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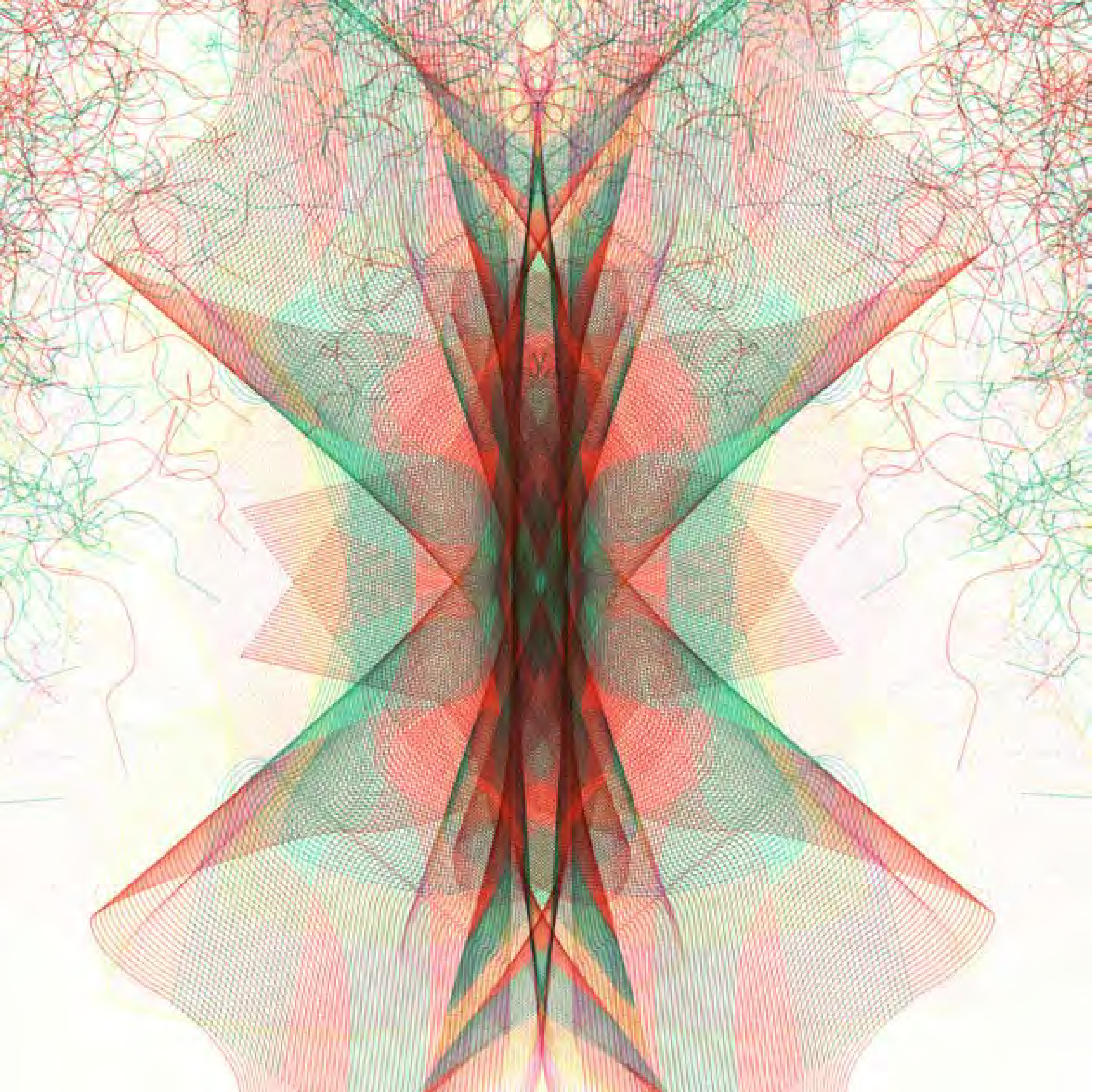
October 2- November 29, 2015

Ukrainian Institute of Modern Art, 2320 West Chicago Avenue, Chicago, IL 60622



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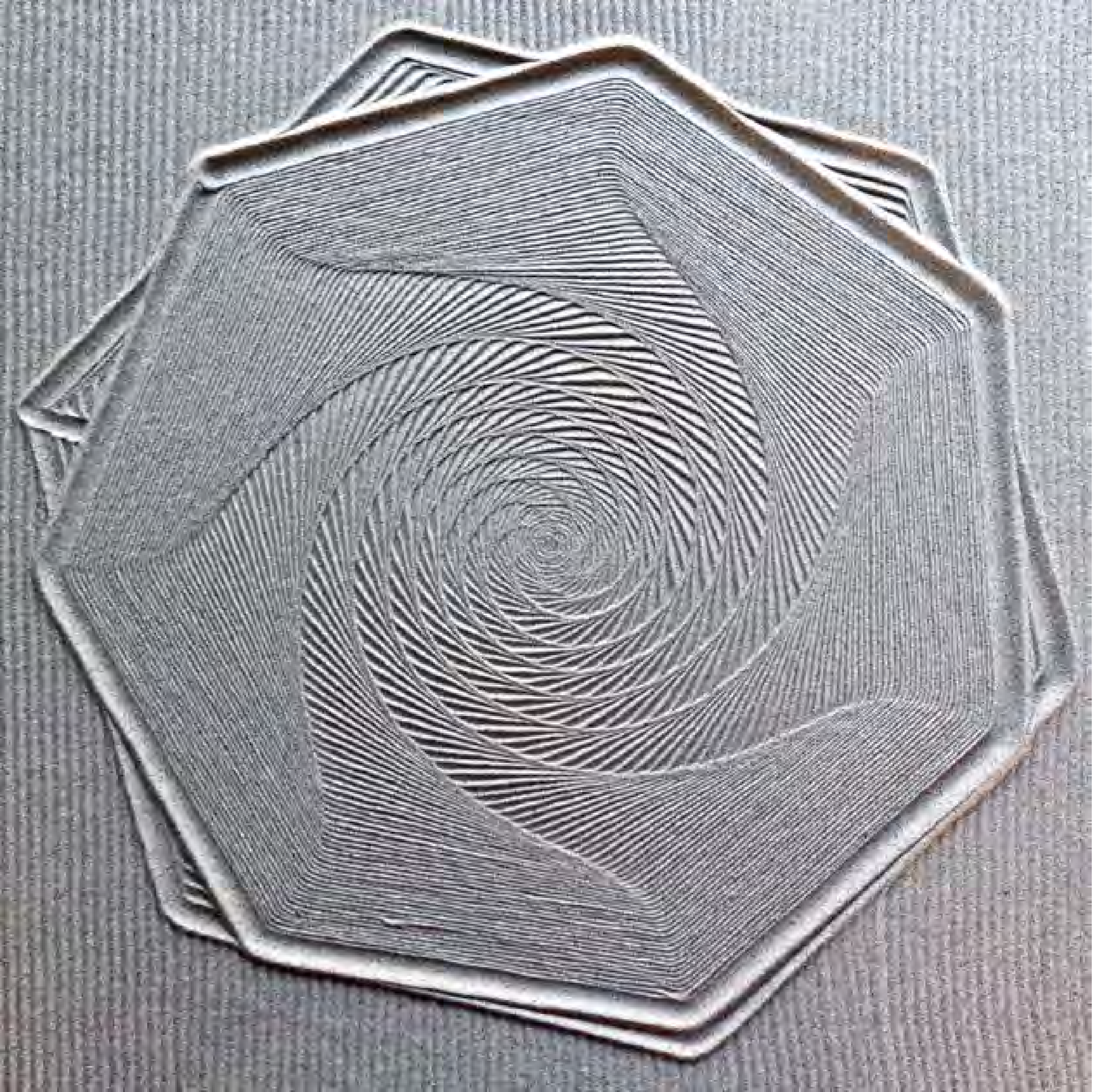
Colette Bangert
Jean-Pierre Hébert
Paul Hertz
Roman Verostko



all.go.rhythm: some words about ideas that make art
by Paul Hertz

an invitation

All.go.rhythm began in the winter of 2013, when UIMA invited me to submit a proposal for a curated group show. "And," my interlocutor was very specific, "we want you to include your own work." I submitted two proposals and—to my astonishment—the program committee accepted both of them. The first was *glitChicago*, a show of new art from "#Chicago," a glitchy virtual city out on the worldwide internet, with quite few artists from Chicago, the city UIMA and I call home. I was, I confess, the oldest artist in *glitChicago*. A few of the youngest artists were former students of mine. The situation is reversed in all.go.rhythm, the second show. Colette and Charles Bangert, Roman Verostko, and Jean-Pierre Hébert inspired and influenced my work. As a good curator, I shall for the most part talk about their work, but I would be remiss in not saying something about Paul Hertz. I know his work well and I will try to put it into context, despite my notorious lack of perspective. With that proviso, let me invite you all to go to *all.go.rhythm*.

algorithms

All.go.rhythm is a show of plotter drawings, digital prints, textiles, watercolors, installation and performance works by artists who work with algorithms. Algorithms are recipes for carrying out a logical or mathematical task. Nowadays we associate algorithms with computers, but the word is ancient and the concept more ancient still. Weaving, music, tiling patterns and architecture commonly use algorithms. Drawings, paintings and sculptures can be made algorithmically, too. Artists are always making up (and then breaking) their own rules. The artists in *all.go.rhythm* have frequently—but not always—conducted their investigation of algorithms using what may be the most transformative technology since the industrial revolution: the computer. Algorithms determine how computers work: "Algorithms + data structures = programs," as the influential computer scientist Niklaus Wirth put it. Programs are the virtual "machines" of computation. In the guise of programs, algorithms shape contemporary culture. Networking and microprocessors and computing devices are now so ubiquitous that we don't give them a second thought—leave that to artists and other critical thinkers. Artists who create their own computer programs, which includes everyone in all.go.rhythm, have become especially aware of the power of algorithms.

algorists

Around 1995, in conversation with Roman Verostko, Jean-Pierre Hébert suggested the descriptive term algorist could be applied to anyone who created an art object using an algorithm where the algorithm was of the artist's own creation. The two of them applied the term broadly, to any artist in any medium, and specifically, as an identifier for artists they knew who were exhibiting art made with computers. Hébert expressed the definition of algorist in an algorithm written in "pseudo-code" (where "&&" means "and", "||" means "or", and "!" means "not"):

```
if (creation && object of art && algorithm && one's own algorithm) {
   include * an algorist *
}
elseif (!creation || !object of art || !algorithm || !one's own algorithm) {
   exclude * not an algorist *
}
```

This text is sometimes referred to as the Algorist Manifesto. Note that no mention is made of computers—any artist producing objects by a set of rules is an algorist! Calling so lean a statement a manifesto takes some audacity, as does signaling any artist who follows rules of her own creating as, *a priori*, an algorist. To be sure, the historic avant-garde was built upon audacious gestures: manifestos and counter-manifestos, alliances and quarrels over aesthetic and social issues, inclusions and exclusions, salons and *salons des refusés*. Verostko and Hébert were well aware of this—in the cryptic "manifesto" there lurks more than a hint of irony. But if there's humor, there's also a declaration of purpose. They assert that artists working with computation can claim a common artistic practice and work together to promote their work, exactly like other artists. This might seem obvious, but in the face of the rejection of earlier "computer art" by mainstream critics and institutions, Hébert and Verostko were deliberately placing their practice within the ambit of all other art and daring anyone to refuse them a place at the table. In placing themselves within art historical tradition, they also marked their distance from early practitioners, engineers and scientists working with computers who were not artists by vocation. Finally, they recognized that there were many artists like themselves, fascinated by the potential of algorithms to make art.

"Algorist" was intended as an inclusive term, one that anyone who identified with the definition could assume. Although the artists whom Verostko and Hébert identified as algorists exhibited together in many different contexts, it wasn't until 2006 that an exhibition with "algorist" in its title took place. The term now seems destined to serve art historians well in identifying a particular group of artists as The Algorists, but we should not forget that it has a broad application, too. [Verostko] All the artists in *all.go.rhythm* are algorists, and so too is any other artist who uses rules to make structures, be she a painter, a sculptor, a weaver, a composer, an actor, or an architect. Darko Fritz, an artist and curator, identified three areas where rule-based or "programmatic" art emerged in the latter half of the 20th century: in Neo-Constructivism and light and and kinetic art, in computer-based art, and in Conceptualism. [Fritz] Sol LeWitt's maxim, "The idea becomes a machine that makes the art" seems applicable to all three tendencies. As a champion of Conceptualism, LeWitt marked his distance from the other tendencies by asserting that the idea is surrounded by mystery and the artist is necessarily guided by intuition rather than by rules. [LeWitt] Rules might be scaffolding that falls away from the realized work, but even algorists who program embrace intuitive work. Hébert has combined physical systems (sand, vibrating water) with digital systems. Colette Bangert's watercolors and textiles point to an ongoing dialog between rules and intuition. Verostko's paintings, created before he began working with computers, reveal a similar shift between rule-based order and intuitive gesture. Hertz's early work with tiling patterns was developed with homemade punch cards that he still uses in performances as Ignotus the Mage, a dysfunctional fortuneteller. Artists who work with algorithms do not sacrifice intuition: they find new ways to empower it.

smooth devices

In his 1967 evaluation of the "Digital Computer as a Creative Medium," A. Michael Noll lists cathode-ray tubes and plotters as core devices for artists [Noll]. Cathode-ray tubes and plotters employed a model of image representation known as vector graphics. Vector graphics uses precise numbers to represent geometry. The numerical representation must be interpreted before it can be displayed, but it is independent of scale—it can be drawn with precision at any size. Later display devices used a raster graphics model, where an array of color sample points called pixels represent an image. Vector graphics' precise geometry and independence of scale are lost in raster graphics, but in exchange they offer versatility, speed and inexpensive manufacturing—a television is a raster device and much cheaper to manufacture than an oscilloscope, a vector device. When personal computers hit the market in the 1970s and 80s, raster graphics were standard, and so most people became familiar with "computer graphics" as blocky, low-resolution pixelated images. With advances in display technology, we now have ultra high-resolution raster displays—pixels are all but invisible and lines are once again seamless and smooth. Colette and Charles Bangert, Jean-Pierre Hébert, and Roman Verostko all began their work with computer graphics using plotters as their output device of choice and vector graphics as the model for their algorithmic research. Since then they have branched out, but as with physical media like a brush applying paint on canvas or a steel needle digging a channel in a copper plate, the model afforded some possibilities and constrained others.

computer grass

A plotter makes images by dragging a pen across the surface of a sheet of paper under the control of stepper motors. A magnified image of a plotter drawing reveals the quirks of pen and ink, the roughness of the paper, the slight hesitations in the line as the stepper motors respond. You could even say a plotter drawing had a signature quality, much as an etching, an engraving, or a woodcut. It is a generalized machine descended from the marvelous clockwork automata of previous centuries that could write a single poem or draw a simple picture: unlike them, it can draw any image you can tell it to draw. Because plotters are essentially machines for drawing, when Colette and Charles Bangert started experimenting with a plotter in 1967 at the University of Kansas they could immediately center their investigations on an element long familiar to artists: the line.

Figure 1:
Colette and Charles Bangert, Closeup of plotter drawing *Land Lines I, Densely Curved*, 1970, plotter drawing, ink on paper, Mary and Leigh Block Museum of Art, Northwestern University, gift of Colette Stuebe Bangert and Charles Jeffries Bangert, 2008.27.7 photograph by Paul Hertz

The Bangerts were familiar with the linear geometries of much of previous "computer art," but they aimed for a different style: variety and irregularity rather than geometric precision, all-over markings rather than separable objects. Their images recall the color field painting of the day. They homed in on the capacity of the plotter to draw smooth curved lines and the capacity of the computer program to make decisions and introduce variation by using random variables. Their subject matter was the landscape of the American prairie, the deep familiar landscape of the place where they live. They studied how to recreate from algorithmic structures the lines that Colette drew in her landscapes in traditional media. They considered how constraining the choices made by random numbers could capture the variability of form in individual blades of grass. It was painstaking work and it revealed not just how to program grass on a computer, but how to understand the artist's process of observing and drawing in a new light. They were capturing not just the form of the grass, but also the way in which it grew and moved. "Computer grass is natural grass," they declared. Their subject was landscape, but they saw that all genres of art were open to a similar investigation of the process of observing, abstracting, and encoding, and that new genres might arise from the process. Full of enthusiasm, they predicted a new Renaissance, to be brought about by the experiences and insights of artists working with computers. [Bangert]

another nature

When Roman Verostko and Jean-Pierre Hébert began working with plotters, they encountered the same painstaking process of development, followed by a similar sense of amazement. At first Hébert drew geometric figures, but he quickly developed an interest in portraying fields, forces, ripples and waves, interference patterns and reflections. He constructed abstract images of physical phenomenon with plotter line alone, in rich and complex compositions. Verostko's equally complex plotter drawings employ densely layered lines, sometimes building up saturated depth in a single color, to achieve shimmering, damasked effects. Both artists mixed their own inks and pigments, and experimented with different drawing implements and surfaces. Hébert used needles to draw on etching plates, which he bit with acid and printed in time-honored fashion. He redesigned a plotter to draw figures in sand with a steel ball dragged along by magnets, and made paper casts of the sand. Verostko extended the plotter's capabilities by attaching brushes, creating brushstrokes that were only to be distinguished from the human hand's creations by their exact repetition of gestures. His study of Chinese calligraphy developed in tandem with a study of the nature of computation as a stream of symbols. Perhaps more than anyone else, these two artists developed the plotter as the equivalent of the printmaker's press and array of tools, as an expressive instrument for making images. As in printmaking, it often took long hours—days, even—to see results. It was worth it.

Figure 2: Plotter arm with brush executing algorithmically coded brushing instruction, 1987. Photograph by Roman Verostko.

