliminary elements of the hyperstructure (*skeleton*). The skeleton can take a very different appearance depending on the primary and secondary chromatism (*Fig. 3*).

Fig. 3 - Skeletons

nD dimensionality

The software is designed to realize hyperstructures defined within spaces of arbitrary dimensions (*n*D hyperspace). However, due to various limitations (power system, user interface, …), the maximum number of spatial dimensions handled is thirty-two (32D hyperspace). The main managed structures are of type
- geometric (polytopes, hyperspheres, ...)
- logical (multivalue logics, fuzzy logic, ...)
- functional (real or complex functions, scalar or vector fields,...)
- table-arranged (XLS or MDB external data, internal data, …)
- miscellaneous (reticular structures with constrains, ...).

Due to the long execution times, some features are currently limited to 2D or 3D hyperspaces.

Structural dynamism

Once defined the chromatic field and the hyperstructure, you can virtually move the skeleton within the hyperspace according to standard modes (zoom, rotational views, ...) or parser managed modes (parametric functions, special functions, …). With similar methodologies to those introduced in physics to describe dynamical systems (absolute and relative motion, center of mass, ...), the software enables each points of the skeleton to move around the origin of the chromatic field or around another special point (*center of structure*). The center of structure is hyperstructure dependent and can be managed by internal or external inputs. The types of functional movement achievable are potentially limitless and can have *deterministic*, *semideterministic* or random character. In particular, the use of the term "deterministic" highlights the ability to target the generation results through the definition of the initial conditions. In contrast, the use of the term "semideterministic" underlines the ability of the software to take autonomous decisions, based on pre-coded rules, in the face of internal or external random events. The setting result of colour and dynamic parameters is to generate a chromatic trace that can be displayed, frozen and memorized in any state.

Operating elements

The generation activity is supported by a VB programming code that integrates several features and permits internal and external inputs.

Support codes

To optimize the management of the structural dynamism, the software makes extensive use of hyperstructural-dependent parsers. At the same time, in order to achieve colours with nuances and details (harmonic gradations, logical-chromatic compositions, ...), the software allows you to manage arbitrary-length integers without approximations. Moreover, the realization of a powerful code to design oscillating systems enabled you to generate special chromatic effects and to support the integrated management of sound waves.

Sound-colour dynamism

The software allows you to dynamically create musical notes that uniquely depend on chromatism, geometry and position of the skeleton in the hyperspace. These musical notes can be built using the standard external media (MIDI, ...) or the internal code designed to handle sound waves and oscillating systems. By combining the versatility of structural dynamism with the ability to associate points, colours and sounds, you get the effect of a skeleton that changes its colours and plays musical notes during its construction or a movement (*sound-colour dynamism*).

Supporting files

The typical storage mode of the chromatic trace is the creation of BMP files. These files can be generated and memorized during a cycle with the consequent possibility of creating sequential frames for video installations. When the sound-colour dynamism is enabled, the software allows you to create WAV files. As images and sounds are generated simultaneously, you can integrate the two memorization types and dynamically create AVI files.

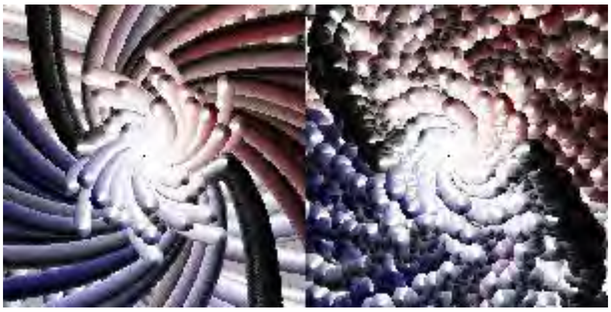

Fig. 4 - Structural dynamism

Interactive aspects

The software allows you to define and change the structural dynamism with internal or external input parameters. These parameters can be random or not perfectly controllable (*random-perturbative parameters*) and consequently generate unpredictable skeletons (*Fig. 4*). As the typical activity consists in the generation of dynamic skeletons inside a loop, the consequence of using random-perturbative parameters is to get results with non-deterministic character. The internal input parameterization is typically assigned to customizable functions accepting cyclic or random variables with or without the use of parsers. The external input parameterization is currently limited to activities related to the use of a mouse or a microphone. Mouse parameterization is managed with or without the use of parsers, while microphone parameterization is handled exclusively with parsers. The results of activities involving the mouse can be addressed while those involving the microphone are generally unpredictable.

Artistic aspects

The software has features strictly devoted to the generative painting and features of more general use in the context of the generative art.

Pictorial capabilities

Operational options allow you to achieve a variety of results that can be associated to different painting styles. This is true in deterministic case and is even more accentuated in semideterministic or random cases. The vertices and the other interstructural elements (edges, center of structure, …) are represented in separate and independent order and have the ability to take autonomous and complex shapes (bands, paths, …). Particularly significant is the opportunity to consider the hyperstructure itself as a brush that can dynamically change shape and chromatism in response to internal or external inputs.

Sound capabilities

The sound-colour dynamism is an important feature of the software and is supported by the presence of code that handles oscillating systems and sound waves. A particular result of this integration is the creation of arbitrary musical scales starting from musical notes defined uniquely in terms of abstract compositions of oscillators.

Sound-pictorial generations

Combining the pictorial and sound capabilities with the interactive aspects related to external microphone inputs, the software allows you to realize random hyperstructural generations capable of self-sustaining. This is justified by a cyclic generation sequence (start→point→colour→sound→perturbative input→start→….) and is supported by parser-manageable functions.

Conclusions

The synthetic elements presented above, let you guess the versatility of the software developed by the author in creating generative painting artworks. Particularly important is the ability to realize, with deeply different painting styles, chromatic traces inspired by the intrinsic beauty of complex mathematical shapes. Finally, the dynamic association between points, colours and sounds, integrated by interactive capabilities, highlights the potential of the software in the direction of audio-visual installations with a variety of applications in the context of generative art.