Verostko, Hébert, and the Bangerts all pursue abstract imagery that in one way or another evokes natural systems. The investigation of the prairie as a living landscape of forms clearly registers in the Bangerts' work, and continues throughout Colette Bangert's oeuvre. Other algorithmic processes they pursued in addition to the construction of abstract lines involve divisions of pictorial space, random walks, and experiments with the human visual response to color. Hébert's moirés, swirls, spirals, and contour lines may recall views of landscapes, water, or scientific imagery of cosmic forces. His interest in physical processes has gained new depth in his role as Artist in Residence at the Kavli Institute for Theoretical Physics at University of California, Santa Barbara. Where Colette Bangert and Jean-Pierre Hébert investigate the natural world of visible motion and invisible forces, Verostko's images, starting with the *Magic Hand of Chance* (1982–84), explore the power of language and symbolic representations. A screen-based installation created before he started working with plotters, the *Magic Hand of Chance* combines an epigrammatic poetry generator with animated and still images, all controlled by software and continually varying. Calligraphic brushstrokes and graphic alphabets populate his plotter drawings. Some represent encoded language and some are purely formal. In his noted artist book the *Derivation of the Laws* and in his various representations of Turing Machines (an abstract, mathematical representation of a computer put forth by Alan Turing) Verostko in effect transforms computation itself into a visual language. His large-scale forms, comparable to Hébert's grand drawings, seem to serve a different purpose, as complex symbols rather than as abstract representations. Perhaps they are the "huge cloudy symbols of high romance," alluded to in the poem by John Keats that serves as a source text for the *Magic Hand*, open to transcendental readings without ever giving themselves away.

Paul Hertz's algorithmic work began with the chance collage of some rusty metal strips while he was studying art during the summer of 1969 at the Provincetown Workshop. From this he derived a set of tiles based on five shapes, which he encoded as a set of 32 punch cards in the winter of 1979, while he was living in Spain. He used the generative system of the cards to generate paintings, for performances as the dysfunctional fortuneteller Ignotus the Mage, and for musical compositions. When he moved back to the United States in 1983, he ported his algorithmic methods over into computer programs. This led to the discovery of new forms emerging from the tiling patterns, such as the loops and "islands" in *Criadero*. The social aspects of his art continued in his performances as Ignotus the Mage and in the design of interactive multimedia installations and virtual worlds. His work sometimes behaves as a sort of double-bottom box: what appears at first as formal is revealed as symbolic, and then used to point to the very human tendency to find meaning everywhere, even in apparently meaningless forms.

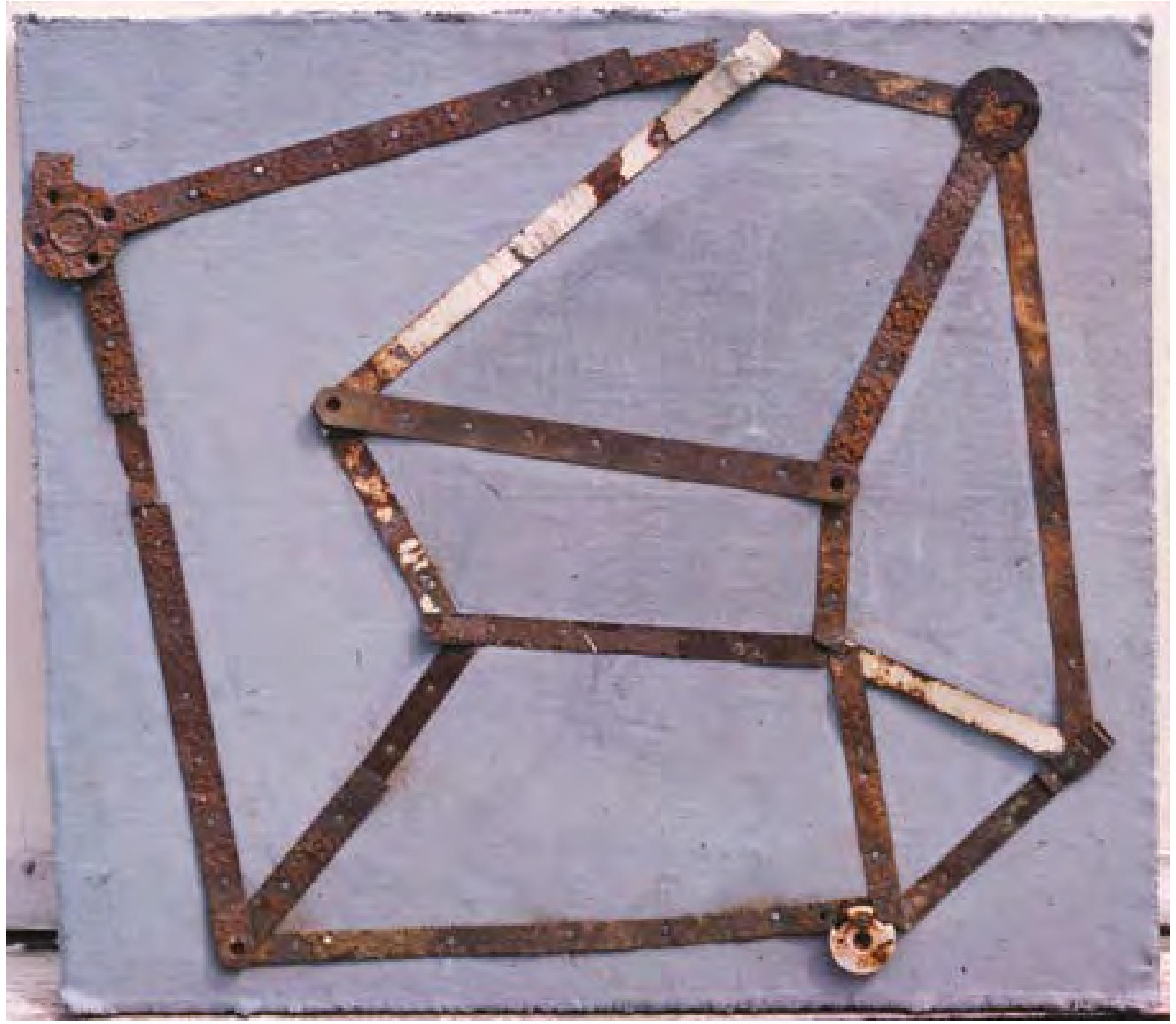


Figure 3: **Paul Hertz**, *Frame*, 1969. Found metal strips mounted on painted canvas.

In various texts in his anthology A *Year From Monday*, John Cage asserts that "the function of Art is to imitate Nature in her manner of operation," an idea he attributes to Ananda Coomaraswamy. Our concept of Nature's "manner of operation," he adds, changes with advances in the sciences. He finds in the concept of "space-time" a particular instance of science changing art: the indeterminacy of space and time in physics confirms the artificiality of distinctions between arts of space and arts of time. Writing in the 1960s, Cage reformulates the tradition of mimesis: the fundamental project of art is not to present a "window on reality" but to discover the processes underlying reality and use them to construct art. Landscape, physical forces, language, and the fabric of society wherein we construct meaning are all natural phenomena—for human beings, what is social is natural. Each of the artists in *all.go.rhythm* explores natural phenomena not directly, but through research and reflection on the way the natural world works, refining observed phenomena to the point where they can be portrayed as algorithmic processes.

new patterns emerge

Modernism offered a vision of art where artists were no longer obliged by tradition to produce works to serve a purpose or sustain a meaning. The work could assert itself as pure form, or so the modernist narrative went. I have written elsewhere of how "computer art could continue the Modernist project of exploring the formal qualities of visual art, even as the critique of authority and originality that came to be know as post-Modernism dismantled the core ideas of the Modernist avant-garde." [Hertz 2009] Partly this is a question of the isolation of computational art in laboratories and academia, but that isolation brought about renovated capacity for formal exploration with a new instrument as computers became affordable and left the engineering lab for the artist's studio. At the same time that this was happening, in the 70s and 80s, a new mathematics of form and dynamic processes was emerging, variously known as fractal geometry, complexity theory, chaos theory, or artificial life. The basic mathematics of these disciplines were wonderfully accessible—one of the criticisms Benoit Mandelbrot, the founder of fractal geometry, had to face was that the fabulous Mandelbrot set was generated from an equation a high school student could understand. Computer simulations were often the only effective way of "solving" systems of equations in these disciplines. Anyone with the freely distributed programming libraries and a modicum of programming skill could explore the simulations, without necessarily knowing the math. Indeed, one could leap over the math and study the patterns it addressed intuitively, in the visual output of the simulations.

Artists and hackers were fascinated by the possibilities. They produced a wealth of images and experiences, from fractal wallpaper to interactive networked simulations of evolution. All of the artists in *all.go.rhythm* have experimented with recursion, a computational technique that figures prominently in complexity theory. Recursion feeds the result of an algorithmic function back into the function.

Bangerts' recursive divisions of the picture plane were sometimes the object of their images, and other times the invisible scaffolding in which other structures were located. In the 100 unique frontispieces in the edition of Verostko's artist's book the *Derivation of the Laws*, clouds of small, multi-colored lines are derived from the data structure of a large black brushstroke through recursion. Hébert and Hertz both produced works where forms emerge from processes in which they are not directly encoded—this sort of emergence is another feature of complexity.

Grant Taylor, in his book *When the Machine Made Art*, points out how both modernist and postmodernist critics read their own particular views of technology into digital art. For the modernists, the computer appeared to be one more stage in the dehumanizing trajectory of machines and technology; for the postmodernists, it embodied an authority whose claims to legitimacy operated in unmitigated bad faith. Neither camp seemed to be aware of the enthusiasm for discovering new forms that artists working with computers were experiencing. This enthusiasm was hardly new: in 1843 Lady Ada Lovelace, the daughter of the poet Lord Byron and arguably the first computer programmer, expressed her delight to Charles Babbage, nineteenth century inventor of computational engines, over how Babbage's Analytical Engine "weaves algebraic patterns just as the Jacquard-loom weaves flowers and leaves." Working in the Romantic period, Lovelace was inclined to see mathematics, invention, poetry, and theology as "part of the same grand endeavor." [Batchen 32] Writing in *Science* in 1988, Lynn Steen declared: "To the extent that mathematics is the science of patterns, computers change not so much the nature of the discipline as its scale: computers are to mathematics what telescopes and microscopes are to science." [Steen 616] Many artists worked with computers for much the same reason, to explore patterns. One might have thought that modernist critics such as Clement Greenberg would have welcomed computers as a source of new forms, proof that formal discoveries were not yet exhausted by all the successive avant-gardes since Romanticism—but the Romantic embrace of science and mathematics had long since grown cold.

Art produced with computers since the 1980s, variously known as "digital art" or "new media art" (in preference to the technoscience-flavored "computer art" of the early days of computing), in various guises such as game art, net.art or glitch art, has finally been making inroads into the world of galleries and museums. In an ironic twist, it has become acceptable to some critics (postmodernists by genealogy) who value the computer as a "technology of rupture rather then an embodiment of Enlightenment vision." [Taylor 32]. Similarly, some cultural critics have embraced networks as a social manifestation of a "rhizome," a non-hierarchical relational structure put forth by postmodern philosophers Gilles Deleuze and Félix Guattari.

These sorts of reversals are interesting, and not altogether absurd. Computational technology accelerates change and disrupts economies and social norms. Networks as organizational structures have become an area of serious research in mathematics, sociology, and the digital humanities. However, this sort of shift towards acceptance of the computer still begs the question of how the formal investigations of artists working with computers should be situated in relation to other art, to visual culture, and to future directions and practices in art production.

questions and communities

Towards the close of the 1980s and into the 90s, one can document two overlapping trends in the presence of computers in the arts. On the one hand, there were the communities of practice supported by universities, industry, and government funding. Venues such as the annual SIGGRAPH conference, the Ars Electronic festival in Austria, the International Symposium on Electronic Art (ISEA) and others were largely responsible for showing this work. These communities were particularly important for fostering an exchange in which artists, scholars, computer scientists, engineers, and entrepreneurs interested in computer graphics, imaging, animation and other applications could meet and exchange ideas. Somewhat later, and with some of the same people, installation art, interactive media, and early networked art began to appear. Directly influenced by video art and Conceptualism, this work was fully engaged with the critique of authority, and less receptive to abstract algorithmic art. Some of it appeared in museum and gallery settings, some in festivals and conferences, as before, and some work struggled to create new systems of reception and distribution, particularly through the Internet.

With the explosive growth of the Internet and the WWW in particular in the new millennium, the situation of the computer-mediated art shifted once again. Alternative systems of distribution and networked communities of practice have proliferated wherever there is a network connection. Glitch art is one recent example of this trend, and a good example of the new situation of digital art as simultaneously a social and aesthetic practice. As in the early days of digital art, amateurs, hackers and professional artists share spaces of distribution and reception, but now no one has to travel to media festivals or conferences to participate—the spaces are virtual. Social media has become an extension of studio space for many artists. Curated online shows organized by groups of artists, aspiring curators, institutions, and commercial galleries have proliferated.

Where do algorithms and algorithmic art fit into this networked mix? Of the former, we can say that they are found everywhere in the form of image and animation processing tools and especially as open source code. The number of people writing code has greatly increased, both among artists and among hobbyists. A whole industry has grown up around people working with microprocessors as "makers" of homemade electronic devices. Those who don't want to muck with code can use algorithms encapsulated into "filters" in commercial software, or use freeware and run free code available online, tweaking it without rewriting it.The continuing popularity of glitch and remix signals an expanding interest in data and data structures, the other half of Niklaus Wirth's equation. Data represents information: a whole new generation of artists and hackers works with information as a system of social exchange. This may seem rather distant from the painstaking coding of algorithmic artists such as those in *all.go.rhythm*, but it probably represents a sea change in the availability of an audience.

What can we expect of that emerging audience, and of ourselves who are swept along by the same circumstances? Abstract algorithmic art will have to submit to the ongoing questioning of authority, of the validity of formal systems, of the political implications of our every gesture—but as one art practice among others, not as a medium specially privileged or specially condemned. Algorithms now intercede in society at all levels and information becomes a new system of exchange, on a par with money. Communities of practice that make use of algorithms—for example, glitch, noise, and remix—already thrive on the Internet. They will continue to construct new meanings and social lexicons for their initially empty creations. Often they won't bother to write code themselves, but will continue to reuse whatever is available. In all of these communities, artists, amateurs, hackers, and makers will realize many times over that moment when a "pattern of patterns" seems to emerge from their experiments. It will be part of their cognitive formation, and part of their survival strategy in a world constructed of information and networks. New art will emerge from these communities. It may require new audiences to understand it, educated in reading the signatures of algorithms and data structures as formerly audiences learned to read Abstract Expressionist brushstrokes, Pointillist dots, Romantic veils of color, or Renaissance perspective. Some of the work that forged the way already moves us to wonder and arms us with new ways of perceiving our world, and my colleagues in *all.go.rhythm* are among those who created it. This is significant work in the history of art, but not because it can be assimilated to a canonical representation of art history, or because it humanizes technology or because it breaks with authority. It rewards us now, and should be honored in the future, because it marks, early on and decisively, a moment of a magical heterogeneity in thinking and representing the operations of the world, a moment when intuition and logic, algorithm and insight converged in a pattern of patterns. The many patterns of patterns that algorithmic insight can reveal are ours to rediscover as we view these works.

acknowledgements

It would be nearly impossible to list all the people who contributed to all.go.rhythm. I cannot fail to mention the support and encouragement of the artists and catalog authors. UIMA curator Stanislav Grezdo's steady hand guided the design and publication of the catalog and countless other aspects of the show. This is the second time we have worked together—I could not wish for a better collaborator. My thanks also go to Lialia Kuchma and the board and staff of UIMA, whose willingness to take risks and whose support of my art and curatorial practice through several years has meant the world to me. Special thanks go to the Thoma Foundation, which stepped in when we were in serious need of funding, particularly for the symposium all.go.rhythm: Communities of Practice. Finally, my family has supported me throughout this long process—I thank them for their love and patience and for the occasional pizza.

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The Mind and the Machine
by Debora Wood

In 1950, while lecturing and working at the Computing Laboratory at the University of Manchester, Alan Turing wrote his seminal philosophical paper "Computing Machinery and Intelligence" in which he proposed two questions: "Can machines think?" and "Are there imaginable digital computers which would do well in the imitation game?"(1) The imitation game involves three players: two human and one computer. The computer and one person are in separate rooms hidden from view of the third player who asks questions of the other two attempting to determine which is the machine and which is human. The player receives replies as text so the answers are not colored by tone of voice or inflection. Turing predicted that by the year 2000 it would be possible to program computers to play the imitation game so well that an average player will mistake the machine for human 70% of the time after just five minutes of questioning. He also predicted that by this time, computers will have become such a ubiquitous part of our lives that "one will be able to speak of machines thinking without expecting to be contradicted."(2)

After rationalizing his own opinions, Turing summarizes the arguments expressed by many diverse factions and individuals including neurologist Geoffrey Jefferson who in his 1949 Lister Oration wrote, "Not until a machine can write a sonnet or compose a concerto because of thoughts and emotions felt, and not by the chance fall of symbols, could we agree that machine equals brain—that is, not only write it but know that it had written it."(3) While it is true that no machine can feel or express emotions the way a human can, a skilled programmer could code a machine to write sonnets with a living voice. Turing's article inspired physicist Christopher Strachey to write such a literary program. Strachey created an algorithm with instructions for basic sentence structure that selected nouns, adverbs, and adjectives from a preselected group of words. The sentences were arranged in short paragraphs that began with a greeting and concluded with a valediction. Strachey's program was tested in summer 1952—the machine successfully composed love letters. The random selection of colorful word parings were imaginative expressions of passion. That same year, Ben F. Laposky, a mathematician and artist from Cherokee, Iowa, made photographs for a project he called *Oscillons*—the first graphic images created with an electronic analog machine. Laposky was interested in designs derived from mathematical, physical, and technical sources, particularly the Lissajous curves appearing as traces of light on the screen of a cathode-ray oscilloscope. Laposky built a generator specifically to amplify and produce very complex waveforms which he then photographed with high-speed film. Laposky said, "*Oscillons* are, I believe, an excellent example of the possibilities of employing modern technology in art and of demonstrating a relationship between science and art."(4) Strachey and Lapsoky set the stage for the creative application of technology in search of new aesthetic experiences.

The computer is the central medium to the artists in the exhibition *all.go.rhythm*. Colette and Charles Bangert, Jean-Pierre Hébert, Roman Verostko, and Paul Hertz embrace algorithmic processes to create drawings, prints, poetry, and textiles that explore modernist interests in line, form, and color. Added to these formal properties are contemporary ideas of ordered systems and chance operations. Some artworks in the exhibition are made with traditional materials, their computations calculated by the artist and executed by hand, but in the other works, the computer expedites the algorithmic process and renders it directly. The artists in *all.go.rhythm* write their own computer code just as some traditionally trained artists mix their own paints. By writing custom code, the artist can go beyond the intended applications of commercial software. The exhibition also features works made by manipulating computer hardware to perform in unintended ways. The Bangerts, Hébert, Verostko, and Hertz use computational technology to create unique aesthetic experiences.

Marshall McLuhan wrote, "The printing press changed not only the quantity of writing but also the character of language and the relations between author and public." In order to master the evolution of media and technology, McLuhan states the need for "new languages in time to assimilate them to our total cultural heritage."(5) Computers, having sparked a new mode of visual expression, therefore required an expanded understanding of techniques and aesthetics.

An algorithm is a procedure or formula for solving a problem. It is a step-by-step set of operations to be performed. In the context of this exhibition, an algorithm is a list of instructions which guides the creation of an artwork. It precisely states every step that must be executed. A computer algorithm, also called a program or code, is written with a language and vocabulary specifically for computers. There are many different programming languages which can be learned just as one studies French, Spanish, or Japanese, but each programming language is suited for different needs. Early programming languages, such FORTRAN and ALGO 60, were designed for numeric and scientific computation. In an early example of the subversion of tools, some of the earliest computer generated artworks were made using these languages. Some languages such as Java and C++ are very complex to serve broad needs and can take years to learn. Others such as Post-Script, designed for vector graphics, and Processing, were created specifically for artistic endeavors. Casey Reas, artist and co-author of Processing, compares an algorithm written in computer language to a knitting pattern:

> Row 1: (RS) *K2, P2* across
> Rows 2, 3, & 4: Repeat Row 1
> Row 5: (RS) *K2, P2, C8F* Repeat to last 4 sts, K2, P2
> Row 6: Repeat Row 1
> Repeat rows 1–6 for desired length, ending with row 4
> Bind off in K2, P2 pattern(6)

To the layman, these instructions may seem like gibberish, but to a knitter, they are clearly defined steps with the goal of creating a finished piece of apparel. The creativity of the resulting work can be seen in the choice of colors, the execution of craft, and the form of the final piece. Some artworks exist only as a set of textual instructions. Sol LeWitt, Lawrence Weiner, and Yoko Ono have made conceptual artworks which describe actions to be undertaken by the owner or viewer. Some of these instruction pieces, such as LeWitt's wall drawings, are intended to be executed by individuals, or teams of people, to bring the artwork into existence. Others bring vivid mental images to mind without the need to fabricate a physical object at all. In *Paragraphs on Conceptual Art* LeWitt wrote, "The idea itself, even if not made visual, is as much a work of art as any finished product."(7)

The algorithm in an artwork gives structure to the composition. An analogy in traditional art can be seen in Josef Albers's series *Homage to the Square*. Albers invented a compositional formula that became the framework for all the works in the series. Within a square canvas are proportionally smaller squares weighted to the bottom edge. The distance from the bottom is a 1:1 proportion, the sides are 2:1 and the top is 3:1. Albers then makes variations on this compositional structure through his selection of colors, values, and hues, and by occasionally omitting one or more of the smaller squares. If Albers did not make variations to this structure, every painting he made would be the same, but he achieves dynamics through the way the colors interact with each other and the compositional variations.

In computer art, executing only the algorithm would generate static, monotonous images. Random elements are added to the program to create interest. This is the expressive process in the computer program. Randomness is an opportunity for the computer to select different courses of action without direct input from the artist. The artist relinquishes control over certain aspects of the composition. An almost infinite number of variations of an image or poem can be produced by a program that incorporates random processes. Albers created hundreds of works over 26 years in his *Homage to the Square* series, but a computer program could make infinite variations on a theme in a fraction of that time.

Systematically applied computational randomness is a central doctrine of generative art. Computer art pioneer, mathematician, and scientist Frieder Nake described the process in 1966, "The first and most important task is to set up the program. This is supposed to enable the production of a whole class of drawings . . . . It should be able to run through a certain scheme, if possible in all its variations. This must be seen in analogy to the procedure of the artist, who pursues a theme in all directions using his 'intuition' . . . the selection of possibilities from a certain repertoire. This intuition is simulated in the computer by the automatic selection of pseudo random figures."(8) The random elements allow the details of the composition to emerge without conscious reasoning.

This method of creation has been a key element to many artists' work. In the 1910s, Jean Arp created a series of paper collages in which the arrangement of the rectangular shapes were based on the laws of chance. Arp dropped torn pieces of dark paper on a white card and attached them wherever they happened to fall. John Cage established his own rules for chance operations around 1950. "My work became an exploration of non-intension. To carry it out faithfully, I have developed a complicated composing means using *I Ching* chance operations, making my responsibility that of asking questions instead of making choices."(9) In the late 1960s, Cage asked an engineer at Bell Telephone Laboratories to write a program that would produce a list of randomly generated numbers which Cage referred to for several years to determine pitch, duration, volume, and other elements in his composition. The objective was to remove conscious control and predictable order, to allow unexpected forms or events to occur.

Random elements are a necessary part of expressive programming. Used alone, randomness would produce chaos and noise. A love letter composed of only adjectives would dismay, not swoon. The algorithm sets parameters and informs chance operations. The beauty in these computer generated works is the evidence of their creation. Much like the minimalist and conceptualist artworks, part of the aesthetic experience is the insight into the program's structure—when the algorithmic and generative processes are visible in the resulting work.

By generating unexpected pairings of elements that elicit an aesthetic response in the viewer, one could be fooled and not recognize that a drawing or poem was executed by a machine. Consider again the question raised by Turing: "Are there imaginable digital computers which would do well in the imitation game?" Is it now possible to program a computer so well that the viewer will not be able to distinguish a work made by a human from the product of a computer? "The reader must accept it as a fact that digital computers can be constructed, and indeed have been constructed, according to the principles we have described, and that they can mimic the actions of a human computer [a human being] very closely,"(10) wrote Turing. Public reception to computer art was not universally enthusiastic, possibly because machines were seen by many as a threat to the unique qualities of being human. Reaction was negative because the creative element and imagination required for algorithmic art was not readily understood.

Georg Nees, a mathematician from Siemens engineering company, made a series of plotter drawings which were included in an exhibition organized by philosopher professor Max Bense at the Technischen Hochschule in Stuttgart. This exhibition, the first ever of digitally-generated computer art, elicited sharp criticism from the art students during the opening on February 5, 1965. Nake, who was in attendance, recalled the reactions to Nees's work:

"Many of the artists at the opening are baffled. They are a bit hostile. One of them gets up [and says], 'Tell me, Mr. Nees, can you make your machine draw like an artist's flow?' Nees ponders for a moment. He is a calm, patient, friendly mathematician of about 35 years of age. Then he says, 'Yes, I can. If you can tell me precisely how to define your way of drawing."(11)

Creativity in computer art is not innate to the computer itself, but to the programmer's abilities. Skill and imagination are needed to write the algorithm and set parameters for the randomized elements. The programmer is the artist, the one who conceives the direction and subject matter of the artwork. Beauty is visible in the resulting work when the artist can express him or herself through programming.

In addition to writing the algorithm and determining the random component of the program, selection of the final work can be critical. The computer can generate many versions of thematically related compositions, each a surprising discovery for the artist. Much of the creative process involves watching and waiting as the program arranges forms into different configurations. The results can be a sublime accident or an awkward mistake. The artist decides what to keep, what to add to the program, and what to eliminate. Some results are thrown away, and some are kept as a final work. The aesthetic choices of the artist made during the culling process are critical for success.

At the time Turing gave his talk, computers were not built for artistic applications. Computing machines were designed for industrial, scientific, and military purposes, fields not traditionally populated with artists. Because of this, the earliest creators of computer art were scientists, engineers, and mathematicians. They knew how to write computer programs because it was integral to their work, and if they had tolerant supervisors, they could engage in creative experimentation. In the mid- to late 1960s many traditionally trained artists were attracted to the potential of the computer as a tool to make art, and although access was challenging, it was not entirely impossible. "With a little luck and plenty of juvenile impudence,"(12) Manfred Mohr gained access to computers and a Benson flatbed plotter at the Meteorological Institute of Paris in 1969. Although Mohr eventually learned how to program himself, his first computer generated artworks were produced in collaboration with engineers.

Some research facilities and universities, particularly in the United States, encouraged cross-disciplinary collaboration between the sciences and the arts. Bell Telephone Laboratories, site of great achievements in telecommunications, gave rise to many artworks, performances, and crucial discoveries in hardware and software built for artistic purposes. Electrical engineers Billy Klüver and Fred Waldhauer from Bell Labs joined with artists Robert Rauschenberg and Robert Whitman in founding the group Experiments in Art and Technology, or E.A.T., in 1967 which, according to Rauschenberg was to "function as a catalyst for the inevitable fusing of specializations creating a responsible man working in the present."(13)

Charles and Collette Bangerts' artworks are seminal examples of the collaborative potential of art and science. Charles Jeffries Bangert, or Jeff, and Colette Stuebe Bangert met in Boston in 1958 while Colette was working toward her MFA at Boston University and Jeff was studying mathematics at Harvard University. They married in 1959. Six years later Jeff was hired as a research statistician at the University of Kansas and soon made his way to the rapidly expanding Computation Center. Colette recalled, "When the University of Kansas was given a plotter in 1967, Jeff was asked to test it. We began to think of drawing lines with it in ways that we found visually interesting. Together, we had enough common background and experience to begin to use the computer graphically. Together we draw with the computer and sign the drawings CB—Colette-Charles Bangert . . . The subject of all my work has been landscape. The elements of both the computer work and my hand work are often repetitive, like leaves, trees, grass, and other natural landscape elements . . . Landscape yields both texture and form. The pictorial form is usually allover, with non-focus details which form patterns, since I feel these are essential properties of landscape."(14)

Together the Bangerts made a series of plotter drawings with a program created by Jeff called Melly. Melly was written in the FORTRAN programming language and created digital images that were then drawn by a CalComp plotter. The series included some of the first plotter drawings to use color inks for purely aesthetic purposes. The Bangerts' early works are notable because they employ a randomized curvilinear line, rather than geometric shapes, to create a composition of soft textures that call to mind wind blowing across grassy plains. The random processes employed by the algorithm mimic the natural variety of plant life. No two lines are the same.

For many artists, it was not possible to explore the creative potential of digital technology until the personal computer became commercially available and relatively affordable. This is true for Verostko, Hébert, and Hertz. As computer technology became more accessible, artists pushed the boundaries of what computers were capable of producing. Hébert and Verostko conceived new applications for printing devices, such as using specially equipped plotters to draw with graphite or watercolor on a variety of papers. Hébert even created a series of etchings and drypoints made by attaching a sharp needle to the drawing arm of the plotter to cut through ground and incise lines into intaglio plates.

In the summer of 1959, Hébert interned at IBM which gave him access to a mainframe computer and the opportunity to write and debug his first FORTRAN program, but it was not until the mid-1970s that he began using a personal computer to experiment with creative algorithms. In 1977 he acquired his first plotter for personal use, giving him the time and freedom to use the technical drawing machine to make art. Hébert wrote his own software in the programming language Lisp. His programs and algorithms allowed the machine to create tonal fields of subtle textures made of layers of lines using either pen and ink or graphite. These unique drawings were produced on many different papers, from thick cotton with delicate tooth to semitransparent ivory wove sheets.

Book reproductions cannot convey the rich surfaces of Hébert's drawings. The delicate and sensual works are devoid of reference to the technologies used to create them, except for the sheer precision of the repetitive lines. Hébert's plotter drawings are intricate and complex and sometimes take days to draw. One can imagine that watching the plotter slowly render a delicate ink drawing would be hypnotizing, and the resulting image is seductive record of that meditation.

Like Hébert, Roman Verostko's most significant artworks are drawings made with a plotter controlled by a personal computer. In the 1950s and 1960s, Verostko embraced life as both an artist and a Benedictine monk. In 1962 he traveled to Paris where his interests in automatism and spontaneous drawing as a means of expressing the subconscious, became concrete while studying printmaking at Stanley William Hayter's Atelier 17. Verostko left the monastic life in 1968 and began teaching art at the Minneapolis College of Art and Design where he continued to make paintings and drawings without rational control, creating abstract works that "delight in the human imagination."(15) His engagement in automatic drawing led to writing algorithms to enable computer automatism. Verostko studied FORTRAN at the Control Data Institute in Minnesota in 1970, and became fully engaged in artistic coding when he acquired an Apple personal computer in 1978.

The Magic Hand of Chance, a program written in BASIC using an IBM personal computer, generates randomized visual improvisations interspersed with witty, poetic sayings. *The Magic Hand of Chance* evolved into Verostko's master drawing program HODOS, which originates from the Greek word meaning journey or pathway. Verostko's mature work began when he engaged his program HODOS in conjunction with a plotter with 14 pen stalls and a rich palette of inks to create eloquent and colorful drawings. Like Hébert, Verostko altered the plotter's intended use by attaching a calligraphic brush to the machine's drawing arm, thus introducing elements of chance and accidental mark making (splatters, drips, etc.). The dramatic, black brush marks contrast with fields of organic, undulating forms drawn with pen and bright colors of ink, and have the warmth of the human touch. The resulting algorithms express devotion and spiritual awakening. Thematically, many compositions were created in homage to important figures in the history of computational creativity such as George Boole and Alan Turing.

Paul Hertz was engaged in making algorithmic art for several years before he acquired a personal computer. He has worked in a variety of media—prints, drawings and watercolors, photographs, installations, performance, music, and digital media—and in many styles, often under different pseudonyms: Juan Teodosio Pescador (also known by his stage name Ignotus or Ignotus the Mage), Pescador's grandniece Alma de la Serra, and Darrell Luce. After receiving his BA in Fine Arts from Brown University in 1971, he moved to Spain where he lived for 12 years working across disciplines, collaborating with musicians and theatrical performers. While in Spain, Hertz developed a generative system for intermedia art.

In 1979 Hertz wrote an algorithm for creating artwork that used handmade punch cards, much like John Cage used the *I Ching* and random numbers, to inform the elements of a composition. The algorithm included a set of five polygons grouped into four different squares. Hertz described the process:

> "My first 'program' for the *ignosquares* consisted of a deck of 32 homemade punch cards. I engaged other people in a game where they chose cards face down, turning them over at the last minute to reveal a pattern which I would then interpret as Ignotus the Mage, a dysfunctional fortuneteller."(16)

The symbols on the punch cards dictated the width of lines and the placement of the polygons which Hertz then executed by hand. The delicate ink drawing *Aiguabarreig* is one such example. When he returned to the United States, Hertz enrolled at the School of the Art Institute of Chicago where he learned to work with computers as a Fellow of the Center for Advanced Study in Art and Technology, earning an MFA in Time Arts in 1985. His full engagement with computer programming happened in 1992 when he began working as a designer and programmer at Northwestern University.

Although Hertz's algorithmic program was created with a great deal of humor and tongue-in-cheek intent, the resulting images are exquisite fields of seemingly repetitive patterns. Their meticulous execution arises out of an elaborate formal language. The elements seem to have been arranged in the moment; the algorithm acting without conscious control.

The algorithmic art of the Bangerts, Hébert, Verostko, and Hertz continues to evolve. Jeff and Collette's collaborative works are manifesting now as minimalist studies in color. Vertical bands of varying widths and hues pulse across horizontal planes. In Collette's solo work, she continues her studies in line, but the final products take the form of handmade tapestries with colorful threads outlining graduating rectangles systematically applied on a dark field. This motif is repeated with subtle modifications in each one. Hébert creates tonal fields of complex lines, now at a much larger, almost human scale that envelop the viewer. From a distance, they appear to be soft, even shades gently rippling across the paper, but up close they are revealed as rapidly shifting marks in brilliant colors. Verostko's most recent works are metaphysical drawings intended to inspire devotional reflection. *Flowers of Learning* is a series of seven plotter drawings created in memory of the Sisters of Nazareth who were the first teachers at Spaulding University. Together the seven drawings create a poetic garden that undulates like translucent fabric reaching upward, each form paired with classic texts from world cultures translated into an invented alphabet. Hertz, in his many artistic personalities, continues to exercise capricious rules for generating innovative and dynamic allover compositions. *The Night Tripper,* for example, originated from formant frequencies of human vowels made visible. The resulting image is a sparkling array of hypnotizing colors.

If the first reaction to these works is delight in the inventive employment of line and the seductive color palette, or pleasure at following ink marks as they dance across the page, then perhaps the computer has won at the imitation game. Computer generated artworks can stand alongside other art forms as beautiful, original works of art. As Turing predicted, computers are an integral part of daily life, and people speak of machines thinking without being contradicted, but this does not mean that the digital computer has a conscious mind. The computer can run through thousands of variations of the artist's program, but the artist decides which works are the best ones in the series. Choosing the work that has the most successful arrangement of forms and color interactions is based on personal taste and perhaps cannot be verbalized or programmed, and is therefore something the computer cannot decide.

Employing computational technology in art has opened a vast arena of opportunities. It has prompted new ways to consider what it means to make art, how to articulate beauty using step-by-step procedures, and how to define artistic instinct. The works in this exhibition embody the expressive possibilities of programing and computer code manipulation. They demonstrate that an artwork generated by a computer can contain such a perfect balance of structure, imaginative form, and unique expression that it evokes a transformative reaction in the viewer. It is true that the computer can write poetry and make drawings, but the fundamental aspects of an artwork are reserved for the human artist. The artist determines the subject and writes the steps that must be taken for its creation, which the computer then executes as an extension of the artist's hand and mind. The final aesthetic decisions and selection will always fall to the human artist. Emotion is the final frontier that exists firmly outside the realm of technology and digital code.

(1) Alan M. Turing, "Computing Machinery and Intelligence," *Mind: A Quarterly Review of Psychology and Philosophy*, vol. 59, no. 236 (October 1950): 433.

(2) ibid: 442.

(3) ibid: 445.

(4) Ben F. Laposky, "Oscillons: Electronic Abstractions," *Leonardo*, vol. 2 (Autumn 1969): 349.

(5) Edmund Snow Carpenter and Marshall McLuhan, *Explorations in Communication: An Anthology* (Boston, MA: Beacon Press, 1960), 2.

(6) Casey Reas, Chandler McWilliams, and LUST, *Form+Code in Design, Art, and Architecture* (New York: Princeton Architectural Press, 2010), 13.

(7) Sol LeWitt, "Paragraphs on Conceptual Art," *Artforum*, vol. 5, no. 10 (June 1967): 83.

(8) Frieder Nake: "Bemerkungen zur Programmierung von Computer-Grafiken," *Programm-Information PI-21: Herstellung von zeichnerischen Darstellungen, Tonfolgen und Texten mit elektronischen Rechenanlagen*. Deutsches Rechenzentrum Darmstadt (April 1966): 3–33, quoted in Barbara Nierhoff, *Ex Machina—frühe Computergrafik bis 1979: die Sammlungen Franke und weitere Stiftungen in der Kunsthalle Bremen: Herbert W. Franke zum 80. Geburtstag* (München: Deutscher Kunstverlag, 2007), 33–34.

(9) Richard Kostelanetz, ed., *John Cage, Writer: Select Texts* (New York: Cooper Square Press, 2000), 241–42.

(10) Turing: 438.

(11) Frieder Nake, "The Semiotic Engine: Notes on the History of Algorithmic Images in Europe," *Art Journal*, vol. 68, no. 1 (2009): 77.

(12) Nierhoff: 416.

(13) Robert Rauschenberg, *Autobiography*, color photolithograph, triptych (New York: Broadside, 1968).

(14) Colette S. Bangert and Charles J. Bangert, "Computer Grass Is Natural Grass," *Artist and Computer (New York: Crown Publishers, Inc., 1976).* Online: www.atariarchives.org/artist/sec5.php

(15) Roman Verostko, "Artist's Statement for the exhibition 'Imaging the Unseen,'" *Roman Verostko, Algorithmic Art* (November 1972): www.verostko.com/history/mpls/mpls.html

(16) An *ignosquare* is a term invented by Hertz to describe the geometric pattern on the cards that Ignotus the Mage used in fortunetelling. Paul Hertz, "A Graphical Disquisition Upon the Ignoverse As Expounded by Ignotus the Mage and Faithfully Recorded by Paul Hertz," presented at presented at SIGGRAPH 99, Los Angeles, *Paul Hertz* (1999): paulhertz.net/worksonpaper/ignotheo.pdf

Digital Iconoclasts

Grant D. Taylor

Great mystery surrounds the first ever award-winning digital artwork. Remarkably, no individual artist was ever credited and technical details were largely absent. To be sure, art without direct attributable agency is rare in the late twentieth century. After all, in the early 1960s when these images were first published, the cult of the artist in the United States was reaching dizzying heights. One would think the act of creating art in an entirely new medium would be an achievement worthy of acknowledgment. Not in this instance. So who was responsible and why has the shadow of mystery shrouded these significant artworks? Indeed, these questions are ripe for speculation. My investigation into the history of these early computer artworks provides insight into a fundamental aspect of digital experimentation—the act of disruption. The artists represented in *all. go.rhythm* are successors to this experimental mode and their artwork is a testament to the power of radically reimagining a medium.

So what do we know about these prize-winning images? In 1963, the United States Army Ballistic Research Laboratories (BRL) in Aberdeen, Maryland, entered a series of printed images into the newly inaugurated computer art contest, which was organized by the early computer science trade journal *Computers and Automation*. The journal's editor, the famed pioneering computer scientist and author Edmund C. Berkeley, created the competition because he deemed recent images generated by early mainframe computers to be "beautiful."(1) Like many of his fellow scientists, Berkeley appreciated the aesthetic allure found in the simple linear designs. Berkeley, perhaps with the help of colleagues at the journal, judged *Splatter Pattern* from the U.S. Army to be the best entry. Printed on an early printer called a *dataplotter* (manufactured by Electronic Associates Inc.) the design was an analogue of the radial and tangential distortions of a camera lens. A year later, the same laboratory won first prize for an image produced from the plotted trajectories of a ricocheting projectile. These are the only known details. No artists or scientists were listed, nor was the computer model responsible for generating these images revealed.

While many in the art world remain surprised, even uncomfortable, with the fact that the U.S. Army was responsible for the first award-winning digital art, it is entirely logical to anyone with knowledge of the computer's history. Because the modern computer was forged in the U.S. Military's well-funded research and development laboratories such unorthodox settings appear natural. What remains fascinating, however, is not the military heritage to these images, but the gaps in information and the deliberate lack of specificity surrounding these artworks. Traditionally, early computer art had been accompanied by a plethora of technical information, often to the chagrin of art critics who saw this as evidence of its overt reliance on science.

United States Army Ballistic Research Laboratories, *Splatter Pattern*, 1963. Computer-generated, graphed on an Electronic Associates, Inc. Dataplotter. From *Computers and Automation* (August 1963). Courtesy of the U.S. Army Research Laboratory.

Even today, the Army Research Labs do not celebrate its place in art history, even though military historians have kept a detailed history of the labs' various accomplishments in advanced computing. Perhaps like Bell Labs, another active site in early computer art experimentation, BRL avoided all publicity that was not associated with its core military or commercial pursuits. To be fair, art and ballistics does seem a highly volatile mix, even by today's standards.

Nonetheless, this most unlikely of scenarios happened. Someone at the BRL in the early 1960s decided to reimagine the possibilities of the computer. Not as a calculator for ballistic problems, but as a generator of aesthetic objects. Considering the culture in the U.S. Army in the 1960s, this act was an astounding leap of faith, an iconoclastic moment that would help produce the epistemological shift that defined the coming digital revolution in arts.

Taking tools designed for specific purposes and reimagining them—effectively redirecting them toward human desires—has been a source of innovation since the Stone Age. The early hominid artists were at the forefront of this repurposing. The human hand, so important to precision tasks, was imagined as a surface, a mark-maker, and a signature. The hand stencil became a symbol of ownership and individuality, elements that would come to circumscribe the act of art making. The stone tools used to tenderize meat and form sharp arrowheads were eventually used to sculpt fertility figurines. The history of art in many ways is a history of disrupting media. But the computer was an entirely new type of medium, being the most complex machine ever invented. The idea of going against the computer's grain, one defined by the practicalities of numerical calculation, emerged early. In 1950, the American writer Kurt Vonnegut penned a satirical story of a military computer discovering the ability to write scores of love poetry.(2) Here we get the first glimpse of an idea in which art displaces the computer's primary mission, thus allowing for entirely new forms of expression.

Perhaps we can picture in our minds that moment—perhaps it was an epiphany—when the computer was viewed differently at BRL. The original images, which now appear lost, were byproducts of ballistics visualization and more than likely were produced through collaborative effort. Possibly it was a combination of engineers, mathematicians, and programmers. If one examines the history of computing at BRL, it becomes clear that women played a part in this milestone in digital art. Women were seminal in the development of the electronic computer. Even prior to the Second World War, women were responsible for manually calculating complex firing tables required for ballistic weaponry—they were in effect human computers. At BRL, large groups of women were required to calculate tables around the clock. Following the War, the best human computers were recruited by male engineers to code the first modern electronic computer, the ENIAC, which was a direct descendant of the computer used in the creation of the first award-wining computer artworks.

The "ENIAC girls," as they are now popularly called, are widely celebrated as the world's earliest computer programmers and would provide the model for female involvement in future groundbreaking ballistics visualization at BRL.(3)

One can surmise that the mainframe responsible for generating the art was the BRLESC- 1. In 1962, BRL designed and built the landmark BRLESC 1, which at that time was acknowledged as the fastest computer in the world. The designs were most likely the earliest plotter-drawn visualizations from the lab's newly developed graphic capabilities. We can only imagine this group of technologists standing in front of an ultra-futuristic looking console with punch cards in hand moving between the computer and the bulky flatbed 3110 Dataplotter. The emerging image from the rapidly moving pen, as it darted across the plotter paper on an x-y axis, would have been mesmerising. How liberating it must of felt to move from the computational workload of solving ballistic problems, army logistics, and weapon systems analysis to one of aesthetics. The beauty of linear geometry must have been too seductive to resist for those forward-thinking individuals. Did they realize that these simple linear marks had profound implications for art?

Within the decade a whole raft of artists would join with scientists and engineers to shape the digital medium. The mass efficiencies of the computer were resisted, often with radically implications. John Cage, as an early spiritual leader of the digital art age, sought to decenter the author by letting other voices speak, sometimes the voice of the machine, othertimes the voice of the audience. Around the world a type of uncompromising experimentalism emerged and provided an ideology for the nascent new media art sense. James Tenney and Lejaren Hiller, at Bell Labs and University of Illinois respectively, defined digital sound. Stan VanDerBeek, Ken Knowlton, A. Michael Noll, Lillian Schwartz, and Nam June Paik were pushing the technological limits of digital image making at Bell Labs. François Morellet in Zagreb was overseeing a new type of materiality with the New Tendencies group, and Max Bense, Georg Nees, and Frieder Nake were repositioning the way the world understood digital aesthetics at the Technische Universität Stuttgart in Germany.

Members of the next generation of artists that followed these early digital iconoclasts are represented in *all. go.rhythm*. From their forebears, these artists inherited a highly experimental mode of practice that sought to break, unsettle or extend the boundaries of the digital medium. Their practice began in the 1970s when the mainframe era was coming to a close and mini-computers and personal computers emerged as potent new tools. Rather than the governmental or corporate laboratory (and all the restrictions that comes with these types of institutions), the artists in this exhibition could experiment with computing in their own studio. The private world of studio—that rarefied space so important to focused investigation—allowed for the reconceptualization of the computational medium. They possessed the freedom to interrupt, to recalibrate, and to reshape tools. They could mess with the machine!

Colette and Jeff Bangert were some of the first artists to subvert the natural proclivities of the computer, and together they were amongst the first to house their own production systems in-house and on a studio scale.(4) Together they represent one of the most fruitful collaborations in the history of digital art. The husband and wife team naturally brought the worlds of art and science into a cohesive union. She was trained artist, as a graduate of Boston University, and he was a trained mathematician. These professional labels, however, were permeable. For Jeff had an art degree too and had been experimenting with drawing media since his Harvard days. What drove their collaboration was a desire to create a symbiotic relationship between diverse fields of knowledge. Together they were able to push the computer in an entirely new direction.

In the early 1970s, the Bangerts joined with other practitioners to see if they could direct the computer toward humanist sensibilities. Early computer art of the era was dominated by geometric abstraction. The machine's symmetry and precision gave the artwork a highly mechanistic appearance. This was due in large part to the technology itself. The simple Cartesian world underpinning graphic space and the early plotter printers innately lent itself to linear and planar construction. As a result, the pioneering artists and scientists of computer art quickly traced this hardedge aesthetic back to early modernist movements, such as constructivism. It was a natural fit and an adroit way to legitimize their work in the eyes of a sceptical artworld. Yet the world of human experience—and the tangible space that surrounds us—remained all but unexplored. Humanist subject matter called out to be charted by the Bangerts, and it was the landscape that would provide the stimulus for their novel practice.

The landscape genre had long fascinated the Bangerts, and like many artists growing up in the Midwest it deeply affected Collette. The much-venerated environs of the Kansas prairie held a unique beauty, one made possible by the constantly shifting field of intersecting lines in space. The Bangerts' first computer-generated drawings were an attempt to introduce the variability of the hand-drawn landscape. In those days, producing a human-like mark was a tough ask. Through a measure of patience and perseverance, the computer needed to be cajoled. Working against the aesthetic of exactness—that cool rhetoric of mechanical abstraction so common at the time—the artists were able to achieve the imprecisions of the natural world. In *Land Lines*, circa 1972, the artists achieve a bodily response to the landscape—something completely innovative in digital art at the time. Subverting the precision and natural symmetry of the computer, the Bangerts employed the simulated expressionistic strokes of the human hand as a way to capture the chaotic patterns found in nature. The Bangerts' practice remained a project of exploring the delicacies of linear form in the natural world. Newer works like *The Plains Series* have remnants of earlier linear works, but this time the effect is that of an oscillating field, a tapestry like construction where the lines produce transparent color fields. While the prints show preciseness common to the machine, the composition's field feels natural, as if in continual flux.

Roman Verostko shares the Bangerts' strong experimental streak and sensibility for organic forms. From the first moment Verostko was exposed to computing, he looked to reshape the very fabric of digital materiality. Early forays into computing, such as *The Magic Hand of Chance*, 1982, saw the artist push the medium towards free association in text and image. Taking the methodologies of automatic art (found in dada, surrealism, and abstract expressionism), the artist proceeded to fuse them to eastern transcendentalism and ancient Greek thought. These worlds were completely foreign to digital art at the time. In fact, Verostko was the first artist to probe, in its multifarious forms, the inner world of the emerging digital consciousness. In *Magic Hand of Chance* the artist channeled the language and spirit of ancient traditions through non-repetitive free forms in sound, image, and text. As these forms cascaded from the artist's small personal computer system, it felt to the viewer as if the Verostko has unlocked a never before opened doorway to a new world of expression and meaning making.

The way Verostko was able to push the digital medium toward a myriad of different poetic and spiritual traditions relates to his complex biography. Born in a coal-mining region of Western Pennsylvania, the artist first studied at the Art Institute of Pittsburgh. After graduating, Verostko took up philosophy at St Vincent College in Latrobe, Pennsylvania, before entering the seminary to study theology, eventually becoming a Benedictine monk. Before leaving monastic life, Verostko travelled and studied widely, accumulating knowledge and experiences that would inform his work and his teaching at Minneapolis College of Art and Design. His interest in eastern cultures would result in the artist's most radical act: attaching a Chinese brush to a pen-plotter. The pen-plotter since the early experiments at BRL had been the tool of the engineer and architect. It was a pragmatic tool made for precision mark-making. It was not designed for the fluidity and spontaneity of the medium of paint. Through trial and error, pushing the plotter, redesigning it, fabricating pieces, and general tinkering, Verostko created one of the most unique digital marks ever attempted. He was able to achieve the expressive energy and dynamic form of the hand-painted mark. In many ways, Verostko built on the Bangerts' desire to overcome the cold mechanical line, forcing the limits of digital production to mimic human sensibilities even more convincingly.

But Verostko did not arrive at this breakthrough by merely attaching a Chinese brush to the machine's drawing arm of the plotter. The artist had to study the ritualized intricacies of Chinese and Japanese calligraphy and develop a sophisticated software routine to activate his system. In his frontispieces of his famed *Derivation of the Laws*, 1990, we see Verostko simulate the expressionistic strokes of the human hand. The line has the temperament of a human creator, a line with energy and force of a master calligrapher. But the plotted brush stroke was not his only innovation. The artist spent endless hours honing his pigments, paper surfaces,

United States Army Ballistic Research Laboratories, Console BRLESC, Ballistic Research Laboratories Electronic Scientific Computer. Courtesy of the U.S. Army Research Laboratory.

and pen tips to create new visual effects. Verostko built complex spatial relationship by scaling, reflecting, and rotating his lines through various geometric transformations. In the left half of *Ezekiel Series, Vision2* the viewer can see the bi-lateral symmetry of self-similar lines building an intricate surface. Under Verostko's direction, the plotter generates a unique drifting glazed effect, which is formed by the physical overlapping of colored inks. The viewer can study at close range the linear complexity and shifting color fields it creates, or step back and grasp the overall symmetry of the form.(5)

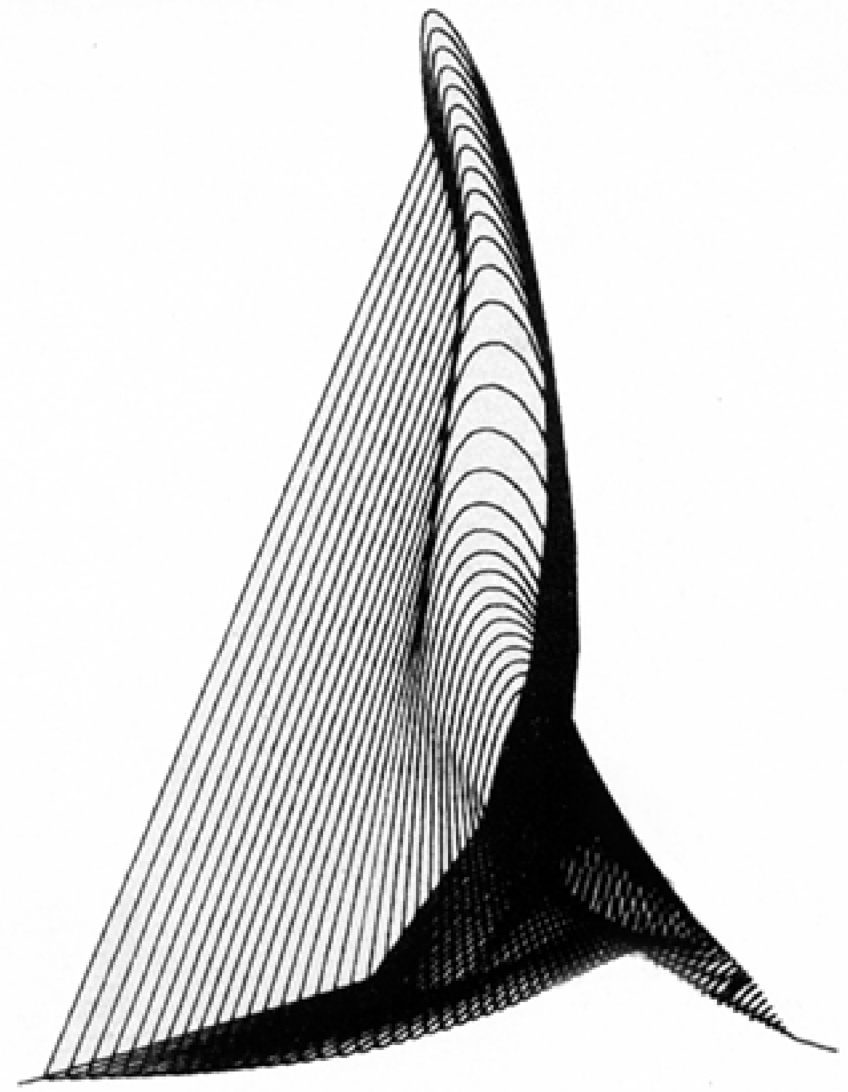
Jean-Pierre Hébert's practice is also defined by pushing technological limits. As an artist he carefully shapes and unifies his various mathematical functions to create algorithms of incredible visual complexity. While complex, his images are always delicate and balanced, exhibiting the subtlest spatial equilibrium. Born in Calais, France, Hébert had an artistic upbringing. Growing up on his grandfather's estate in Vence, the medieval-walled village at the foothills of the French Alps, the artist was in the centre of modern art. The town is commonly known for the Matisse Chapel (*Chapelle du Rosaire de Vence*), which was built and decorated by Matisse as a gift to the Dominican nuns who helped the artist recuperate after illness. Picasso's Madoura pottery studio in Vallauris was nearby, and because the town was in the orbit of Picasso's playground, the French Riviera, Hébert was exposed to the famed modernist. Hébert's held his first solo show at the Chave Gallery in 1989. Entitled *Sans Lever La Plume* (Without Lifting the Pen), the exhibition showcased some of Hébert's most finely rendered computer-generated plotter drawings. Some of the works shown revealed one of Hébert greatest achievements in the digital arts—his single, continuous plotted line drawing technique.

Rather than disrupt the machine, or manipulate it, or engineer augmentation, Hébert pushed the software and drawing technology to its outer limits. Works like *Laque Noire*, 1990 illustrate this power. To generate this linear configuration required years of painstaking work in which the artist, through trial and error, found the most suitable plotter, pens, and inks to support the process. Some of his larger, more complex works would take over 60 hours to plot, which was mentally and physically exhausting. Any impurity in the ink could clog the pen, or the risk of a power outage was ever present. If a problem arose, the printer would fail and because the design was reliant on the single, unending line, no retracing or starting from the same point was possible. If a technical failure occurred, three weeks of preparation would be for naught and the artist would need to start again.(6) Like much of Hébert's art from this period, *Laque Noire* is made up of one finely rendered line that when viewed in total creates an intricate tapestry, a kind of translucent topology that mirrors the effect of light passing through a permeable membrane. In this case, the dark field feels to the viewer like intersecting wavelets on the surface of water.

As the plotter became obsolete in the 1990s, Hébert found new capabilities with the ink-jet printers, which enabled him to make even smaller, more intricate lines, and allowed his moiré patterns to resonate with added intensity. In his *Interfering Wavelets in Camaïeu of Reds* the delicate structures reverberate, creating a linear membrane where shapes seem to surface only to recede. The sophisticated effect of Hébert's inkjet line is also reflected in the Bangerts' new works as they both push the computer and the printer to ever-greater visual effects.

The field of visual complexity found in the art of the Bangerts, Verostko, and Hébert is also reflected in the work of Paul Hertz. Hertz's practice, however, possesses a totalizing system that directs all his digital experimentation. The artist's *Gesamtkunstwerk* acts as continuum, an artistic response to the world around him. These reactions are not just to the physical realities but also to the theories that undercut all belief systems. The artist attempts to understand a theory—be it mathematical, political, or cultural—and then subvert its logic through algorithmic methods. His tool for exploration is code and his subversion involves a complex imagining of a generative possibilities inherent in a mode of thought. As a result, Hertz's generative practice is prolific. As a way to organize his unending visual response to the world of intellectual constructs and the stream of data that bombards our everyday phonological experience he has created the universe of "igno." As a suitable vehicle to carry the ambiguity and sense of play inherent in his practice, Hertz classifies his art into different levels and paths that creates a type of superstructure that informs all his work.

Hertz's interest in intermedia and generative systems began in Spain in the 1970s when new media was beginning to infiltrate the art scene there. His early works, such as *Aiguabarreig*, 1979, show his interest in the four-color theorem and all the permutations inherent in the geometric variation of a tile system. The artist's work would remain indebted to Spanish intellectuals and writers to this day. Once he moved back to the United States, he became a major part of the Chicago art and technology scene, teaching a variety of innovative courses on software development and virtual reality at Northwestern University and the School of the Art Institute of Chicago. Hertz, always a community minded individual, emerged as an innovative curator and writer, eventually becoming a great proponent of pioneers of digital art and as a promoter of emergent artists. Beyond the inventiveness of his generative systems, what made his practice so original was the way he took the rationalistic approach and the dead-pan seriousness of computational modes and injected it with humor and whimsy. The artist's alter ego, *ignotus mago* (the *unknown wizard* in its Latin form), imagined the digital realm as an ever-shifting supernatural world of shadows and illusions. While Hertz's "igno" world is one of dizzying contradiction, it is also one of improvisation. Language and forms, be they textual, musical or visual, are continually interwoven. Once you are following his theoretical trail, he suddenly shifts, moving toward mixed and multidimensional media forms (as seen in his performance works).



United States Army Ballistic Research Laboratories, *Trajectories of a Ricocheting Projectile*, 1964. Computer-generated, graphed on an Electronic Associates, Inc. Dataplotter. Courtesy of the U.S. Army Research Laboratory.

Hertz's generative image making system produces excesses that seem to overflow and bamboozle the senses. Works from *The Book of Falling Silent* best illustrate the artist's ever modulating field, one built on the changing frequencies of the human voice. Here the artist embraces the errors and slips that continually infiltrate the analog and digital world. The glitch, that an unexpected error or behavior of an electronic device becomes the method for form creation. Glitch art, now a burgeoning subgenre in digital art, sees artists exploiting the error as a way to explore new dimensions of our digital experience. Indeed, the idea to make art using the computer originated from a glitch. A. Michael Noll, the renowned engineer from Bell Labs, began making computer-generated imagery in 1962 in response to an accident that occurred when the intern Elwyn Berlekamp's microfilm plotter produced an unusual linear design.(7) The results from Noll's experimentation resulted in the first exhibition of computer art in 1965 at the Howard Wise Gallery in New York (it is worth noting this year marks the 50th anniversary of that ground-breaking exhibition). The artists in this exhibition have been taking advantage of the chaotic and surprising results of the machine error ever since.

The artists in this exhibition share many commonalities, which are appropriately reflected in the exhibition's title *all.go.rhythm*. They all work algorithmically, employing the incredible procreant powers of computer programming. They also share an aesthetic based on complex abstraction, with compositions made almost entirely from richly oscillating fields of linear geometry. But what makes these artists so important to the history of art is their unyielding experimental mode of practice. Through a shared desire to reconfigure and reshape coded media, this group of artists shifted the boundaries of the digital medium. Interestingly, each approach varied. The Bangerts successfully humanized early computer art by introducing a mark that mimicked the bodily gesture of the artist. Such an organic mark made possible the motif of the landscape. Building on a tradition of biological form, Verostko took an immensely innovative technical step by simulating the complexity of the calligraphic line and instilling in the medium new modes of mysticism and ideas from ancient cultures. Through his complex mathematical configurations, Hébert pushed the medium to its outer extremes by producing miraculous linear feats with an array of printing technology. Hertz took the ultra rationalist tenor of the digital media and injected it with humor and the absurd. He saw the error, with its inherent expressive ambiguities, as a generative engine to structure his response to the world. Together, each artist of *all.go.rhythm* has yielded highly experimental practices that probe the very heart of the digital medium, and in doing so have created an art that continually evolves and shifts.

(1) Edmund C. Berkeley, "The Computer and Art," Computers and Automation (August 1963): 3.

(2) Kurt Vonnegut, "EPICAC," Collier's Weekly (November 25, 1950).

(3) Grant D. Taylor, "Up for Grabs: Agency, Praxis, and the Politics of Early Digital Art." In Lateral (The Journal for the Cultural Studies Association) Edited by Katherine Behar and Silvia Ruzanka (Issue 2. 2013 May).

(4) Judy Malloy, Women, Art and Technology, ed. Judy Malloy, (Cambridge, MA: The MIT Press, 2003) 7.

(5) Grant D. Taylor, "Linearity and the Algorithmic Search." In The American Algorists: Linear Sublime. Exhibition catalog, Annville, PA: Suzanne H. Arnold Art Gallery, Lebanon Valley College, 2013.

(6) Taylor, "Linearity and the Algorithmic Search."

(7) A. Michael Noll,"The Beginnings of Computer Art in the United States: A Memoir," Leonardo, Vol. 27, No. 1, (1994), pp. 39-44.

Colette Bangert

During the 1930's Jeff grew up in Fargo, North Dakota and Colette in Indianapolis, Indiana. In 1958 they met while driving from Boston to New York City. Jeff was a mathematics major and learning about creating visual art at Harvard Collage. After a five year BFA painting program at Herron School of Art, Indianapolis, Colette received a MFA in painting and drawing from Boston University. They married in Evanston, Illinois in 1959 and moved to Grand Forks, North Dakota. Jeff earned a BA in art and mathematics from the University of North Dakota. They moved to Topeka, Kansas in 1962 and then to Lawrence, Kansas where they still live and work.

The place they lived together with their personal art and mathematical insights have grown their collaborative art practice. Visual art, technology, computers, and the Midwestern landscape became their connection and way to understand and be in the world.

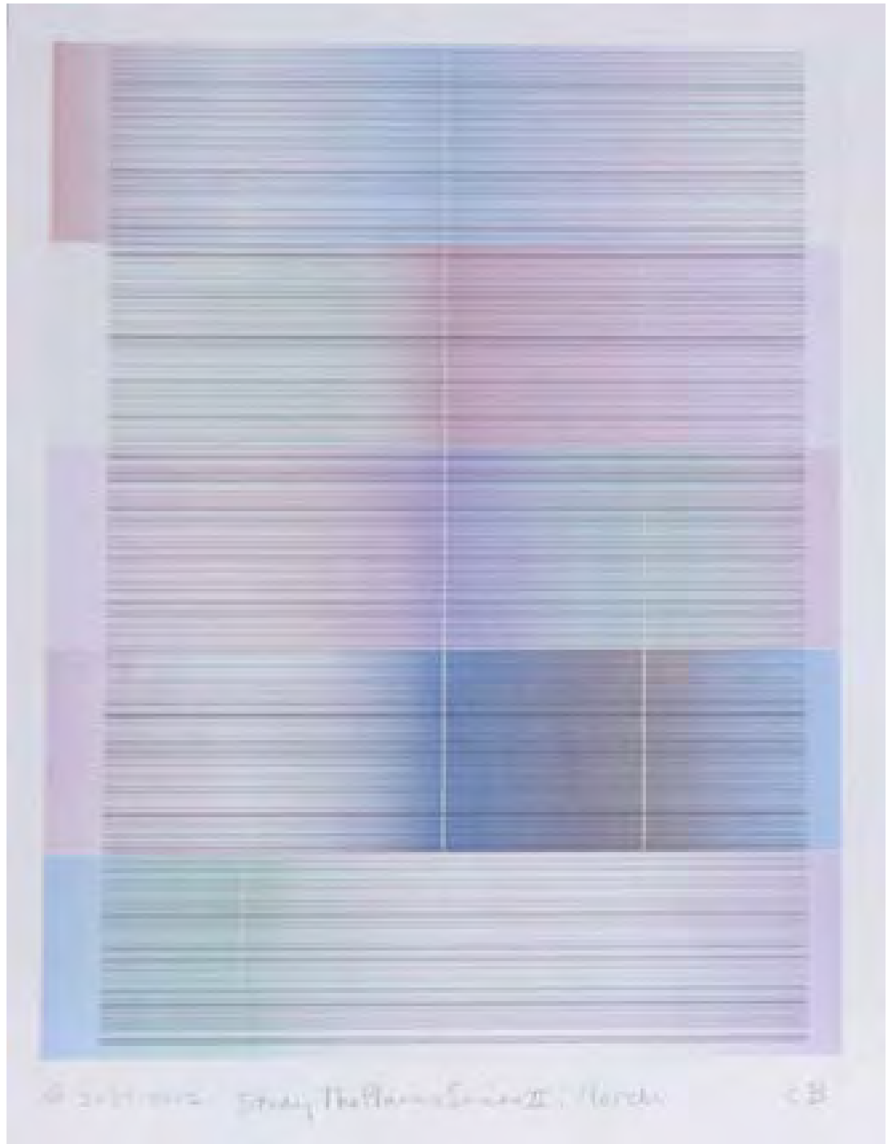
Their work is in the collections of: The Mulvane Art Museum, Topeka, Kansas; Museum of Modern Art, NYC; Spencer Museum of Art, University of Kansas, Lawrence; Sheldon Gallery, University of Nebraska, Lincoln; Victoria and Albert Museum, London, England; and the Block Art Museum, Northwestern University, Evanston, Illinois.

Curator's note: Colette Stuebe Bangert and Charles Jeffries Bangert collaborated on computer-generated algorithmic art over many decades and signed their work "CB." Colette Bangert has also created watercolors, drawings and tapestries, which she signs "CSB."

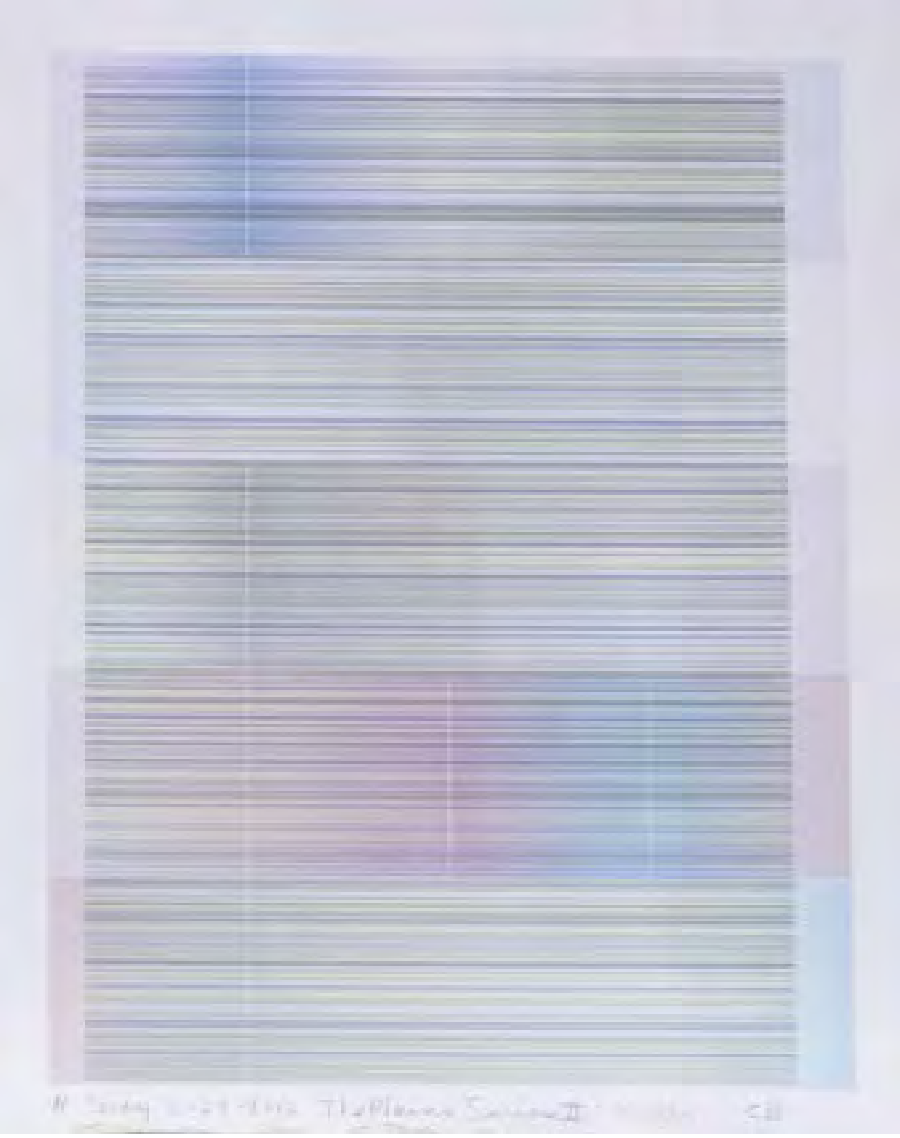
Colette Bangert, *The Field: Bright* , 2014, Thread, Cloth, Yarn, 54 x 41 in.

Colette Bangert , *The Field: Greening*, 2014, Thread, Cloth, Yarn, 54 x 41 in.

Colette Bangert, *Field Colors: Horizonal And Vertical* , 2015, Thread, Cloth, Yarn, 53.5 x 42 in.



Colette Bangert , *G 2-23-2012 Study The plains series II: March CB,* Computer, plotter, colored ink jet prints on paper, 11 x 8.5 in.



Colette Bangert, H Study 2-23-2012 The plains series II: March CB, Computer, plotter, colored ink jet prints on paper, 11 x 8.5 in.

Jeff's and my collaborative life has explored what a line can become. Thread, paint and ink are ancient mediums creating hand lines. Algorithmic ideas and computers are newer. A mix of textile, painted art, hand lines, with digital mediums informs our drawings. A painted mark, an ink line, colored thread lines, programmed lines, a line drawn by hand all create the abstract look of our drawn work.

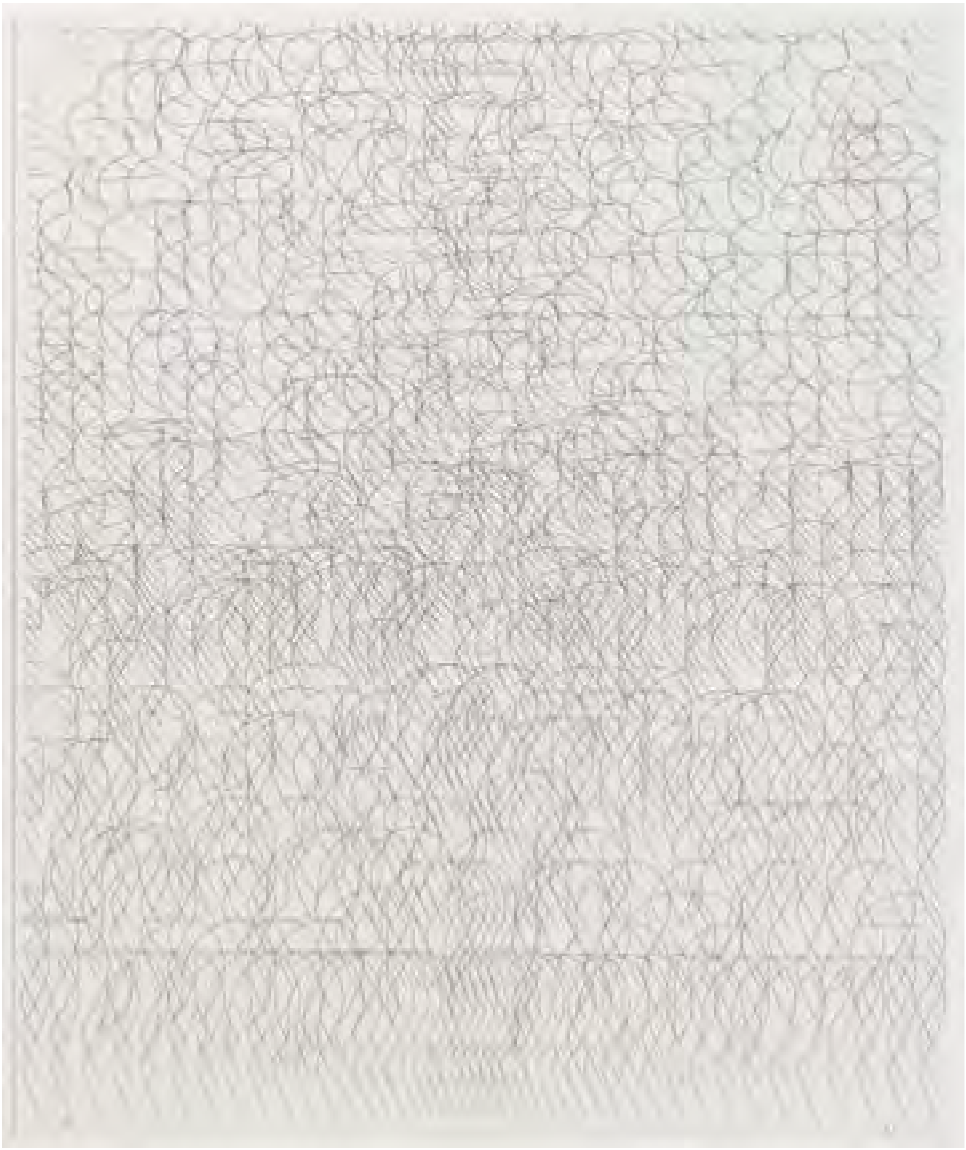
Midwestern landscape as our subject has taken many form variations: leaves as leaves, trees, grass as prairie, fields as land, the flowering and decay, seasons and cycles, garden and desert, personal and collaborative, by hand and digital plotter, intuition and algorithmic, needle, paint, paper, and pen, universal yet common and day to day, abstract yet real, colors and patterns and real lines.

Jeff's mathematics and algorithms have given my work a way to extend the experience of what makes a landscape image signed, titled, and called an example of the art of drawing. My meditative hand drawing practice has given our collaborative war« a deeper understanding of line as form that we both have seen daily throughout our years living in eastern Kansas. Several decades ago I found ways to use thread as colored lines in addition to paint and ink and algorithmic ideas. Real lines as colored thread, cloth, and yarns directly extended what lines can become as landscape lines, just as the algorithmic drawings extended my own working ideas. Just as all the hand work extends what algorithmic drawing can become.

These days the thread pieces, the digital collaborative drawings, the mixed mediums on paper are a result of our daily practice focused on tiny elements which when combined add up to whole images depicting the space we live within between the blue sky and the brown/green earth.

Colette and Jeff Bangert

Lawrence, Kansas
April, 2015



Charles Jeffries Bangert, Colette Stuebe Bangert, *Land Lines I, Densely Curved*, 1970, plotter drawing, ink on paper, 29.25 x 29.5 in.
Mary and Leigh Block Museum of Art, Northwestern University,
Gift of Colette Stuebe Bangert and Charles Jeffries Bangert, 2008.27.7

Jean-Pierre Hébert

Jean-Pierre Hébert (b. 1939 in Calais, France) lives and works in Santa Barbara. From the 70s on, he has pioneered computational drawing and focuses on defining algorithmic drawing processes and translating them into images in traditional and new media. He has been artist-in-residence at the Kavli Institute for Theoretical Physics, University of California, Santa Barbara since 2003, and has been awarded a Pollock-Krasner Foundation award in 2006 and a David Bermant Foundation grant in 2008. In 2012 he received the Siggraph Distinguished Artist Award for Lifetime Achievement in Digital Art.

Hébert has exhibited his work internationally at institutions including the Victoria and Albert Museum (London, UK), the Brooklyn Museum (New York), the Kiasma Museum (Helsinki, Finland), the Block Museum at Northwestern University (Chicago), and the Tweed Museum at University of Minnesota (Duluth); at independent venues including the Santa Barbara Contemporary Arts Forum and Arizona State University (Tempe); at galleries including Galerie Alphonse Chave (Vence, France), SolwayJones Gallery (Los Angeles), and DAM (Berlin); and at conferences including Isea, Siggraph and Imagina.

Hébert has coined the word Algorist and founded the Algorists group with Charles Csuri, Manfred Mohr, Ken Musgrave, Roman Verostko, and Mark Wilson. His work is present in collections including the Victoria and Albert Museum (London), the Brooklyn Museum, the Getty Research Institute, the Block Museum, and the Tweed Museum.

Jean-Pierre Hébert, *Laque Noire (Black Lacquer)*, 1992, plotter drawing, ink on paper, 19 x 19 in.
Mary and Leigh Block Museum of Art, Northwestern University, Anonymous gift, 2008.12.1

Jean-Pierre Hébert, *In Visible Cities : an artist's book,* 16.75 x 11 in.
Digital printing and letterpress on handmade and Niyodo paper, Edition Reese, 2012

Poems and illustrations are inspired and structured by Italo Calvino's text and by John Cage's mesostics.

First, the book title as mesostic line filters and selects proper city names as wing words.
Then, city-name mesostics assemble each poem from snippets chosen in their order of appearance within each city chapter.
Last, fractal timelines animate worlds of lines, colors, and symbols implied by each city character and text properties.

Generative poetry composed by ideas translated into code, deliberate rule breaking through chance or bugs, and digital humor.

A goal without a plan is just a wish
––Antoine de Saint Exupéry

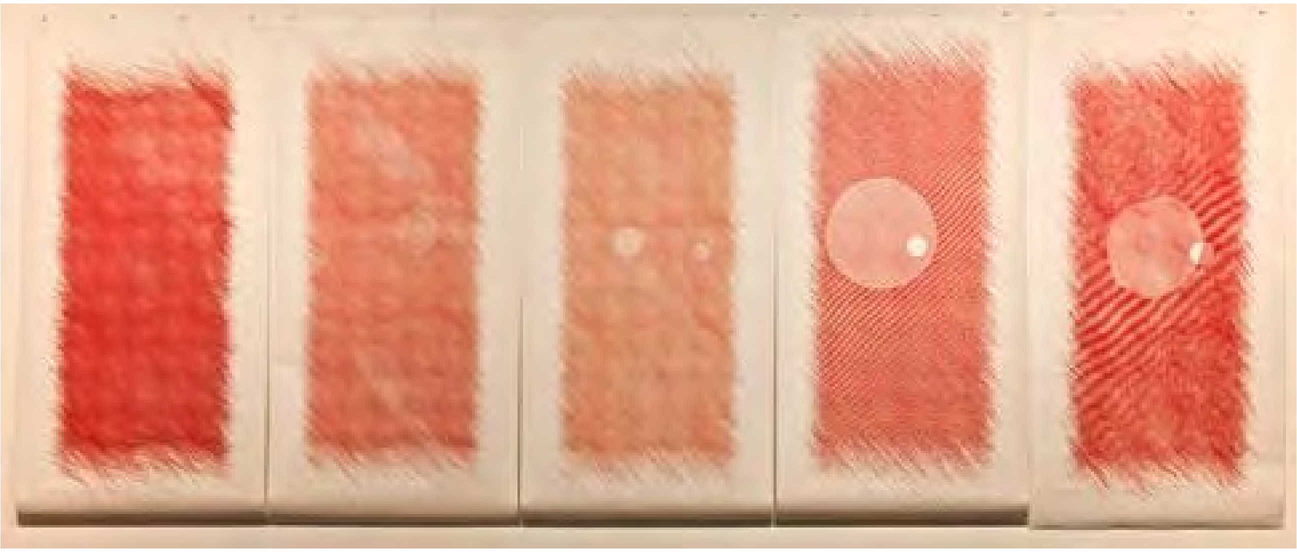
My works are detailed projections in two dimensions of our complex multispectral reality. Or else: abstract miniature landscapes, ephemeral metaphors, derisory reductions, humoresque simulations, algorithmic dreams, traces of chance, tears of physics.

Simple lines, circles, spirals, white paintings, black squares, zen traces, silences, have all to bear witness to the marks, currents, folds, discontinuities, fields, chasms, strangeness met in the higher spaces visited prior to their invocation in a drawing. Their shapes so altered, they reveal my understanding, my perception, my experience of our physical universe, as it intersects with my daily life, with my affective, intellectual and spiritual concerns. And vice versa, the other way around.

These drawings are my poetry, and I love all that inspires me to create them.

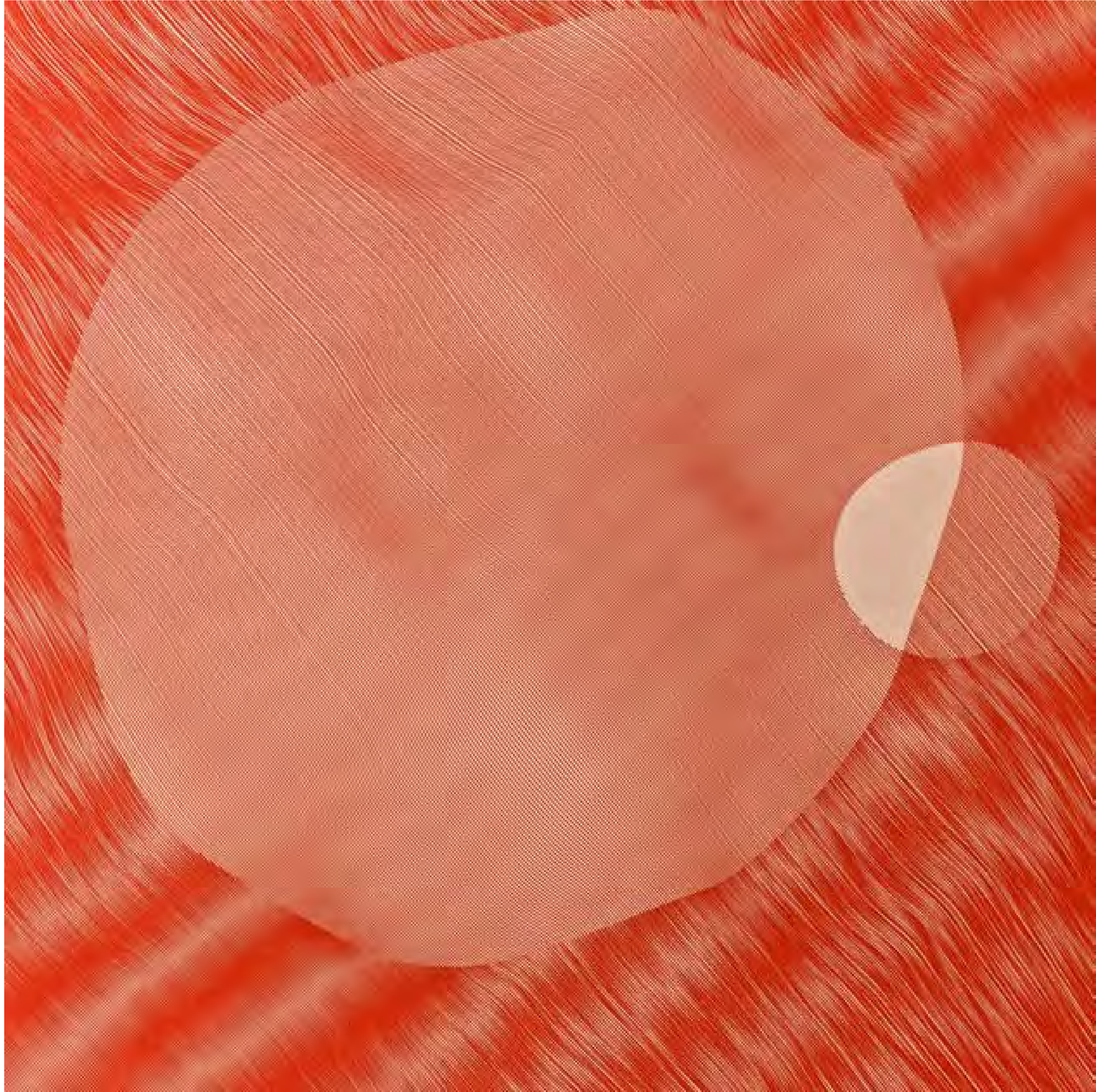
(The mathematics and computations involved in the process are in fact irrelevant and accidental, just tools of our age. As aptly noted by Anne Spalter, I would do the same works with other tools. Poetry is important, tools are insignificant. But it has been propitious that my tools have been harmoniously coherent with my search.)

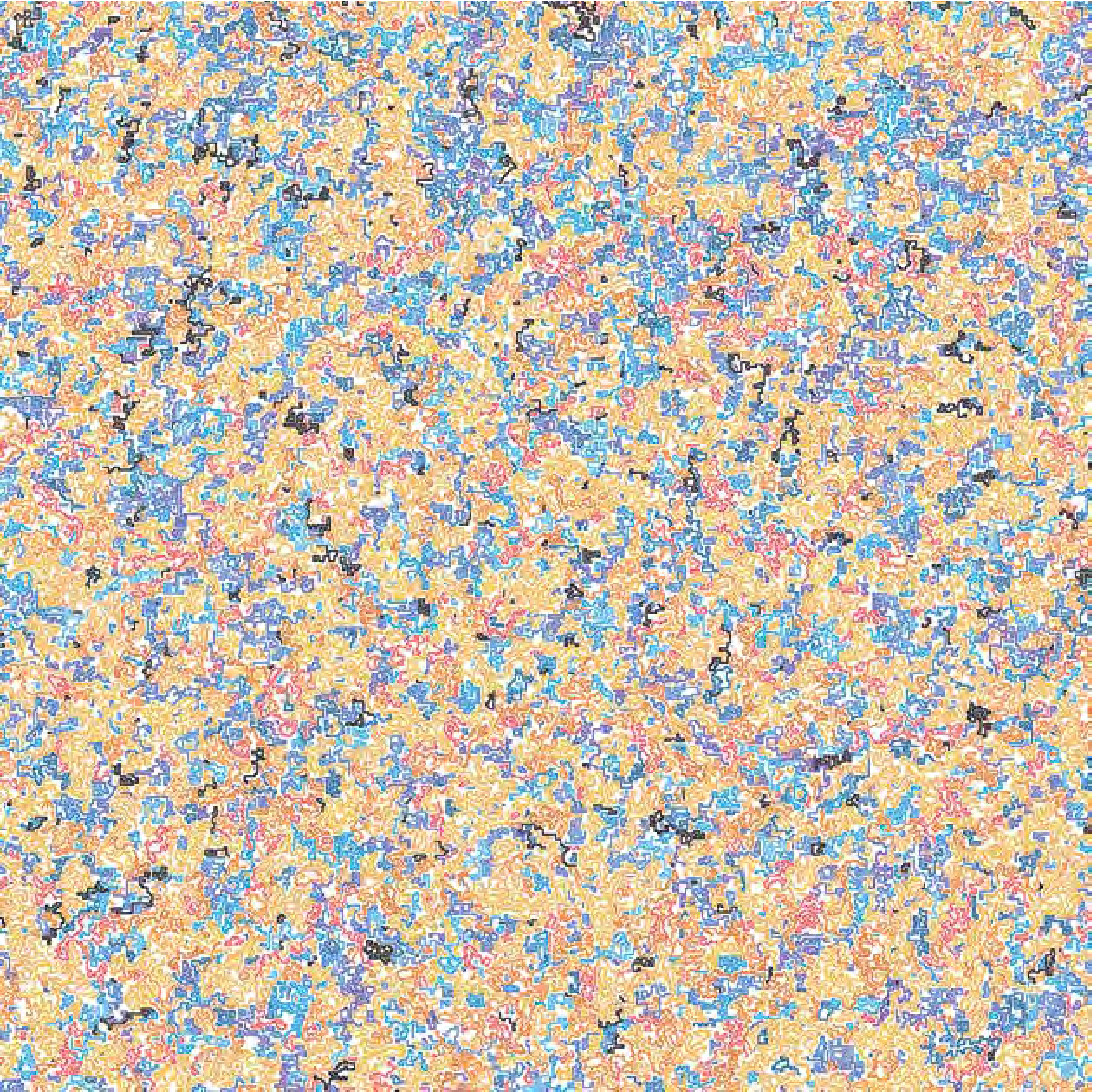
––Jean-Pierre Hébert, Santa Barbara, November 2011



Jean-Pierre Hébert, *Bright Wavelets en Camaïeu Vermilion*, 2008
Digital drawings, inkjet pigments on Torinoko paper
76"x190" total (5 panels 76"x38" each)

Just Enough Chance – All the elements and details combining into these five panels have called upon Chance. The interfering lines, the underlying waves, the vermillion hues, the willful drawing imperfections are the result of Chance, but not totally. Chance is tamed, and its actions are limited within reason so as it will always surprise me, without ever disappointing me.





Jean-Pierre Hébert, *Six Transitions of Four Palettes Two by Two*, 2015, (detail on the left), archival pigment print, 6 panels, each 6 x 3 feet.

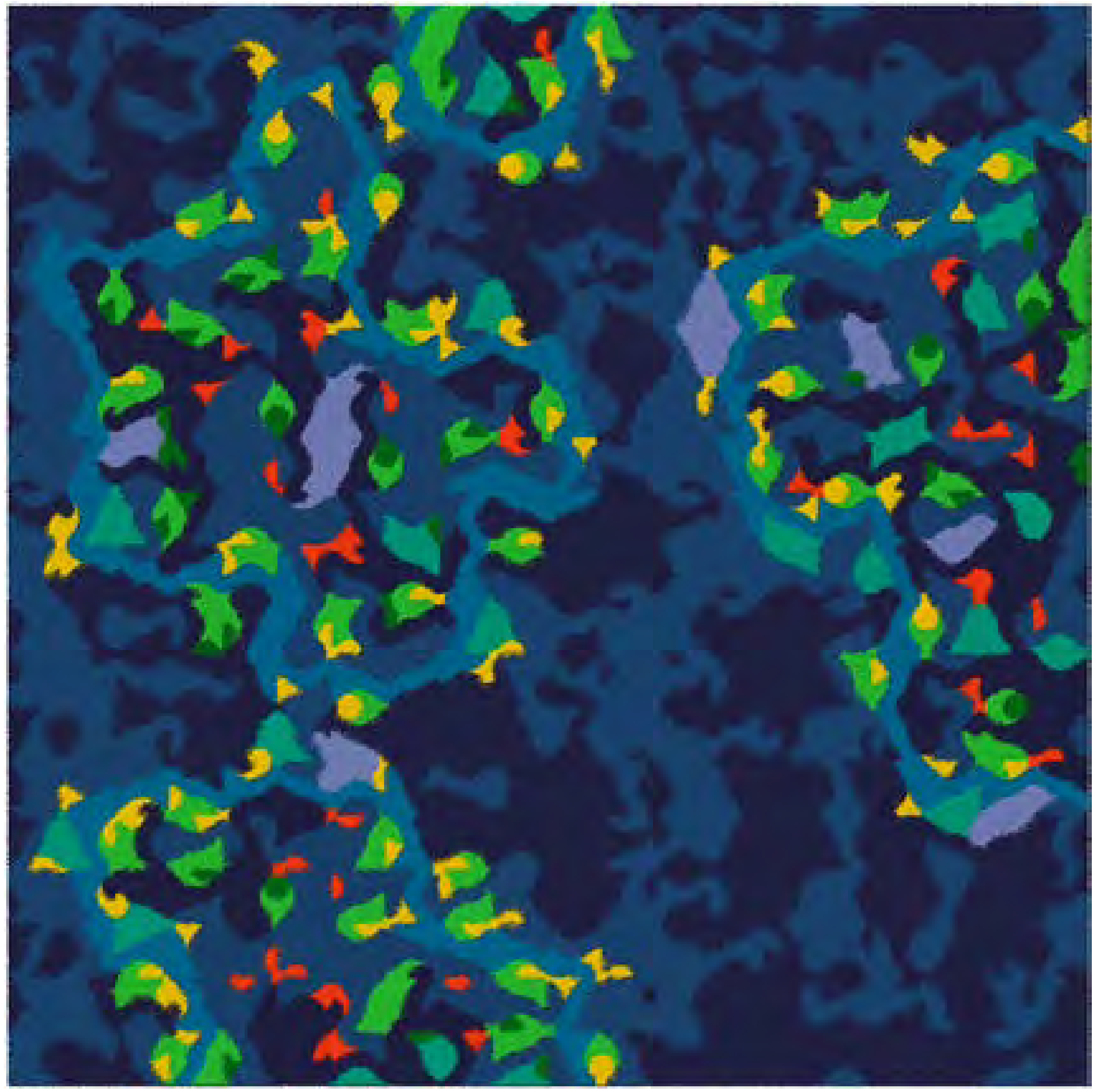
These panels are not open windows for the viewer's eyes, they are objects for the viewer's mind. They reveal not what I see in Nature, but what I think about Nature. They have to be approached and thought about at different distances and scales.

Combinatorics frame the investigation and provide a sense of completion – Arrangements of four palettes, two by two: six combinations, six panels. Each palette appears three times. Three subsets of two panels will include the four palettes.

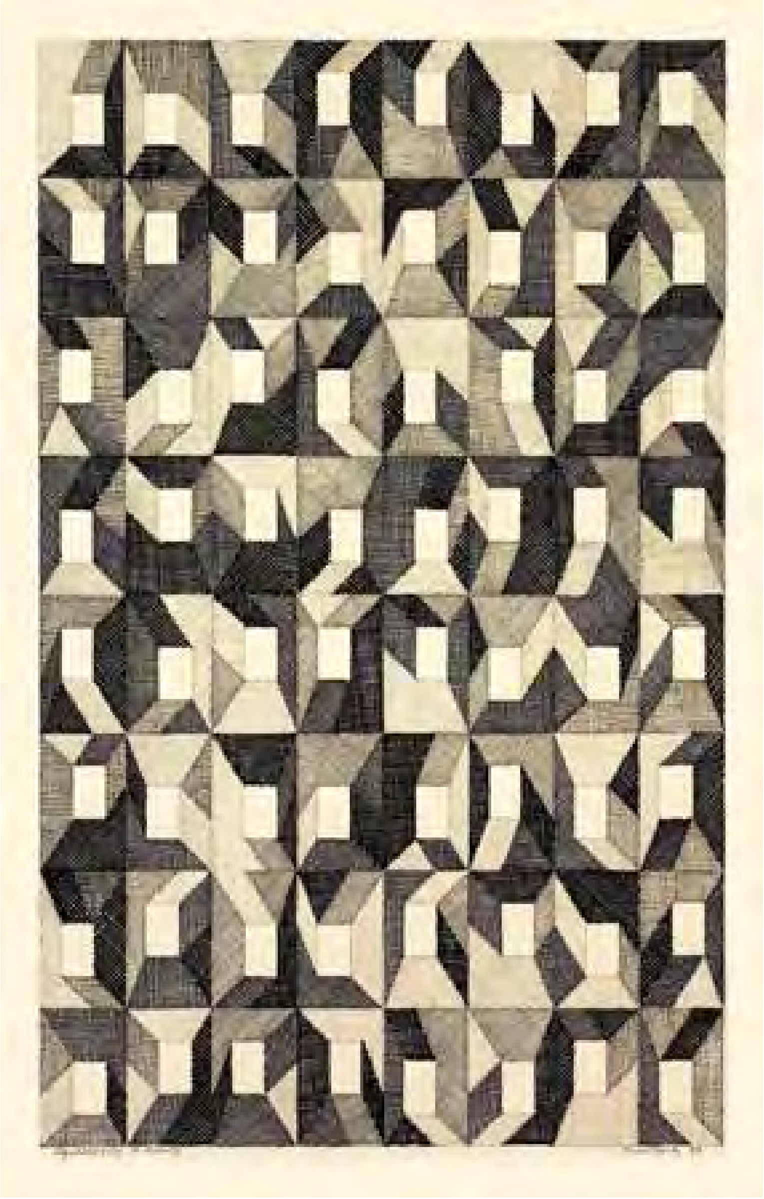
The population of short stringlets making up the six panels is roughly equivalent to that of the New York or Los Angeles metro areas. Each stringlet has its own genome defining its size, shape, color, behavior. They all must keep their distance from their neighbors and never touch them as they fill the space.

Paul Hertz

Paul Hertz is an independent artist and curator who teaches art history and studio courses in new media at the School of the Art Institute of Chicago. He has worked with computers for over thirty years. In 2014 he curated the group show "glitChicago" at the Ukrainian Institute of Modern Art. Other curatorial work includes "Imaging by Numbers" at the Mary and Leigh Block Museum, Northwestern University, 2008; "Second Nature," UIMA, 1999, and "La Finca: The Homestead," Universidad Politécnica de Valencia, Spain, 1995. From 1992 to 2009, Hertz worked at Northwestern University, where he developed software for the Collaboratory Project, taught new media and virtual reality courses, and served as co-chair of the Center for Art and Technology (2003-04). His free software "GlitchSort" has been widely used in the glitch art community. He delights in dysfunctional fortunetelling, faux symbolism, intermedia, code sourcery, glitching and social interfaces. His work has been exhibited in many international media festivals and other venues, most recently in Porn to Pizza, a group show at DAM Gallery, Berlin.

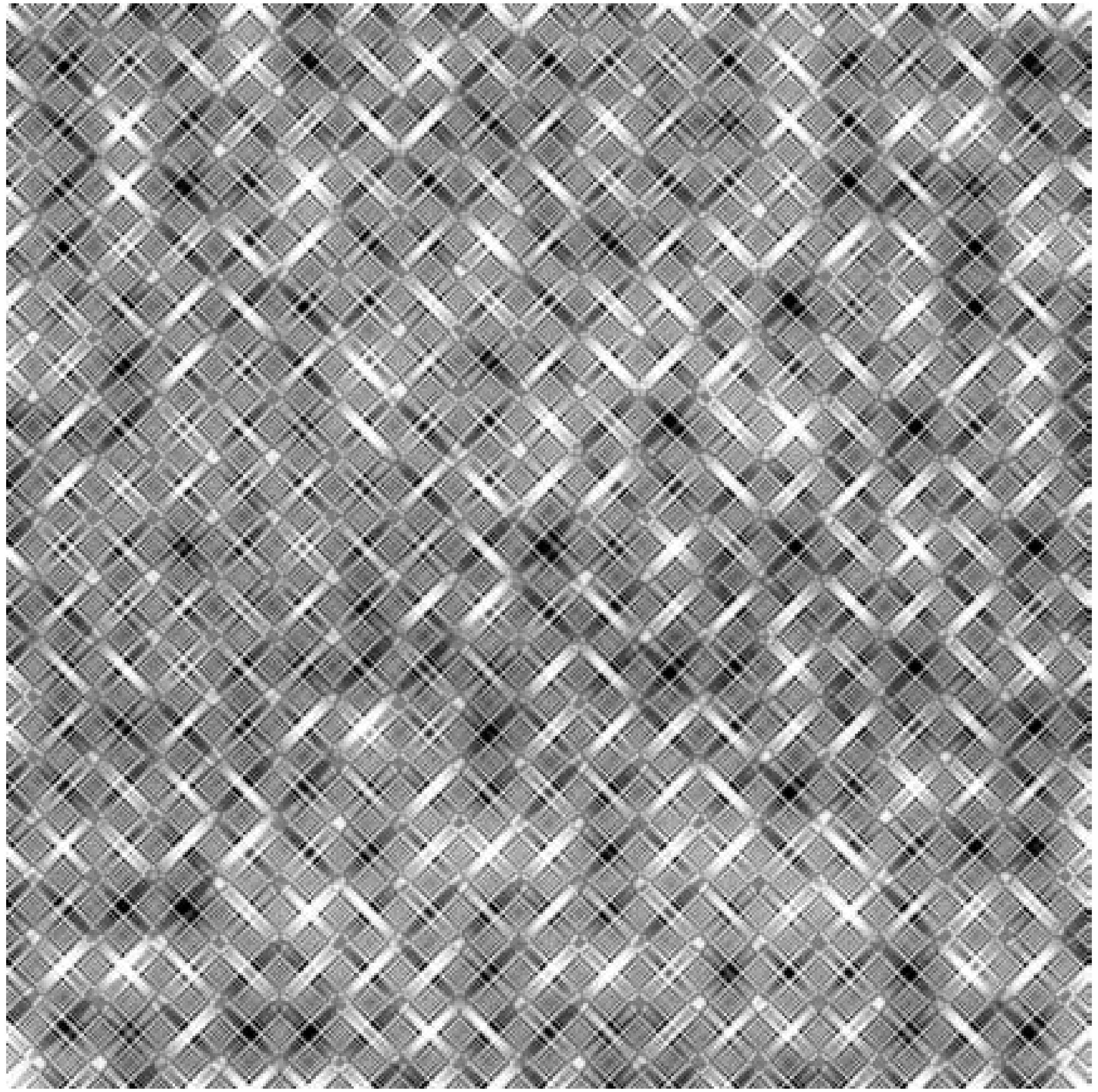


Paul Hertz, *Criadero,* from the series *Recordatori,* 1999, printed 2009, Inkjet print, 24 x 24 in.
Mary and Leigh Block Museum of Art, Northwestern University, gift of the artist, 2009.11

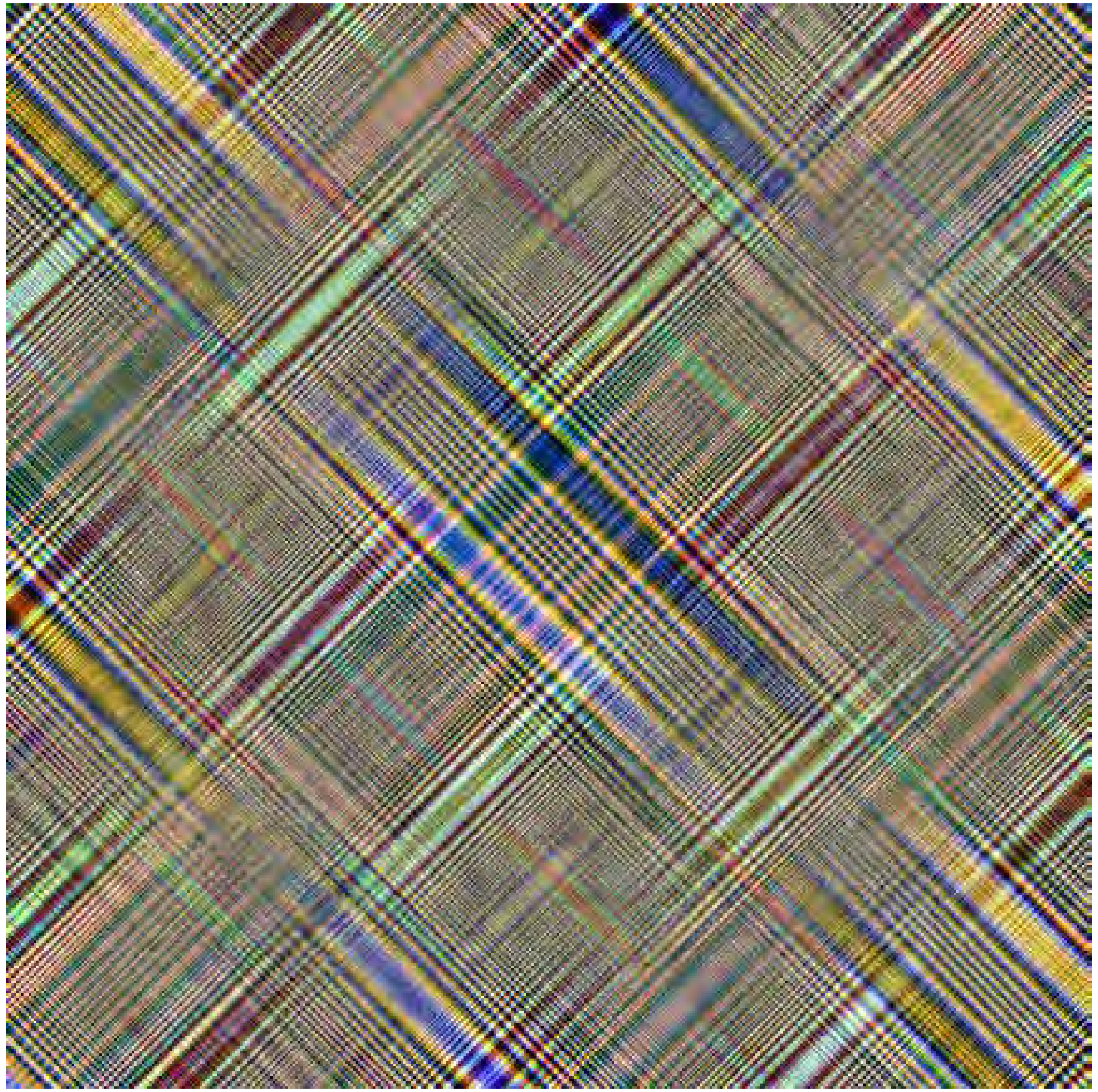


Paul Hertz, *Aiguabarreig*, 1979, Ink drawing on paper, 17.25 x 12.5 in.

Paul Hertz, *Land Lines*, 2012 - 2013, Archival pigment print, 10 x 37 in.



Paul Hertz, *I as in bit, from The Book of Falling Silent*, 2015, Archival pigment print, 18 x 18 in.



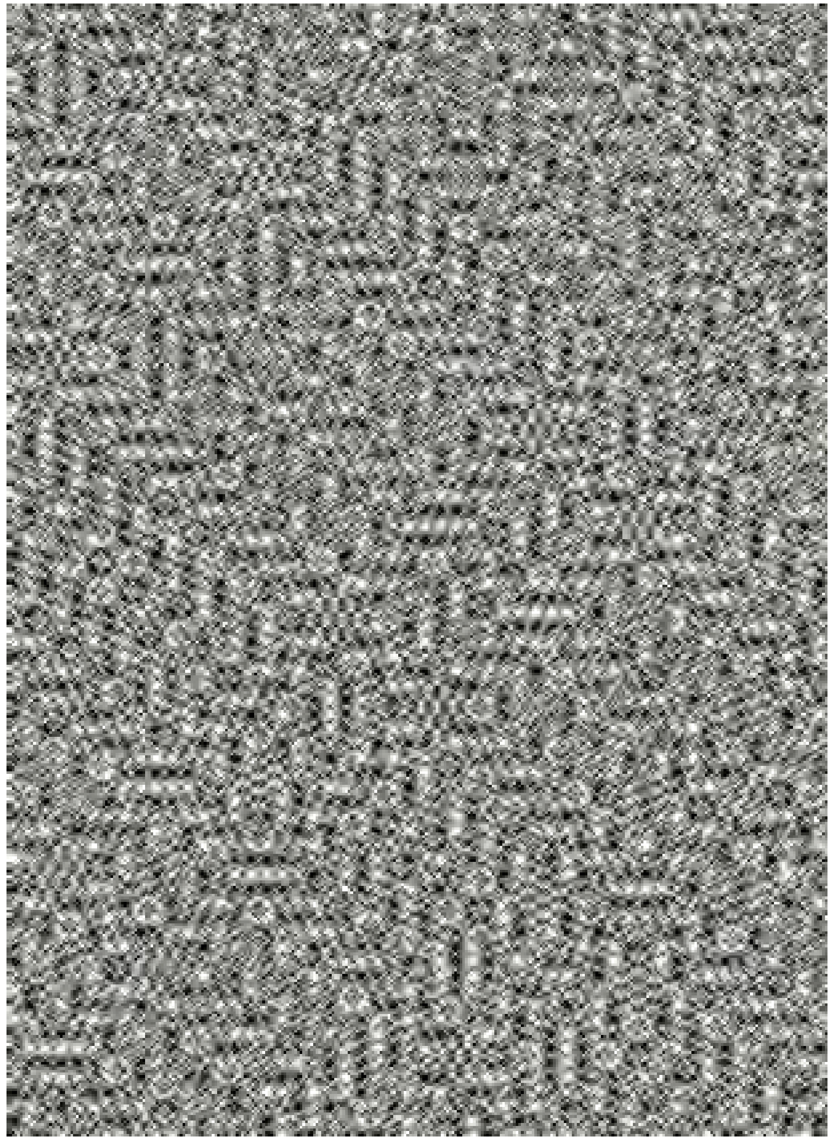
Paul Hertz, *Rabbit Function Two,* from *The Book of Falling Silent*, 2015, Archival pigment print, 18 x 18 in.

Some core ideas have driven my work over several decades: the blending of visual and musical art, audience participation and interaction, and the power of DIY communities. Early on, while living in Spain, I collaborated with actors and musicians and created a rule-based intermedia generative system. One component of the system was a deck of homemade punchcards that I used for creating patterns for music and painting and for performances as Ignotus the Mage, a fortuneteller who can only see the present. In Chicago, these experiments led me to computer programming and interaction design and to discovering a community of artists working with digital media.

My work draws on contemporary media trends such as glitch and on earlier algorithmic art. I work with rules, but I muddy formal precision with error, noise, and arbitrary symbolism. The media I use vary. Digital printmaking is a core practice, as is writing software for algorithmic art and interactive multimedia installations. My free glitch software, GlitchSort, and my Processing library, IgnoCodeLib, are popular with digital artists. I have experimented with virtual reality and electronic music, and studied jazz improvisation, which has become increasingly important to my understanding of art.

I have been an active participant in and curator of Chicago's new media and glitch art scene. My work as a curator has pushed my work as an artist into new territory and given me a role as an art historian of new media. I have taught for several decades at local universities and the School of the Art Institute of Chicago. I imagine myself in the future working with online art communities, developing media and software that is responsive to the social, creative, and critical capacity of people working together.

Of the works I have on display in all.go.rhythm, Aiguabarreig and Criadero are products of the generative system I created in the early 1980s, which I call ignoTheory. Land Lines, an hommage to the work of Colette and Charles Bangert, was produced by tracing the paths of simulated flocks of birds. The works from The Book of Falling Silent were produced by using the frequency spectrum of human vowel sounds to generate images. My performances as Ignotus the Mage have been in my repertory since 1979. "IgnoGumbo," a performance shown on opening night with Ei Jane Janet Lin as the Mage's Apprentice, is a new intermedia work created especially for all.go.rhythm.



Paul Hertz, *Little Sister of the Rainbow*, from *The Book of Falling Silent,* 2015,
Archival pigment print, 63 x 42 in. Collection of Robyn Farrell and Drew Roulo.

Roman Verostko

Roman Verostko (1929), who pioneered coded procedures for expressionist brushwork, is also known for his richly colored algorithmic pen & ink drawings. Schooled as an illustrator at the Art Institute of Pittsburgh (class of 1949), he has been active as an exhibiting artist since 1953.

He began working with electronically synchronized audio-visual programs in 1966 exhibiting his "Psalms in Sound & Image" at Marymount Manhattan College in 1967. As a Bush Fellow at MIT in 1970 he set out to "humanize our experience of emerging technologies". In 1970 he studied FORTRAN at the Control Data Institute and exhibited his first fully algorithmic work, "The Magic Hand of Chance" in 1982. This program, written in BASIC, grew into his master drawing program, HODOS, generating art with both ink pens and brushes mounted on drawing machines. The front and end pieces for his 1990 limited edition of George Boole's "Derivation of the Laws…" demonstrated the emerging power of generative art. Twenty years later, his "Algorithmic Poetry" exhibition celebrated "generative art" as visual poetry (DAM, 2010). He is currently working on his archives and experimenting with 'mergings' of hand & machine.

Verostko's algorithmic work is distinguished by his efforts to merge fine arts traditions with electronic arts practice. As Director of the 4th International Symposium on Electronic Art (1993) he focused on the "Art Factor" as the critical core in merging new technologies with the arts.

Roman Verostko
Untitled painting, 1989
Robotic, HI DMP52 plotter, brush, watercolor & black ink.
23 x 38 in.

The artist experienced rejection and disbelief that his brushwork was executed with his code driving a drawing machine. Repeating the same expressive stroke, rotated and scaled, this painting demonstrated one of the many features of the algorithmic leverage.

Algorithmic Poetry

My generative work is rooted in the tradition of early 20th Century artists who sought to create an art of pure form. Influenced by pioneers like Malevich and Mondrian, my pre-algorithmic work turned to the new reality, a non-descriptive art with a life of its own. This quest for "pure form" has dominated my work for 60 years.

In 1970, following a course in FORTRAN at the Control Data Institute, I experienced the "form-generating" leverage of algorithms executed with computing power. The advent of personal computers brought that leverage to my studio where I spent endless hours coding routines I viewed as my "score for drawing", a score I adapted to guide both brushes and ink pens.

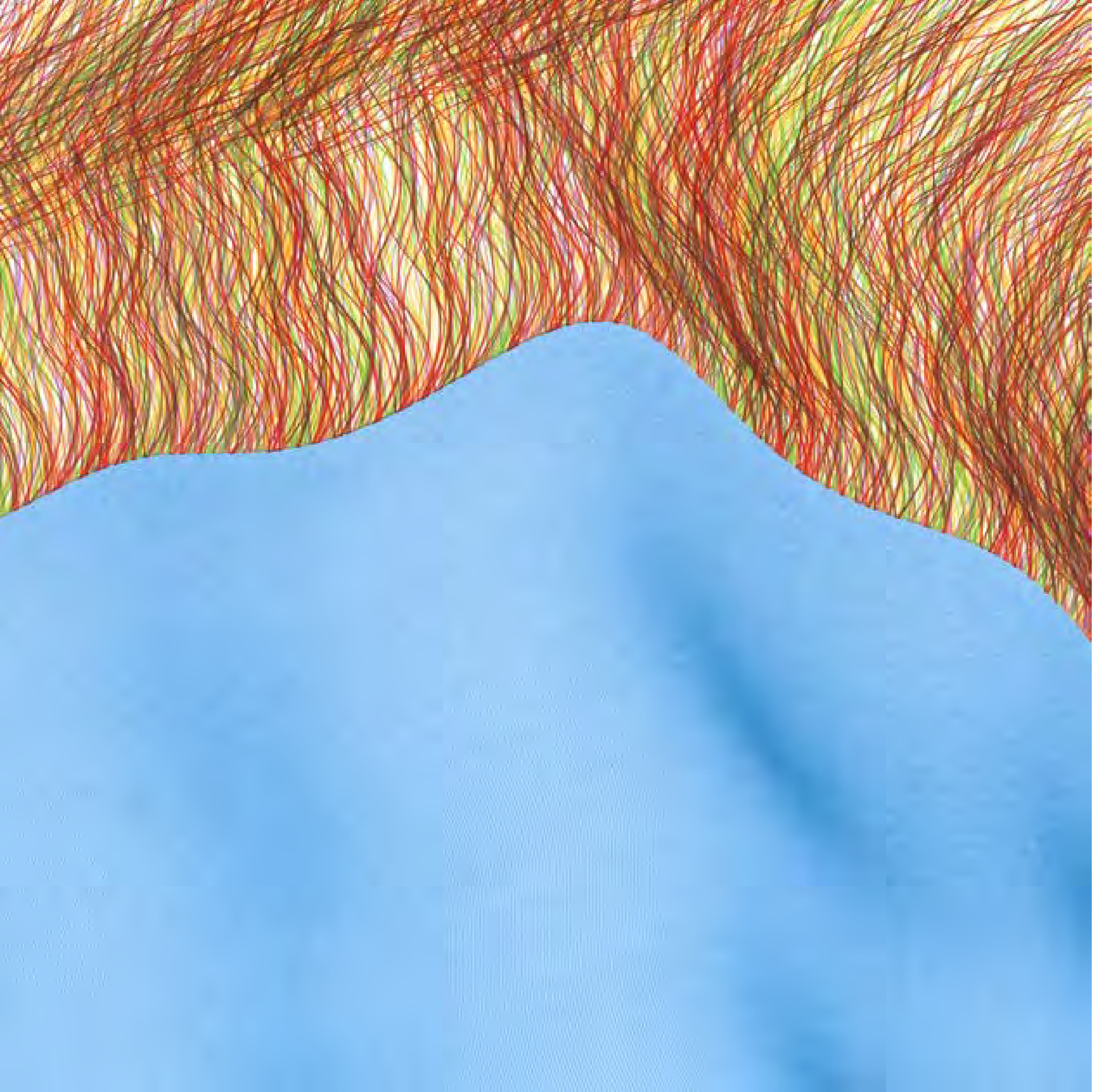
The "form-generators" in my master program grew from 30 years of experience as a painter. For me these coded procedures opened new form frontiers that I could never have visualized without computing power. These art forms do not describe or refer to other realities - rather they themselves are the "realities" with a visual life of their own. They celebrate the code by which they were generated.

Roman Verostko 2015

Roman Verostko
Ezekiel Series: Vision2, 1993,
Robotic, pen, ink and brush with an
HI DMP plotter.
32 x 38 in.

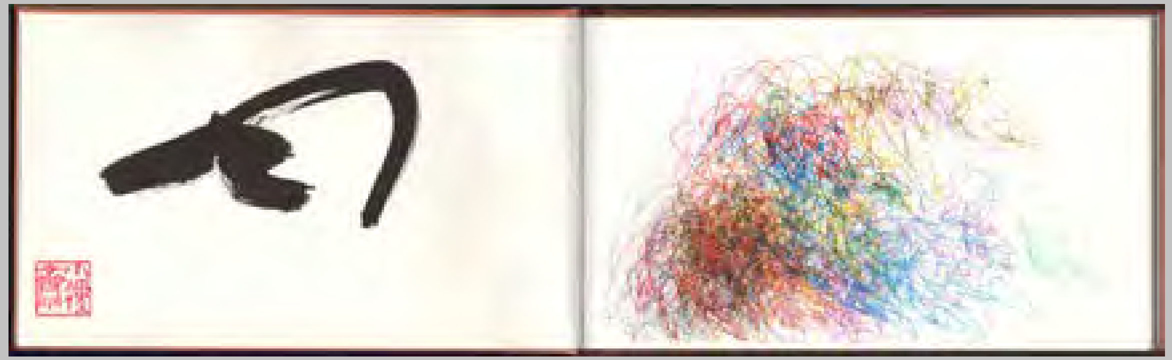
Gold leaf by hand identifies the master stroke, mirrored on both the X & the Y axis. Peter Beyls likened this information as the DNA for this work. Every pen & ink stroke and the two brush strokes were generated with the same information controlling the illuminated mirrored stroke. The same information, at a larger scale controlled the distribution of the pen stroke clusters while the more geometric figure distributes the pen strokes on the spline of the Bezier curve controlling the stroke.

The self-similarity of "a stroke within a stroke" evoked the O.T. Ezekiel vision of a "wheel within a wheel".



Roman Verostko
Flowers of Learning Series:
Shakespeare: In memory of Sister
Mary Eunice Rasin
ca. 2006
(detail on the left)
Pen and ink plotter drawing
40 x 30 in.

I know a bank where the wild thyme blows,
Where oxlips and the nodding violet grows,
Quite over-canopied with luscious woodbine,
With sweet musk-roses and with eglantine.
Shakespeare - A Midsummer Night's Dream



Roman Verostko, *Derivation of the Laws*, 1990
Three books from limited edition as Homage to George Boole for his contributions to symbolic logic underlying the information revolution. The illustrated text is an excerpt quoted from "An Investigation of the Laws of Thought . . ." by George Boole (St. Sebastian Press, 1990 ISBN I879508-08-7). Boole's Investigation was first published by Macmillan, London, 1854.

Roman Verostko, *Algorithmic Poetry: Green Cloud*, 2011. pen & brush, robotic with HIPLOT-6000, 22 x 28 in.
The drawing was coded to begin at sunset and end at sunrise as part of the Minneapolis "White Night" on the night of June 4-5 in 2011. An 8 hour video of the drawing was made beginning with the first pen stroke and ending with the last calligraphic brush stroke. This 8 hour drawing session, projected on the North Three story white brick wall at MCAD, displayed the pen tracing the green lines, as it were, on the wall. A 3 Story Drawing Machine.

Symposium

All.go.rhythm: Communities of Practice

Saturday, October 3, 2015, 2:00–5:00 pm

2:00 pm Opening remarks, Paul Hertz
2:10 pm Presentation, Grant Taylor
2:30 pm Presentation, Debora Wood
2:50 pm Presentation, Paul Hertz

3:10 pm Break

3:30 pm Round Table with artists Colette Bangert, Jean-Pierre Hébert, Paul Hertz, and Roman Verostko, and authors Grant Taylor and Debora Wood, moderated by Grant Taylor
4:30 pm Open discussion
4:50 pm Closing remarks, Paul Hertz

The artists in all.go.rhythm developed their work in the context of various communities: schools, universities, professional organizations, commercial and independent galleries, and networks of friends and colleagues. The symposium will discuss the origins and development of computer-mediated algorithmic art and the work of the artists exhibiting in all.go.rhythm in the context of the many communities that supported (or thwarted) algorithmic art/digital art/new media art. We are particularly interested in how non-artists contributed to these communities and influenced the work of the artists, and in how artists and non-artists enabled systems of exhibition and distribution for experiencing the artists' work.

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Performance

At the opening reception Friday, October 2, 2015 at 7pm

Paul Hertz as Ignotus the Mage with Ei Jane Janet Lin as the Mage's Apprentice. Music and text by Paul Hertz, with improvisation by both performers. Chicago-based performance/video artist Ei Jane Janet Lin teaches at School of the Art Institute of Chicago. She also freelances as an illustrator with 2-D collage works, and creates soft fiber sculpture and wearable projects.

The performance Ignotus the Mage is part of my oldest generative system. It is algorithmic art made without a computer, and a play on the very human tendency to create symbolic meaning everywhere. I designed pattern-making cards and the character of Ignotus the Mage, Dysfunctional Fortuneteller, in Vilanova i la Geltrú, Spain in the late 1970s. I have used the generative system for creating images, music, virtual worlds, interactive multimedia installations, and performances. In the 1980s in Chicago I created various computer-driven versions of the card game. See http://paulhertz.net/mage/ for more information.

Exhibition curated by **Paul Hertz**
Essays by **Paul Hertz, Debora Wood and Grant D. Taylor**
Catalog design by **Stanislav Grezdo**
Cover image: **Charles Jeffries, Colette Stuebe Bangert**, *Land Lines I, Densely Curved*, (detail) 1970, Mary and Leigh Block Museum of Art, Northwestern University
Illustration image on page 2: **Roman Verostko**, *Ezekiel Series: Vision2* (detail), 1993
Illustration image on page 4: **Jean-Pierre Hébert**, *Heptagonal Spiral,* 2012, Ephemeral digital drawing on sand, 32 x 32 in.

Special Thanks to:
Mary and Leigh Block Museum of Art, Northwestern University
Carl & Marilynn Thoma Art Foundation

Catalog produced for the exhibition:
all.go.rhythm
idea>>machine>>art
October 2 - November 29, 2015
at the

Ukrainian Institute of Modern Art (UIMA)
2320 West Chicago Avenue, Chicago, IL 60622
773.227.5522
www.uima-chicago.og

UIMA was created in 1971 by Achilles Chreptowsky, Konstantin Milonadis, and Mychajlo Urban to preserve and promote the knowledge and appreciation of contemporary Ukrainian art, and has grown into viable museum in the local community and greater Chicago area, in promoting the arts. Its initial intent as a nonprofit cultural institution was geared toward educational purposes. The wide range of creative exploration in contemporary art, music, poetry presented by the UIMA over the decades is proof of the vitality of its activity and dynamism.

Six major exhibits are held annually in the main gallery which occupies roughly 2100 sq ft, and an adjoining side gallery houses the permanent collection consisting of works of Chicago artists as well as that of painters and sculpture of Ukrainian descent. The third component of the Institute is its archival and research center which through the years has amassed an impressive collection of contemporary works.

Ukrainian Institute of Modern Art is open to the public Wednesday – Sunday, 12 - 4pm.

Thank you for your support: