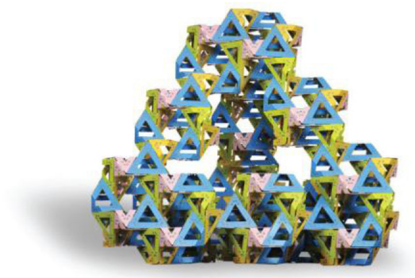
BRIDGES TOWSON

Mathematics, Music, Art, Architecture, Culture

Art Exhibition Catalog

2012

Celebrating the 15th Annual Bridges Conference at Towson University
Towson, Maryland, USA



Bridges

TOWSON ▲ 2012

MARYLAND, USA

Art Exhibition Catalog 2012

Robert Fathauer and Nathan Selikoff, Editors
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BRIDGES TOWSON

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PREFACE

Ten years after a successful Bridges Conference at Towson University in 2002, and after going around the world from Granada, Spain, to Banff, Canada (twice), to London, UK, to San Sebastián, Spain, to Leeuwarden, the Netherlands, to Pécs, Hungary, and to Coimbra, Portugal, Bridges returns to Towson in 2012. Towson University, one of the largest Universities in Maryland, is located in the Baltimore metropolitan area, one of the most visited cities in the US. Established in 1634, Baltimore has an interesting history and provides a rich backdrop for this diverse, interdisciplinary conference.

The International Bridges Conferences, created in 1998 and running annually since, have provided a remarkable model of how to integrate seemingly diverse disciplines such as mathematics and the arts. Here practicing mathematicians, scientists, artists, teachers, musicians, writers, computer scientists, sculptors, dancers, weavers, and model builders have come together in a lively and highly charged atmosphere of mutual exchange and encouragement.

The lasting record of each Bridges Conference is its Proceedings – a valuable and highly regarded resource book of the papers and the visual presentations of the meeting. For this year, the reviewing process was co-chaired by Bob Bosch, professor of Mathematics, Oberlin College, award-winning artist and author, and Douglas M. McKenna, award-winning software developer and mathematical artist and the President of Mathemaesthetics, Inc., Boulder, Colorado. Bosch and McKenna led a diverse program committee of forty experts from around the world in a rigorous review of papers in three categories: regular papers, short papers, and workshop papers. The program committee in turn obtained the assistance of additional expert reviewers. We thank all these many volunteers for their careful work, which made possible this volume you are holding. This is the first year that the program committee chairs have come from outside the Bridges Organization board, and we look forward to continuing and expanding this trend of widening the circle of leadership.

We are very happy to have a series of international figures as keynote speakers, including Nobel laureate John Mather; the president of the International Mathematics Union, Ingrid Daubechies; and renowned sculptors Helaman Ferguson and Brent Collins.

An exhibition of mathematical art has been an annual feature of Bridges since 2001, and it has grown steadily over the years under the dedicated leadership of Robert Fathauer. This year, because of the availability of the gallery spaces at Towson University, we have been able to put together what must be the largest exhibition of mathematical art ever, with one hundred ten artists included. Diverse artistic media are represented, including wood, metal, stone, ceramics, beadwork, and fabric, in addition to a variety of two-dimensional media. Christopher Bartlett, Anne Burns, and Nat Friedman joined Robert Fathauer on the jury. For this year, a portion of the exhibit is being shown as a one-month exhibition at the College of Fine Arts Gallery, curated by Christopher Bartlett.

The Bridges Organization website, including the art exhibition pages, is managed by Nathan Selikoff, who also created the full-color catalog documenting the art exhibition. Ergun Akleman continues his tradition of making an exciting cover for the Proceedings that highlights some of the artwork.

The conference includes many evening events, one of which is a musical concert organized by Dmitri Tymoczko, featuring a combination of new and old music: Bach puzzle canons, Tom Johnson's "Narayana's Cows" (almost a mathematics proof set to music), and three or four new premieres, including a memorial for one of the greatest mathematical musicians of all time. Diane Luchese coordinates the local performers. There is also an informal music night in which conference participants display their musical talents, organized by Vi Hart.

As always, the conference includes an Excursion Day, with a trip to local sites of interest. This year, the excursion features a visit to the Walters Art Museum, which houses the Archimedes Palimpsest. Will Noel, Archimedes Project Director and Walters Curator of Manuscripts and Rare Books, gives a special lecture on this unique mathematical document. At the Baltimore Museum of Art, participants explore the internationally renowned 90,000-work collection. At Fort McHenry, the birthplace of the “Star-Spangled Banner,” William Duffy, who recently created a sculpture there of Francis Scott Key, presents a short talk and visitors can tour the fort. After these three stops, participants visit The American Visionary Art Museum, The Maryland Science Center, or the Baltimore Inner Harbor.

For Family Day, the larger community is invited to join conference participants in a celebration of mathematical ideas with a special emphasis on topics appropriate for a younger audience. The day includes the Third Annual Bridges Short Movie Festival, which will feature a variety of juried and curated videos and short films that have been created for educational and artistic purposes. Family Day also includes a Math/Poetry event featuring works from traditional to multimedia and from lyrical to visual, in which ten poets will read selections from their work. An Experimental Theater event provides a spirited, engaging theater performance that is as rewarding to the audience as it is to the conference participants who volunteer as actors. Family day concludes with a special Mime-Matics Night in which Tim and Tanya Chartier present a mime performance conveying mathematical ideas.

We wish to thank the Office of the Provost, the College of Fine Arts and Communication, and the Jess and Mildred Fisher College of Science and Mathematics at Towson University for support which made the conference possible. We are grateful to the Towson University Mathematics Department for supporting faculty and graduate students attending the conference. Special thanks go to Louis Miller, Joseph L. Schuberth, and Rick S. Pallansch for excellent marketing services to promote the conference. This year's Bridges Conference also celebrates the retirement of Jim Paulsen, one of the scientific organizers, and we thank him for his leadership and support. In addition, we thank faculty who volunteered time to help organize the conference, from various departments in the colleges of Fine Arts and Science and Mathematics. Without all their help, we could not have had Bridges at Towson.

The Bridges Organization
bridgesmathart.org
Board of Directors: George Hart, Craig Kaplan,
Reza Sarhangi, Carlo Séquin


devotion
candles
PLATONIC SOLIDS

EXHIBITING ARTISTS

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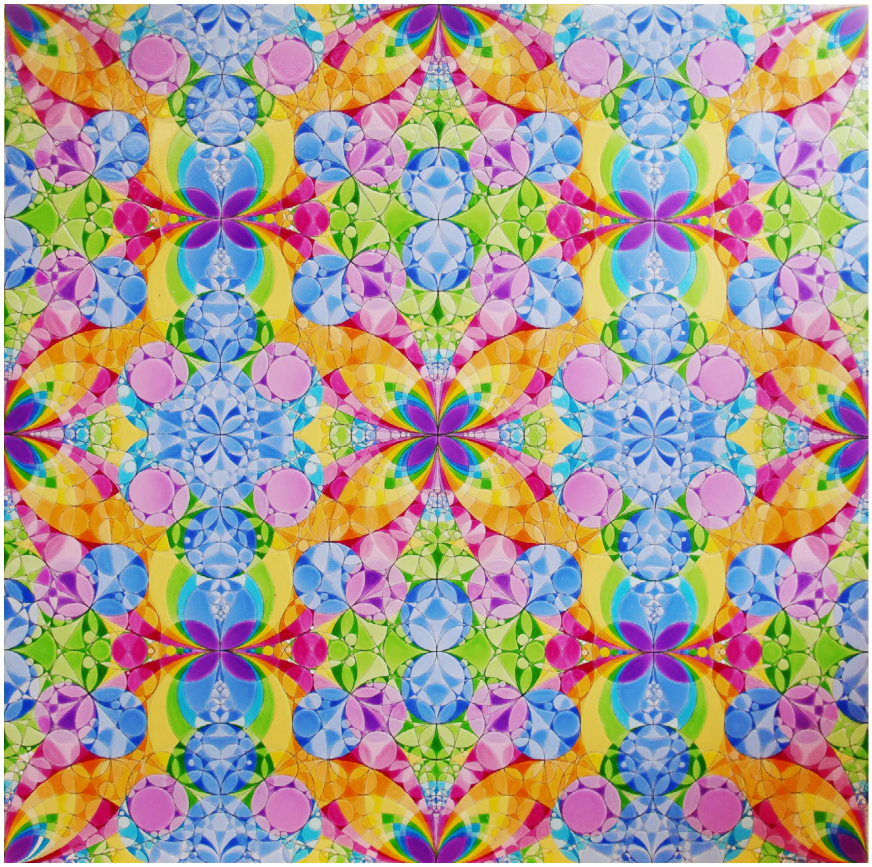
Ascension 2012
24x24 in. print detail of 48x48 in. original
(original) acrylic paint on wood
2012

It is important to note that none of my artwork is computer generated. The basic drawings are all done by hand using simple tools such as a ruler, compass, and circle templates. It can take from six weeks to several months to understand and decipher the concepts behind the drawing, a process which would ordinarily be performed by a computer. I do not use a calculator in order to create these paintings, I use my mind to do the math. The value of this process is that, as the painting is completed, I embody these patterns and concepts and carry them within myself.

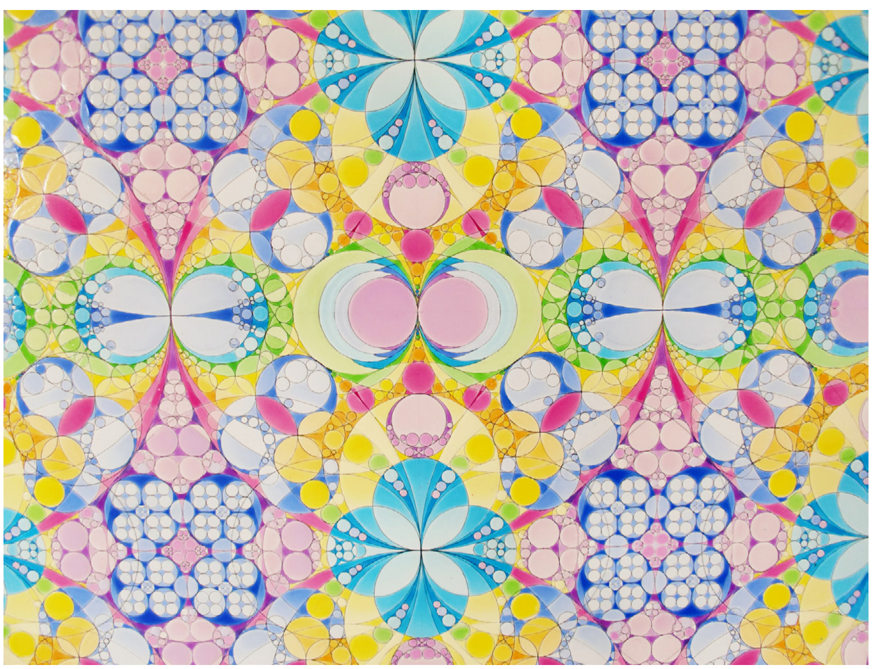
These paintings are more than just decorative colors and patterns. There is a mathematical subject matter, as each painting is based upon an internally-consistent set of rules and stands as a type of "visual equation" or "visual math problem" . The paintings also refer to physics, and the rules which describe and govern the behavior of light waves.

Ascension 2012 • Utilizing elements of both the Mobius Transformation and the 'Rotating Snakes' optical illusion, this painting integrates the human energy field within a matrix of non-physical energy. Humans have an electro-magnetic field which exists congruent to the physical body and comprises such non-physical aspects of self as the mind, emotions, heart, and inner vision. A non-local energy field pervades all matter and the human energy field is but a small portion of that larger pattern which links together everything in the universe and beyond.

Interdimensional Homework 1 and 2 • These paintings were some of my Interdimensional Homework assignments, a series of 3 pieces that were the beginning exploration into overlapping a previously-developed pattern based upon 12" circles with a similar pattern based upon 24" circles. It was truly exciting and eye-opening to discover how the two patterns merged, and especially when the tangential circles that filled an interior space had a whole number diameter. This exploration led me to the next painting in the series, and eventually to a much larger piece entitled "Ascension 2012"



Interdimensional Homework 1
24 in x 24 in
acrylic paint on archival masonite
2011



"Interdimensional Homework 2"
24 in x 24 in
acrylic paint on archival masonite
2011

ELLIE BAKER AND SUSAN GOLDSTINE

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Toroidal Tessellations
12 X 12 inches
glass and sterling beads, thread
2012

Bead crochet bracelets have an allure that is hard to resist. For the wearer, adorned by the firm but pliable packing of beads into a sleek, snake-like skin, the appeal is both visual and tactile. For the crafter, the technique is meditatively repetitive and the bead color and texture choices endless. But for the mathematically minded, the greatest allure is in creating bracelet patterns. Behind the deceptively simple and uniform arrangement of beads is a subtle geometry that produces compelling design challenges and fascinating mathematical structures. We have been collaborating over several years on bead crochet design methods and on a variety of design questions that intrigue us. This project represents one of our forays.

Toroidal Tessellations • Inspired by the tessellated drawings and tiled pillars of M.C. Escher, each bracelet in this series has a pattern consisting of interlocking copies of a single shape in two to four colors. Designing such patterns for bead crochet bracelets is more challenging than designing them for prints or mosaics, both because the bracelet provides a narrower canvas and because the beads form a continuous spiral around the bracelet. This underlying spiral makes it especially challenging to align design motifs. With our original mathematical technique for bracelet design, we have tessellated our bracelets with natural and abstract forms, such as fish, lizards, stars and flowers.

CHRISTOPHER BARTLETT

CONTACT

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Baltimore, Maryland

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Golden Horn, Istanbul
22 x44 inches
acrylic on canvas
2010

My littoral landscapes usually depict foreign locations from sea to shore or shore to sea. An important principle of design and composition is repetition, so creating any structure such that the elements of a painting are aligned within self-similar areas and consequently at repeating measures from each other would satisfy the goal of unity. It is the thread that holds together an otherwise loose tapestry of forms in space and provides a structure of harmonizing ratios of distance. My compositions are based on the golden ratio that has the quality of bringing harmony and unity through self-similarity of proportional divisions to the compositional design. The canvas rectangle can be divided ad infinitum into similar rectangles forming a geometric progression with a ratio of 1:Φ, this being an illustration of the Greek notion of 'dynamic symmetry'. These divisions may be reversed so that long side measures are used on the short side as well as employing squares and symmetrical divisions.

Golden Horn, Istanbul: compositional layout
22 x 44
acrylic on canvas
2010

PETER BANKSON

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Fiber sculptor
Pastor (Servant Leadership Team at Seekers Church)
Retired Army officer (Infantry, Viet Nam veteran)
Seekers Church, Washington, DC
Alexandria, Virginia

S=6∑ (n=0-9) 2^n
15"x15"x6"
Crocheted wool on steel hoop
2011

"Number Theory by Hand"

When I entered MIT as a freshman in 1957 there was an elective called "Number Theory." I didn't know what that meant, so I signed up. But by about the fourth week it was clear that I was too lost to learn very much, so I dropped out. Memories of that unsuccessful encounter hung around for years. I discovered sculptural crochet as I threaded my way through several careers. I was inspired by the crocheted coral reef at the Smithsonian Institution Museum of Natural History. I could understand those complex forms nemerging from the simple stitchery I'd been doing for 40 years.

These pieces study the effects of sustained rates of growth over ten generations. They might apply to populations, or savings, or garbage in a landfill. It took me 50 years to get a feel for what the math might tell others in an instant. Finally I got a feel for the MIT motto, "Mens et Manus," mind and hand. Sometimes it takes both art and equations to get a handle on things.

S=6∑ (n=0-9) 2^n · This piece represents a rate of increase of 100% per cycle over 10 cycles. It might illustrate the excitement of a "double your money" scheme, or the population growth of some life form that has access to enough food and faces no threats. It looks a lot like brain coral for good reason.

S=6∑ (n=0-9) 1.667^n
15"x15"x5"
Crocheted wool on steel hoop
2011

S=6∑ (n=0-9) 1.667^n • This piece represents a rate of increase of 66% per cycle over 10 cycles. At 2/3 of the rate of growth of the larger piece it has fewer than 25% of the stitches in the larger piece.

S=6∑ (n=0-9) 1.5^n
15"x15"x5"
Crocheted wool on steel hoop
2011

S=6∑ (n=0-9) 1.5^n • This piece represents a rate of increase of 50% per cycle over 10 cycles. It grows at 1/2 of the rate of the largest piece but in the end includes just over 11% of the stitches in the largest piece where the growth rate is 100%. These three pieces represent a series that explores the emergent patterns as growth rates vary from 100% to zero per cycle over 10 cycles.

CHRIS BATHGATE

CONTACT

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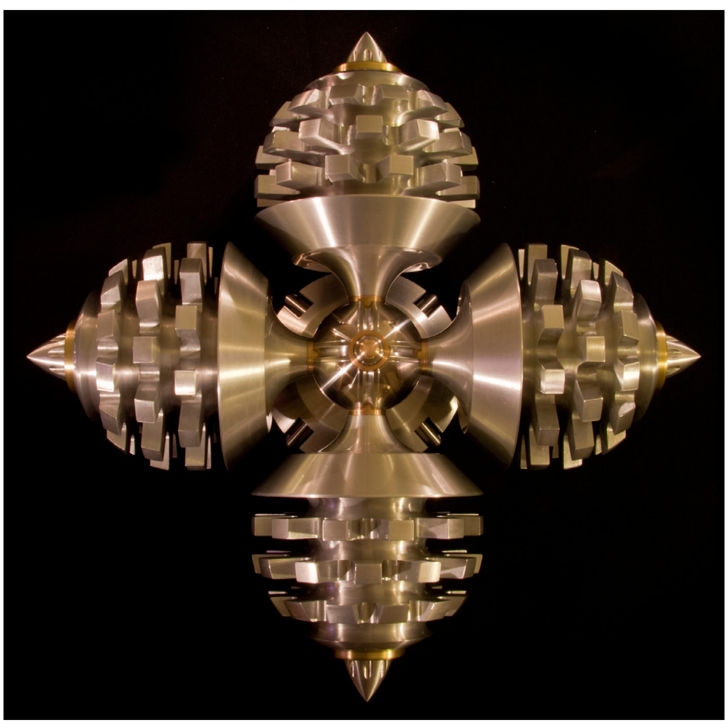
NT 554416312254
30"x24"x3" (wall mount)
Machined Aluminum, Stainless steel and Bronze
2012

In contrast to many of his contemporaries, Chris Bathgate's use of metal is neither structural nor illusionistic. It does not refuse to transform the medium, and it does not play on the medium's opposites, e.g. lightness from metal's weight, or organic forms from its rigidity.

Bathgate's process most closely resembles that of a machine builder or engineer. In the last two years, he has become increasingly involved in using mathematical techniques. This has allowed him to achieve the high degree of precision necessary for assembling such intricate works (these sculptures are not cast). The result is indeed a transformation-the pieces fit together in such a way that they cease to appear man-made, and yet in spite of this lack of bumpiness or personal touch emanate a presence that is unmistakable and engaging.

NT 554416312254, SC 415522332, ST 722232835563624434 • My work is a combination of Abstract formalism combined with a logistics based approach to engineering and design. I utilize a cross discipline skill set (engineering, mechanics, chemistry, mathematics, and fine art) to better understand and amplify my own aesthetic.

SC 415522332
22"x6"x7" (wall mount)
Aluminum, Bronze, Copper, Stainless Steel
2011



ST 732232835563624434
18"x18"x7" (wall mount)
Aluminum, Brass, Bronze, Stainless Steel
2011

FRANÇOISE BECK-PIETERHONS

CONTACT

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Inspiring Sea Tranquillity
300 X 300 mm
Acrylic paint on wood
2010

Free-lance writer and Italianist, I express in animal painting my immense love and respect for our so-called 'inferior' friends. In a math-art community, why not try to capture participants' interest to aspects of animality close to mathematics, through the emotional appeal of the painting medium?

Inspiring Sea Tranquillity • This Buccinum undatum sea snail, known as the common whelk, found along the North Atlantic shores and namely in Belgium, is an interesting and wonderful example of a 3D spiral, where an animal lives 'coiled' ('lové', in French). It can be considered a reference to the symbolism from the old Egyptian thinking, where the spiral is life. May I invite you, while observing the painting, to imagine the appeal of this spiral geometry to mathematicians, musicians, and even acousticians. The latter indeed are specially interested in the large cousin found in warm waters, the Charonia Tritonis sometimes called the Triton's Trumpet.

JOHN BISHOP

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String Theory
22 x 24 x 3
oak, screen, fabric
2011

Music
24" x 20"
Archival inkjet print

I lived in Nutley, NJ before going to colleges where I earned degrees from Rutgers University (BA) and Cornell University (MS and PhD). I have had a life-long interest in art, and in retirement, I have spent a lot of time doing art.

I often base my art on concepts. One particular interest is, " Where does one thing begin and another end? " Different kinds of edges, end points and surface textures reflect this question in my work. I also like to interject humor and playfulness into some pieces.

String Theory • String theory provides a conceptual framework for connecting materials that seem unrelated and separate. The wavy nature of the wood and scintillating diffraction patterns of the screen in this piece are meant to imply energy, even in items that appear inert.

Music • This piece depicts an imaginary musical instrument. The instrument appears to release ovoid sounds from a vibrating contoured surface.

TATIANA BONCH-OSMOLOVSKAYA

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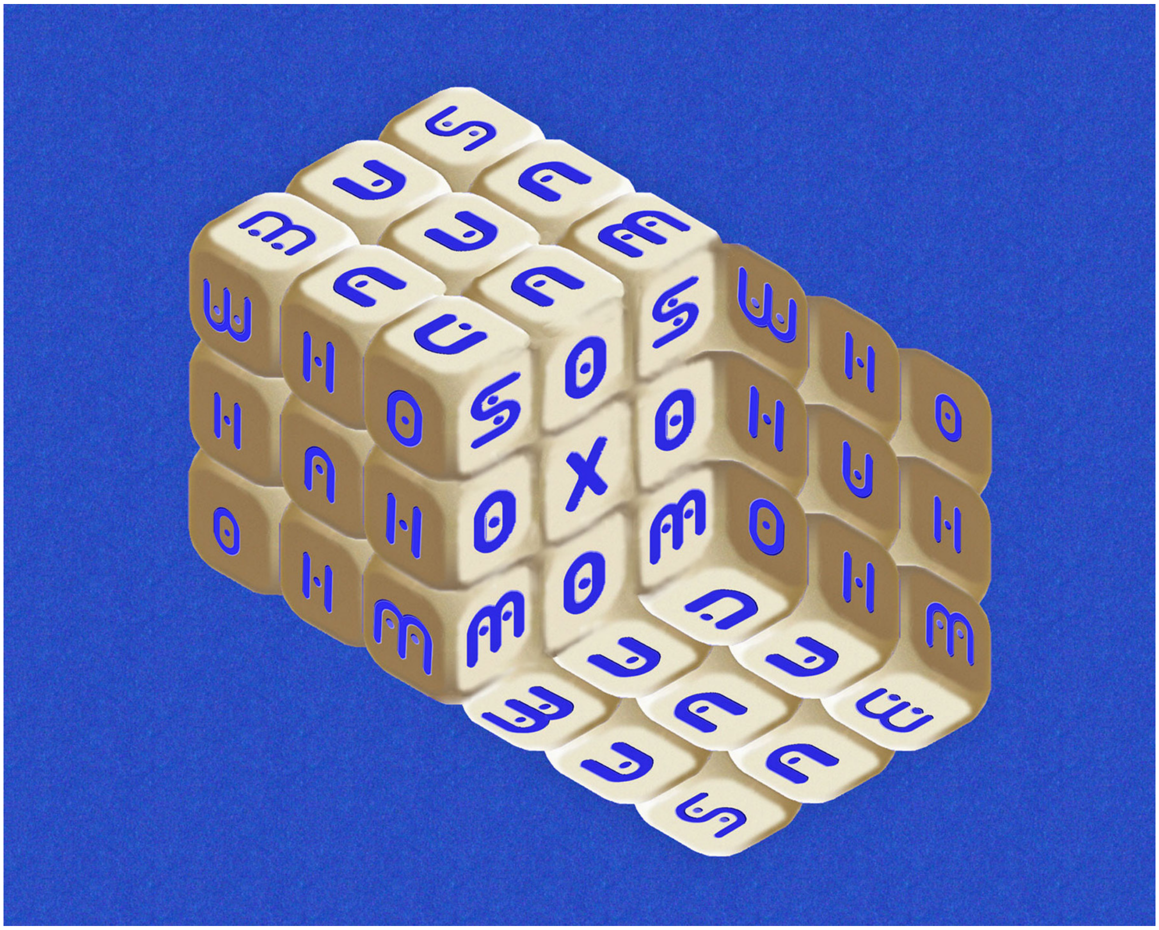

Magic cubes
7.9" X 9.8"
computer graphics
2012

I am interested in applications of mathematics to literature. This realm is sometimes called 'combinatorial poetry' though not just combinatorial methods are applied to texts, and not just to poetry. Visual representation of these texts provides the most obvious results.

"Magic word square" is a matrix with a letter in each cell so that meaningful words can be read by every line in any direction. The presented "magic cube" is an impossible figure where two cubes looking in different directions are united. Magic words' squares are written on each face of this cube. A special print type was developed, so that the letters transform into each other making words when the figure is turned over itself: a <–> u, b <–> e, c <–> d and so on. To find the appropriate words amongst the three-letters' English words that allow the transformation, a computer program was written, and another one for listing a set of words for a particular magic square. One of these cubes is shown on the picture.

Magic cubes • On five visible faces of this impossible cube three magic words' squares are presented. Proper names, abbreviations or dialects are allowed. For this type the letters 'U' and 'V' are not visually distinguished, as well as letters 'A' and 'N'. As the result, on the central face, the words 'SOS', 'OXO' 'MOM are written by horizontal lines and 'SOM', 'OXO', 'SOM' – by the verticals, transforming when rotated by 180 degrees into words 'WOW', 'OXO' and 'SOS' by horizontals and 'WOS', 'OXO', 'WOS' by verticals. On the side faces, the words 'WHO', 'HAH', 'OHM' are written on horizontal lines as well as by verticals, transforming into themselves when rotated. On the upper and lower faces, the words 'BUS', 'AVA', 'CAM' are written by horizontals and 'BAC', UVA' and 'SAM' by verticals transforming into 'WUD', 'UNU', 'SAE' and 'WUS', 'UNA' and 'DUE' respectively. On the faces invisible to observer, there are more magic squares chosen from approximately 400 found versions.

ROBERT BOSCH AND DEREK BOSCH

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Equivalent
6" x 6" x 2"
Nylon (selective laser sintering)
2011

The mathematician in me is fascinated with the various roles that constraints play in optimization problems: sometimes they make problems much harder to solve; other times, much easier. And the artist in me is fascinated with the roles that constraints play in art. All artists must deal with constraints, and many artists choose to impose constraints upon themselves. The benefit of this was well expressed by Joseph Heller (paraphrasing T.S. Eliot): 'If one is forced to write within a certain framework, the imagination is taxed to its utmost and will produce its richest ideas.'

Equivalent · Equivalent is a three-piece, 3D-printed sculpture that consists of three topologically equivalent variations of the Borromean rings. In the Borromean rings, no two of the three rings are linked, so if any one of them is destroyed, the remaining two rings will come apart. For the photograph, we positioned Equivalent on a piece of Lenox china (a wedding gift).

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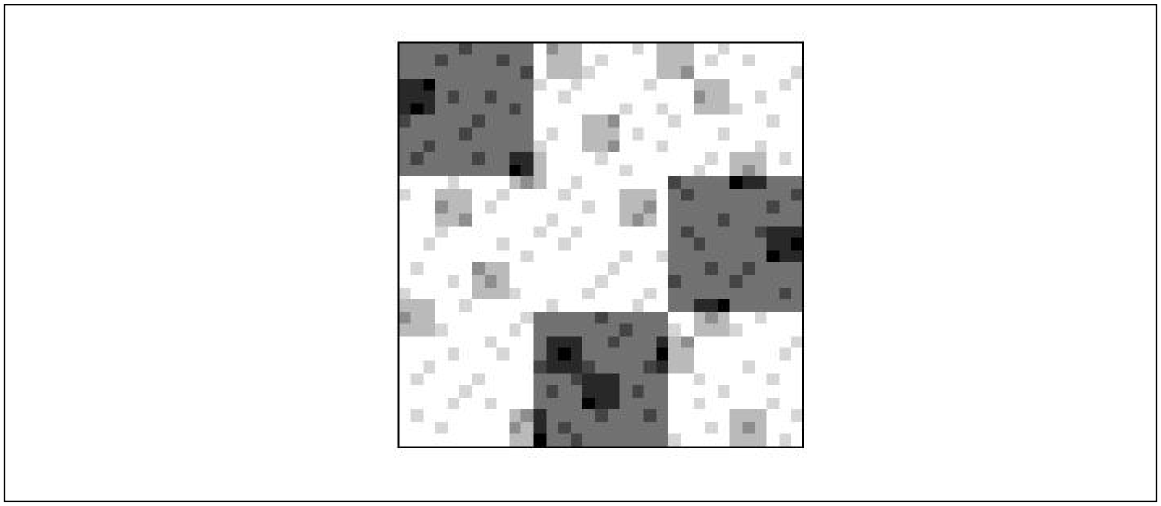
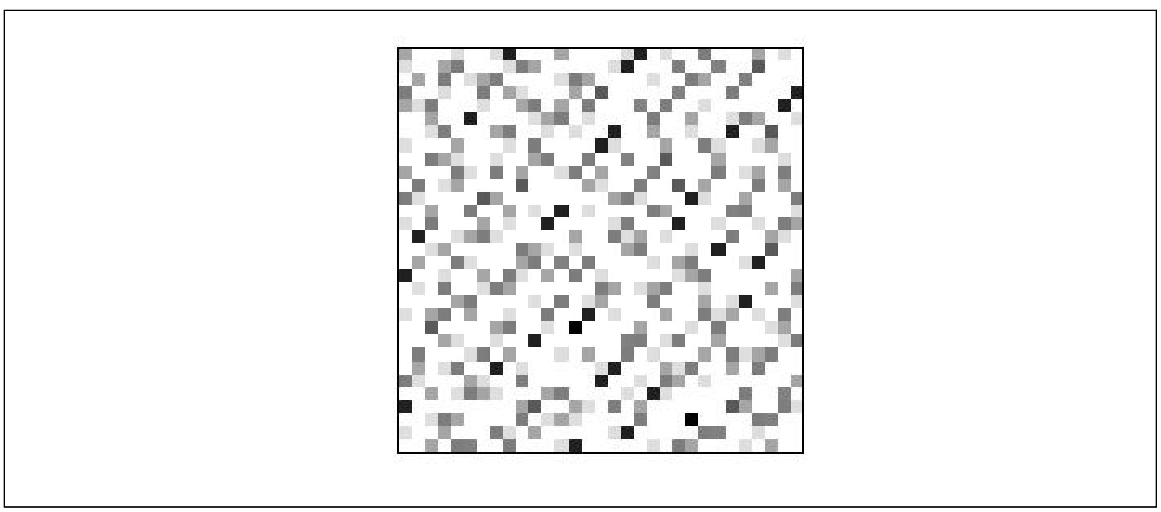


coming together
14 x 14
image
2012



all is one
14 x 14
image
2012

One of the main goals of both science and art is to reveal fundamental principles governing the order of space and time. This task can sometimes be facilitated by juxtaposing structure and randomness, intention and accident.

coming together, all is one · The two images "coming together" and "all is one" are parts of a series called "stainglasses". The series is a homage to the Samuel Beckett's play "Rockaby". The stainglasses can be viewed as representations of alternative life histories of the character of the play, encoded by a combination of cyclic and seemingly random patterns. The mathematical apparatus used to generate these patterns is based on a group-theoretic concept called "bat permutation". Despite the simplicity of the bat permutation condition, which requires that the difference between the index sequence and the bat permutation, taken modulo the length of the bat permutation, is a permutation, many aspects of bat permutation construction remain unresolved. In particular, the structure and the numerics of bat permutations is currently a subject of an intense investigation.

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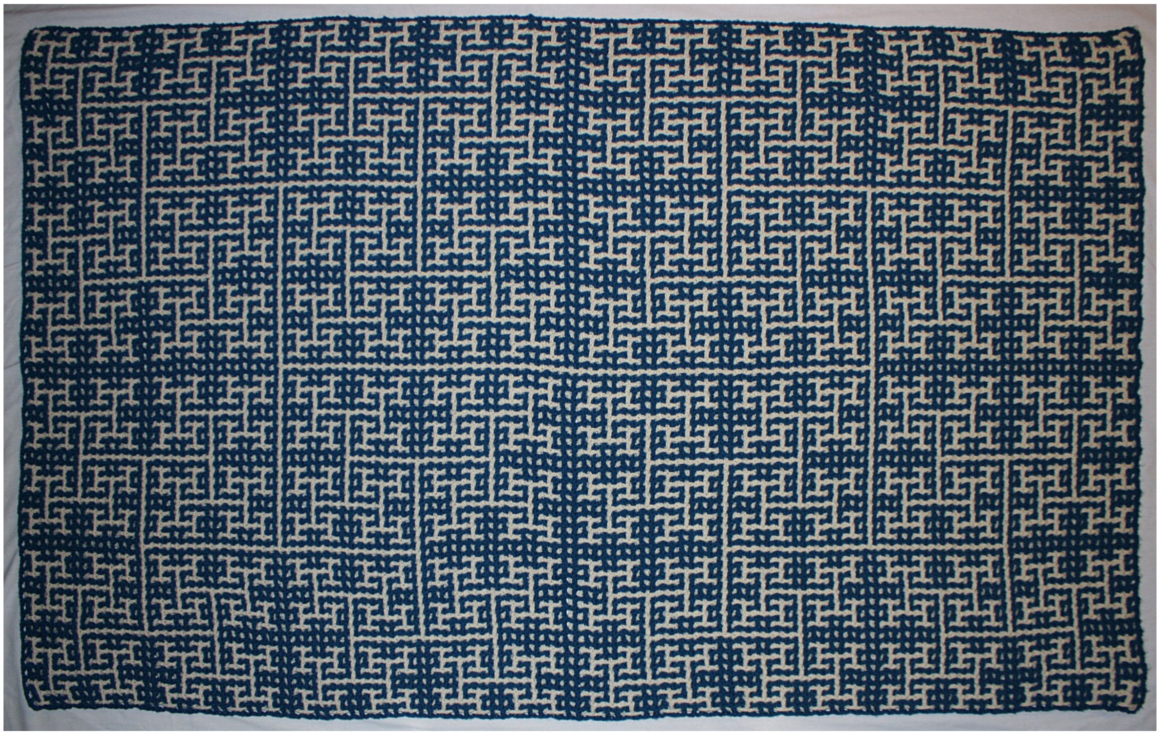

Crocheted H-Fractal Blanket
70x45 inches
acrylic yarn
2012

I am a mathematician by training who has picked up a habit of crochet and has an interest in the creative visual expression of mathematical ideas. Recent work has centered around the idea that some fractal curves have dimension 2 (i.e. space-filling curves), which is coincidentally the dimension of a blanket (ignoring the thickness, of course).

In a nutshell, I find the strong geometric ordering of iterative fractals provoking, the slow process of embedding them into crocheted work therapeutic, and the contrast between rigid geometry and soft fabric enjoyable.

Crocheted H-Fractal Blanket • This piece is a crocheted blanket with an H-fractal pattern, using an interlocking mesh technique. I have been interested in the idea of creating patterns based on space-filling curves, and the interlocking technique is useful for creating reasonably crisp patterns that conform to a square grid. This technique is not at all common, but I find the fact that the pattern arises from how two completely separate plain square meshes are interwoven to be quite fascinating.

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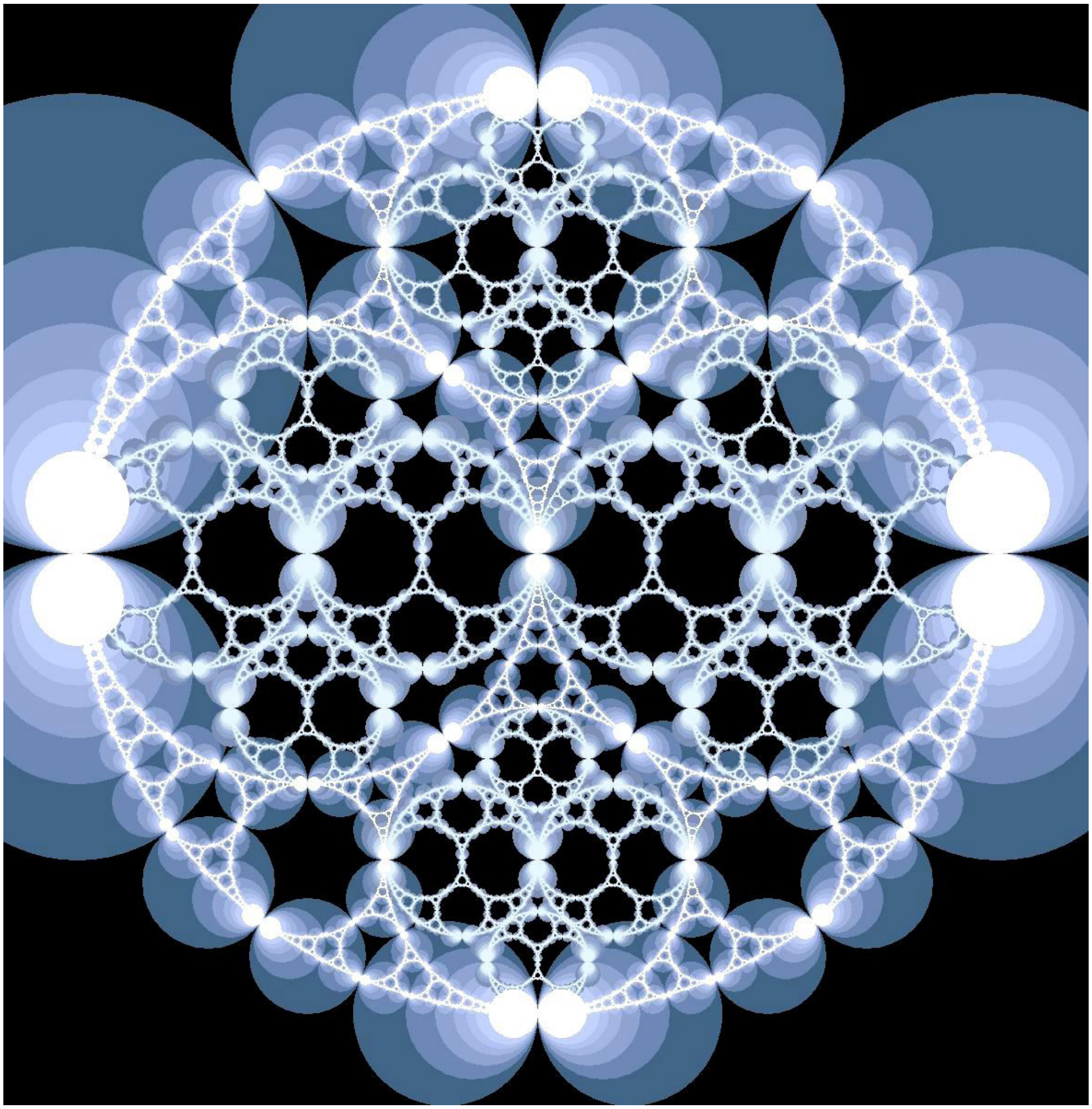
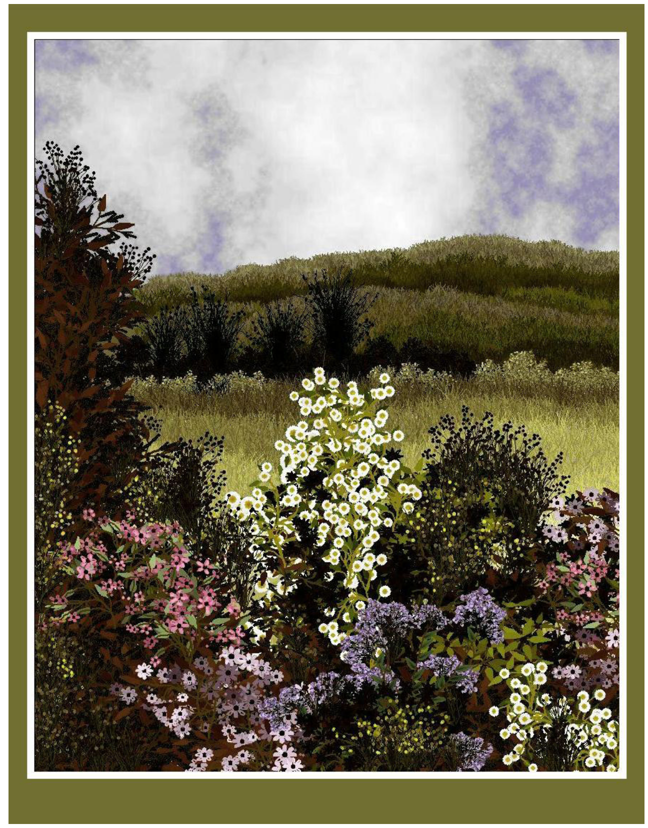


Appolonian Gasket
12"X 12"
Digital print
2012

I have always been fascinated by the connections between mathematics, art and nature. I began my studies as an art major, but later switched to mathematics. After I bought my first computer in the late eighties I spent all my spare time programming, trying to use mathematical ideas to imitate art and nature.

Appolonian Gasket • An Appolonian Gasket is constructed as follows: starting with any three mutually tangent circles the two circles that are tangent to the original three are added.. At the next stage 6 new circles are added, each one tangent to three of the circles from the previous stage.. Continuing in this pattern; at each stage, for every triple of circles, new circles tangent to each of the three are constructed.

Organic Forms
16"X12"
Digital print
2012



Imaginary Garden
14" X 11"
Digital print
2007

Organic Forms • In my 2011 Bridges paper I described a method of creating interesting designs by attaching vectors to curves in the plane. In this picture a vector f(z), for a function f of a complex number is attached to the points on the graph of an eight-leaved rose. The vectors are semi-transparent and rendered over a background of computer generated vines. The color and value of a vector is a function of its slope.

Imaginary Garden • The clouds are the result of a midpoint algorithm. The flowers and leaves are generated using string rewriting sysems. The trees are fractals with controlled random lengths and angles designed to avoid regularity. A blade of grass is a sequence of very short lines whose slopes and lengths vary randomly.

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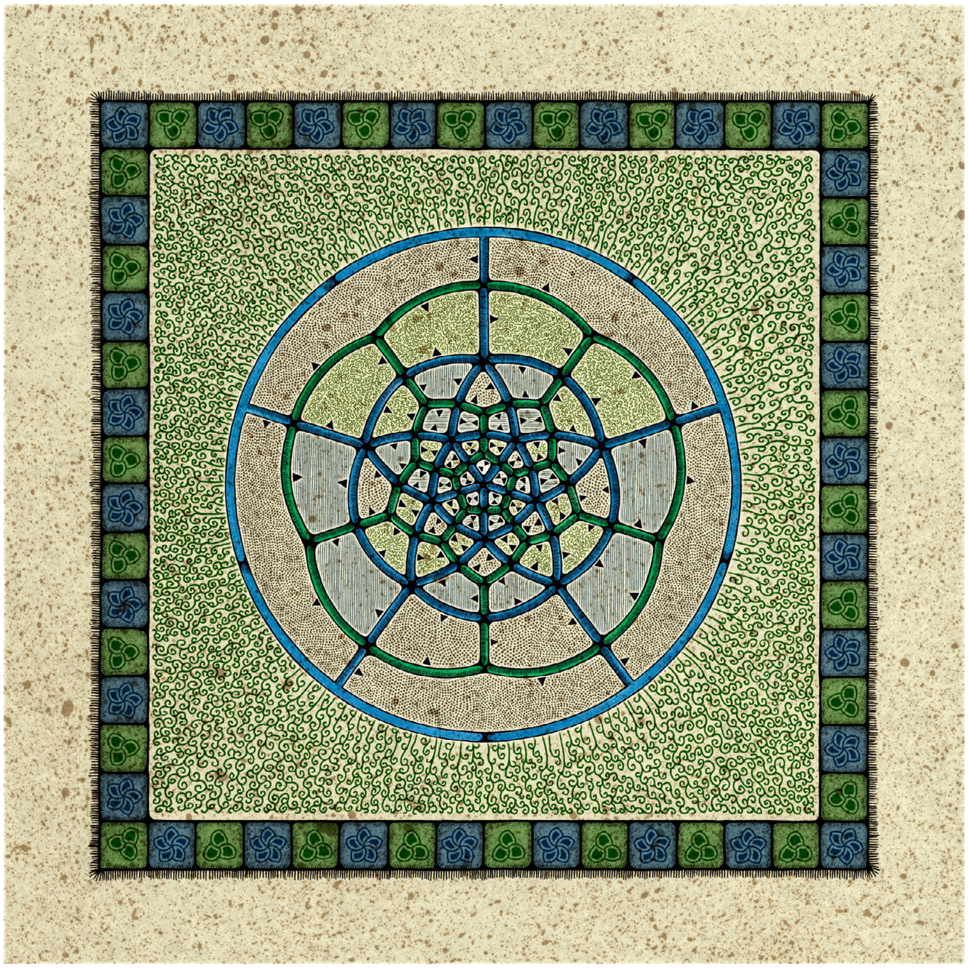
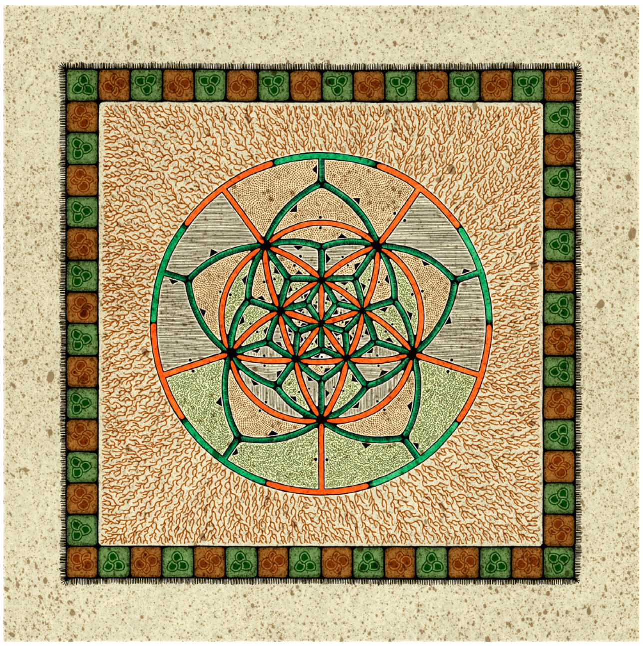


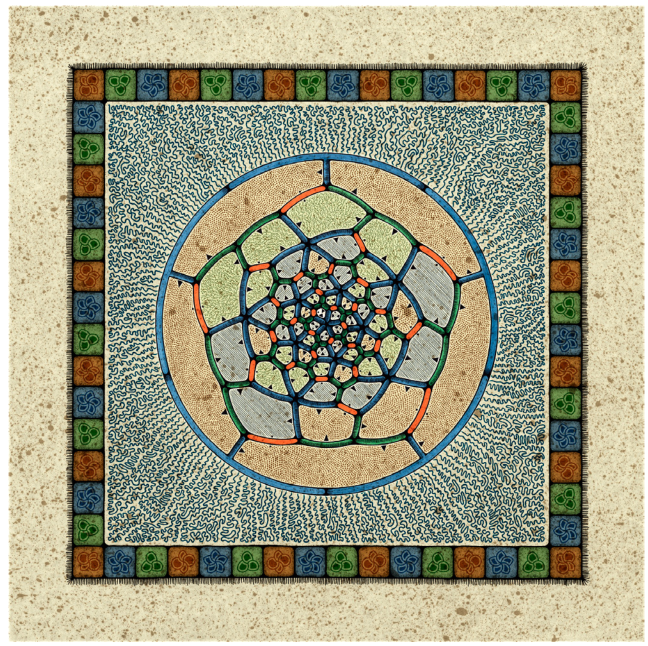
Esoteric Diagram I
24"x24"
Archival Digital Print
2012

My work is motivated by a fascination with the occurrence of mathematical and scientific imagery in traditional art forms, and the frequently mystical or cosmological significance that can be attributed to such imagery. Mathematical themes both subtle and overt appear in a broad range of traditional art, from Medieval illuminated manuscripts to Buddhist mandalas, intricate tilings in Islamic architecture to restrained temple geometry paintings in Japan, complex patterns in African textiles to geometric ornament in archaic Greek ceramics. Often this imagery is deeply connected with how these cultures interpret and relate to the cosmos, in much the same way that modern scientific diagrams express a scientific worldview. I am especially interested in symmetry as a mechanism for finding order in the universe, from its intuitive appearance in ancient cosmological diagrams to its important role in modern theoretical physics, and my recent works explore various forms of symmetry.

Esoteric Diagram I · This work belongs to a series of images which explore the structure of the alternating group on five elements (A5), also known as the icosahedral group. This image is based on a particular presentation of A5 given by two generators of orders 3 and 5, shown in green and blue, respectively. The elements of the group are associated with the faces of one of the Catalan Solids, the tetragonal hexecontahedron, shown here projected into the plane. The edges of this polyhedron form the dual graph to the Cayley diagram for this presentation of the group, and indicate the relationship between the generators and the group elements. Different textures are applied to the spaces representing the group elements according to their conjugacy classes. The image is constructed from multiple hand-drawn elements and natural textures which are scanned and digitally manipulated to form a composite image and subsequently output as an archival digital print.



Esoteric Diagram II
24"x24"
Archival Digital Print
2012



Esoteric Diagram III
24"x24"
Archival Digital Print
2012

Esoteric Diagram II • This image uses a presentation of the icosahedral group given by generators of orders 2 and 3, shown in orange and green, respectively. The elements of the group are represented by the sixty triangular faces of the triakis icosahedron, projected into the plane.

Esoteric Diagram III • This image uses a presentation of the icosahedral group given by three generators of orders 2, 3, and 5, shown in orange, green, and blue, respectively. The elements of the group are represented by the sixty faces of the pentagonal hexecontahedron, projected into the plane.

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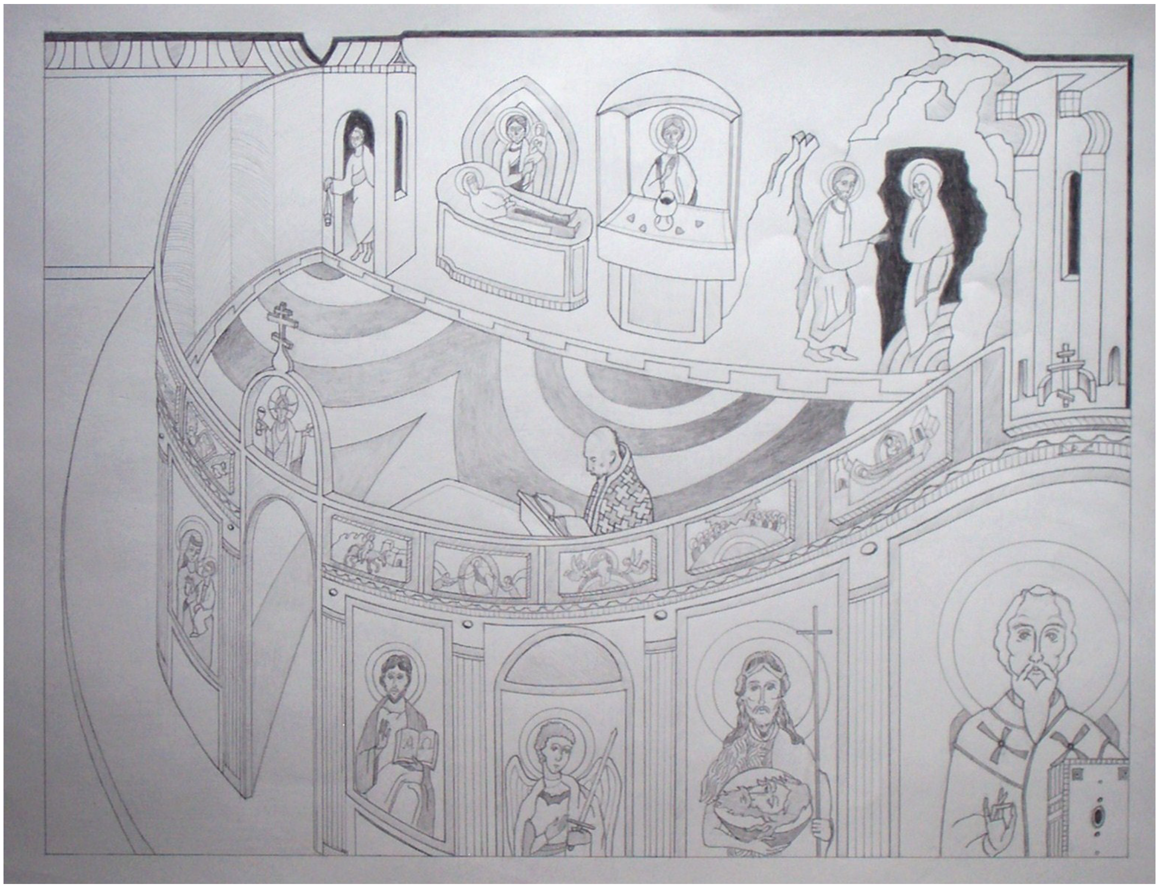
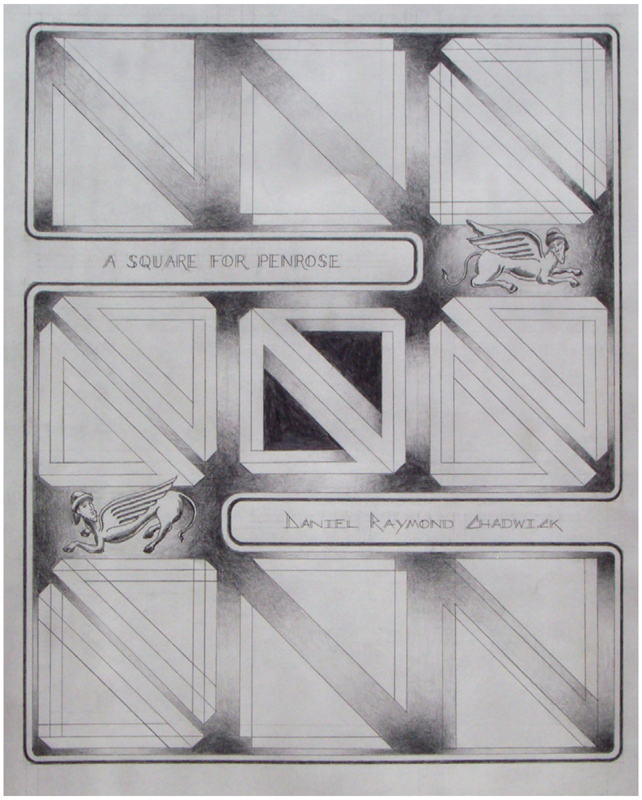


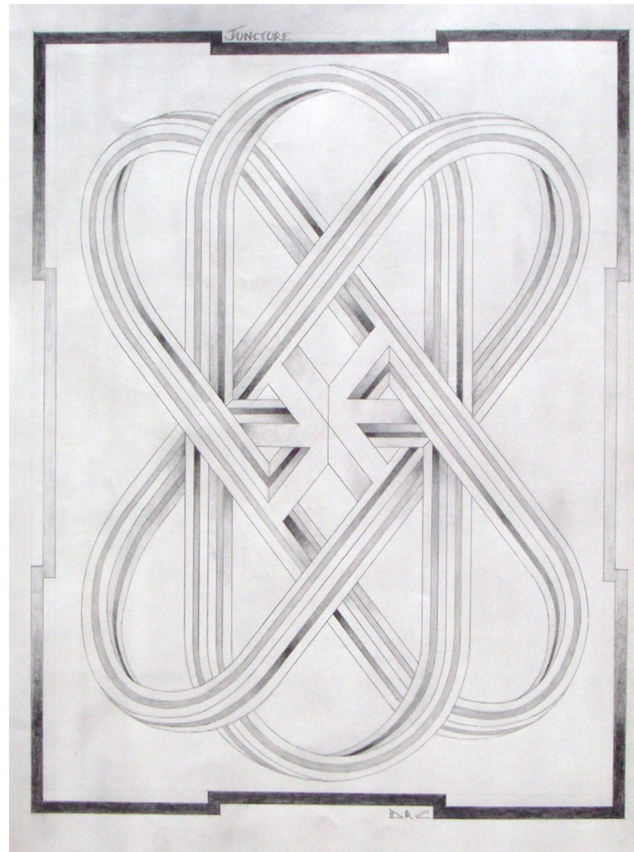
The Altar Screen
14" x 18"
pencil on paper
2012

I enjoy creating images that employ ideas from mathematical and philosophical sources. This new myth of mathematics and science is one that can inspire humankind to continue the heroic journey. My drawings consist of continuous forms, impossible objects, and stretched spaces within which discovery of the content in a new way may lead to the wonder of curiosity.

The Altar Screen · The golden ratio defines the curve of the altar screen; additionally, the far right icon is a multistable perceptual phenomenon which alternates between foreground and background space. Lastly, the priest's robe consists of cross tessellations.



A Square for Penrose
18" x 14"
pencil on paper
2012



Juncture
18" x 14"
pencil on paper
2012

A Square for Penrose • Isosceles right triangles mutate to form Reutersvard/Penrose triangles, of which these combine to form a hybrid multiple perceptual phenomenon square. Two hybrid creatures of ancient imagination look upon this spectacle with indifference.

Juncture • Three multistable perceptual phenomena, cousins to the mathematical versions of the Necker Cube and other such phenomena, combine in an impossible way.

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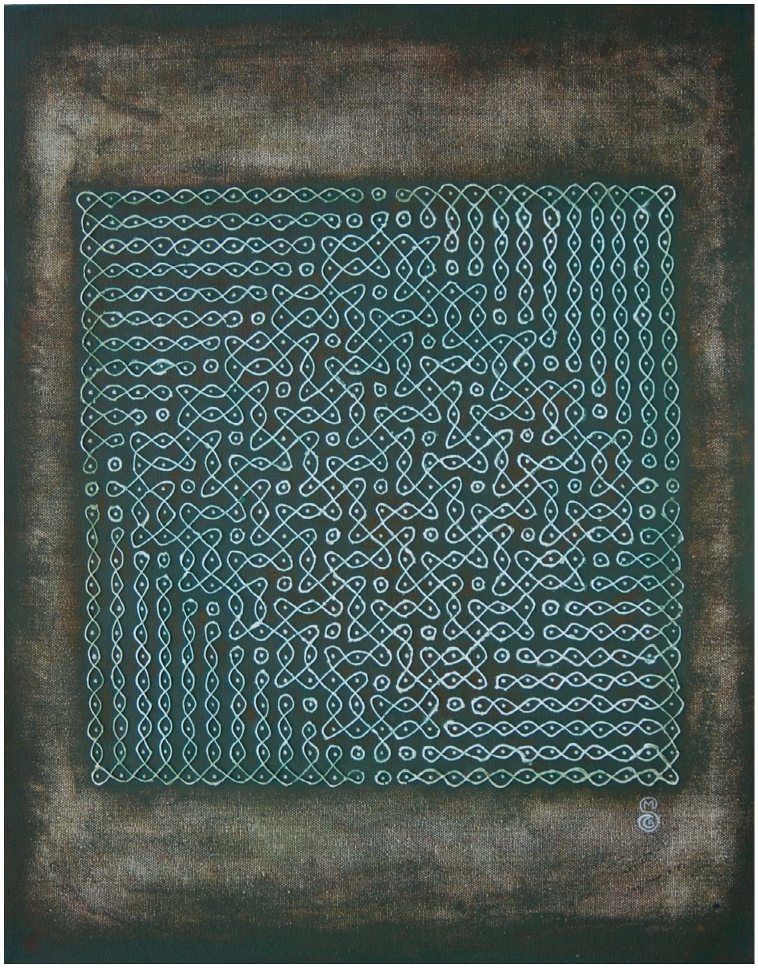
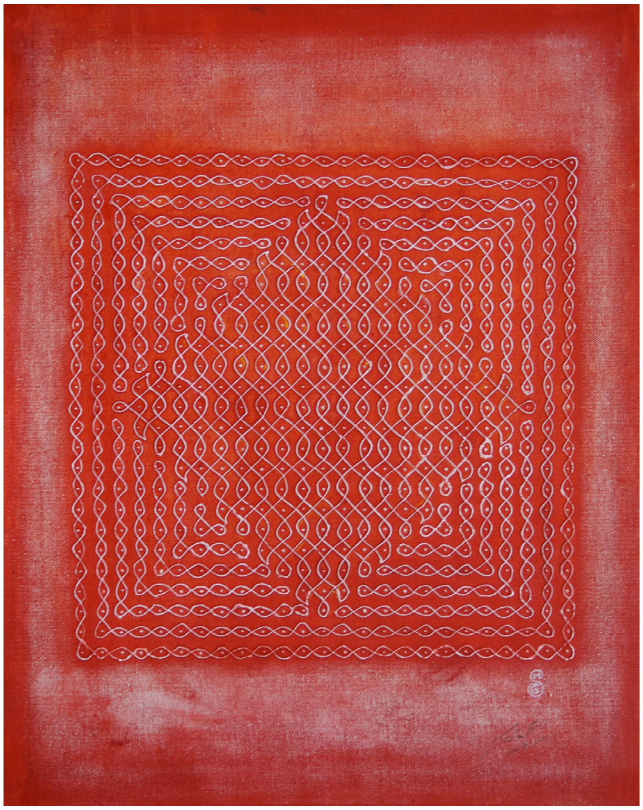


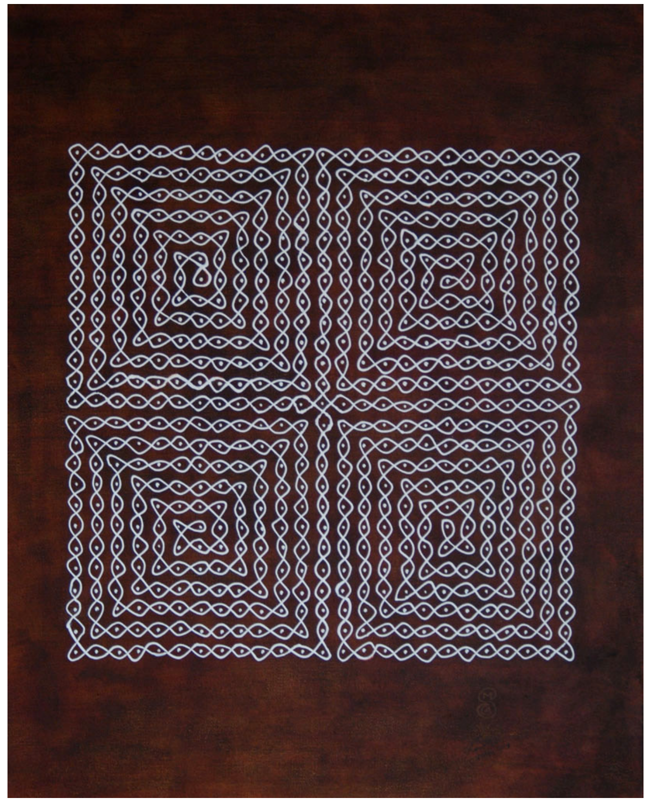
Kolam- Green
20"x16"
Acrylic On Canvas
2010

Kolam: Indian women often begin their day and sometimes also end it by drawing kolams on the ground just outside the front door. These repeating patterns, a type of Tantric Art, have been passed down from generation to generation for centuries, and symbolize the scientific and philosophical patterns innate to and infinite throughout the cosmos. Like Native American sand paintings or Buddhist mandalas, the kolams are part of the cycle of creation and destruction. If the dots represent the obstacles in life and a woman can weave her way through them, her problem solving skills help her be successful in life. It is an environmentally friendly art form as it is created using natural materials like rice flour and rock powder. It is also an artistic approach to mathematics. Mathematicians have been working on the various math concepts involved in Kolam drawing. The concepts range from symmetry at different levels to permutations and combinations to fractals.

Kolam- Green • Kolams are made of dots and one or more lines. There are rules that determine the shape of the array of dots and the direction of the lines as they weave around them. The shapes that are formed around each dot depend on the number and position of the dots around it. The lines cannot overlap more than once or go over the same path twice. Also every dot has to be included in a closed line. Keeping these rules in mind, I wanted to play around by placing a tradtional Kolam in a square grid of 25x25 dots and see the effect. The central Kolam in this painting has rotational symmetry and consits and several repeating smaller units. This Kolam is unique in that the smaller units also have rotational symmetry and has a pattern that repeats diagonally.



Kolam- Red
20"x16"
Acrylic on Canvas
2010



Kolam- Brown; Four Spirals
20"x16"
Acrylic on Canvas
2011

Kolam- Red • This is another Kolam I incorporated into the 25x25 dot array. The Kolam has reflectional symmetry and is the repetition of two different types of line patterns in the central Kolam. These two line patterns alternate vertically. Also, the negative space that is created by the Kolam interests me.

Kolam- Brown; Four Spirals • I was inspired by quilt patterns and created this Kolam based on that. It is a single line Kolam that ends at the same point where it started. The four spirals in the painting create an optical illusion of other shapes. The use of a slight relief work in the dots and lines also gives the impression of a changing pattern as the viewer walks past it.

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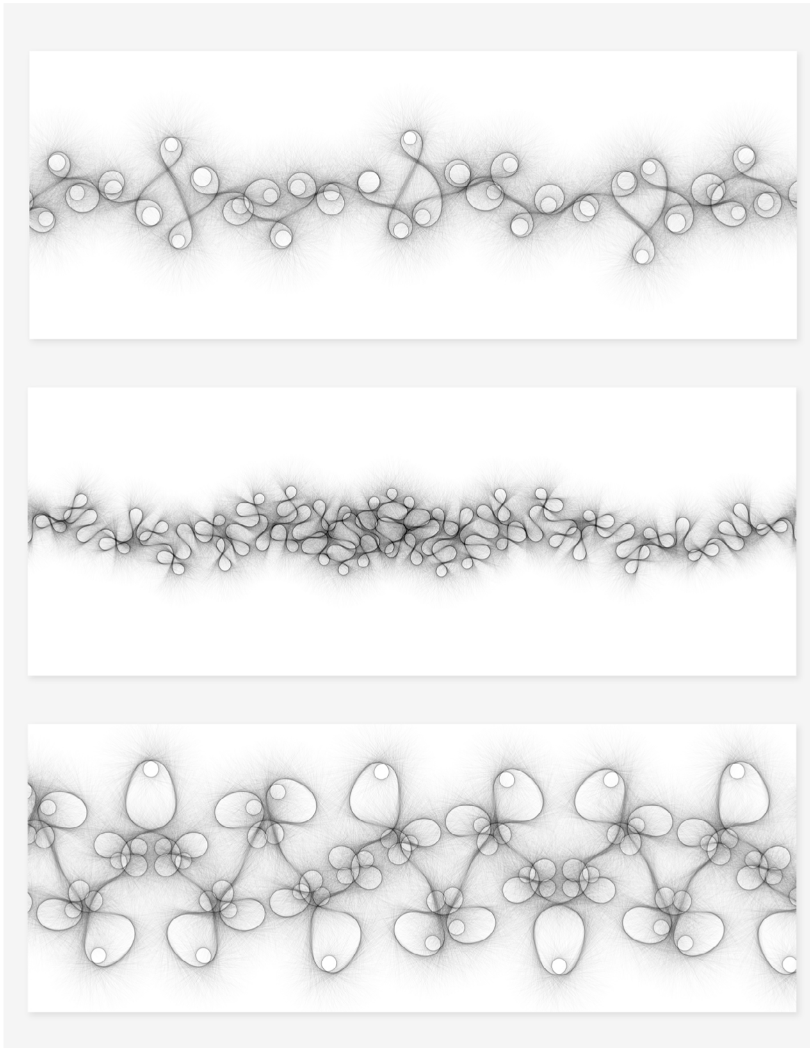
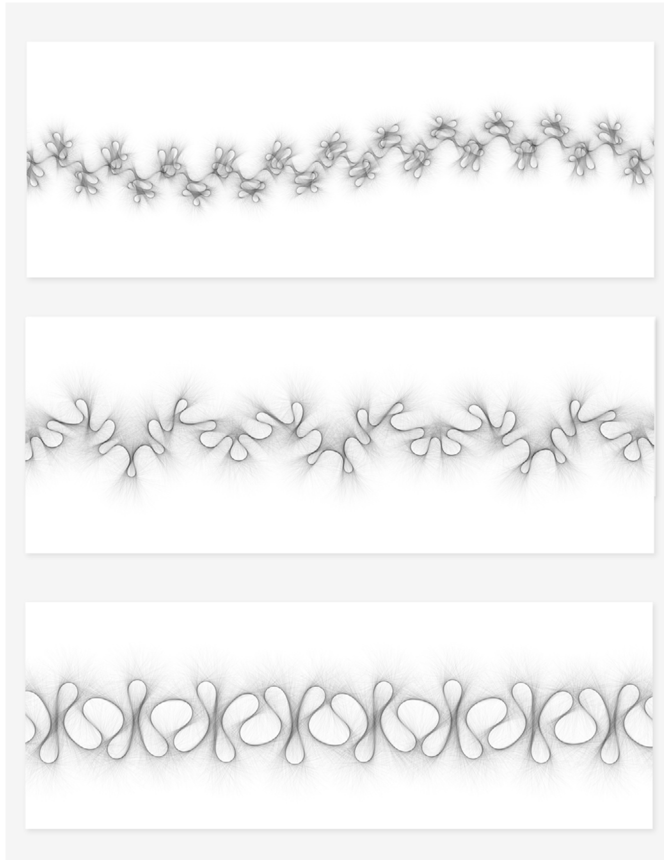


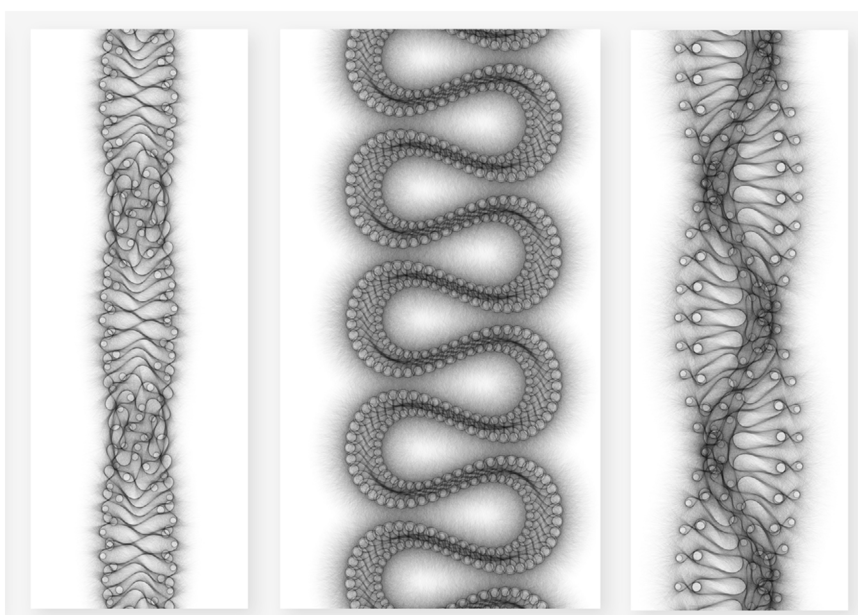
Meander #6
20"x16" Triptych (three 6"x16" panels)
Archival Inkjet Print
2012

The universe has rules. Energy is conserved, opposites attract and life evolves toward increasing complexity. I like my art to follow rules as well. Or, more precisely, I consider the act of creating rules to be my art form. Once the rules are set in motion, I sit back and watch my universe unfold. Rules that produce symmetry, self-similarity and textures are well known. But which rules suggest organic variation, musicality or a sense of playfulness? I experiment with systems that lead to symmetry breaking and variations on a theme in order to explore the boundary between mathematical illustration and evocative art. I seek mathematical rules that generate simple, elegant, expressive and whimsical forms.

Meander #6, Meander #13, Meander #5 · The digital, computer-generated sketches presented are created from a single family of curves in natural coordinates (i.e. the tangent angle of the curve is expressed as a function of the arc length). Each curve is the sum of just two or three sine waves. The form of the curve is controlled by the frequencies and amplitudes of the sine functions. Visual phrases are seen to repeat through the curve when the composite sine functions beat against each other. The pattern of loops and curves vary from phrase to phrase, creating variations on a common theme.



Meander #13
20"x16" Triptych (three 6"x16" panels)
Archival Inkjet Print
2012



Meander #5
16"x22" Triptych (two 16"x6" panels and one 16"x8" panel)
Archival Inkjet Print
2012

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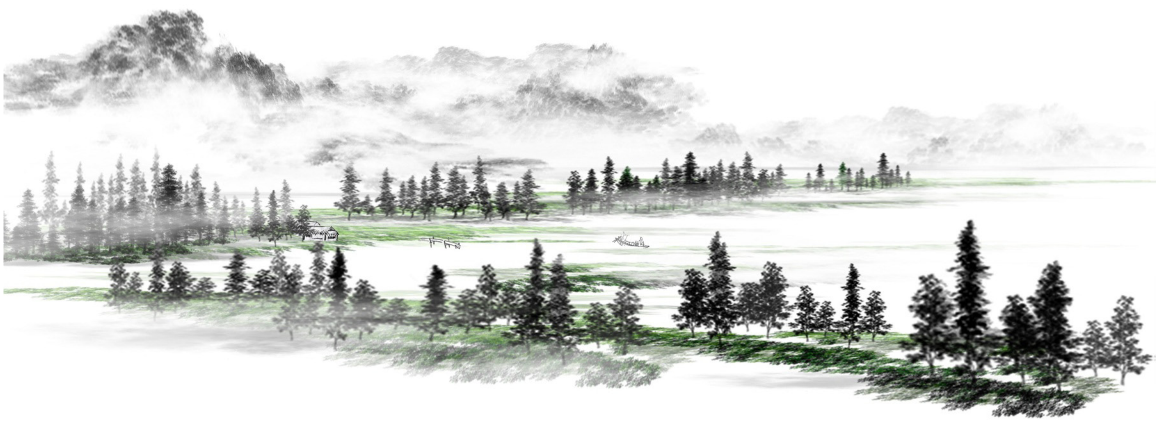
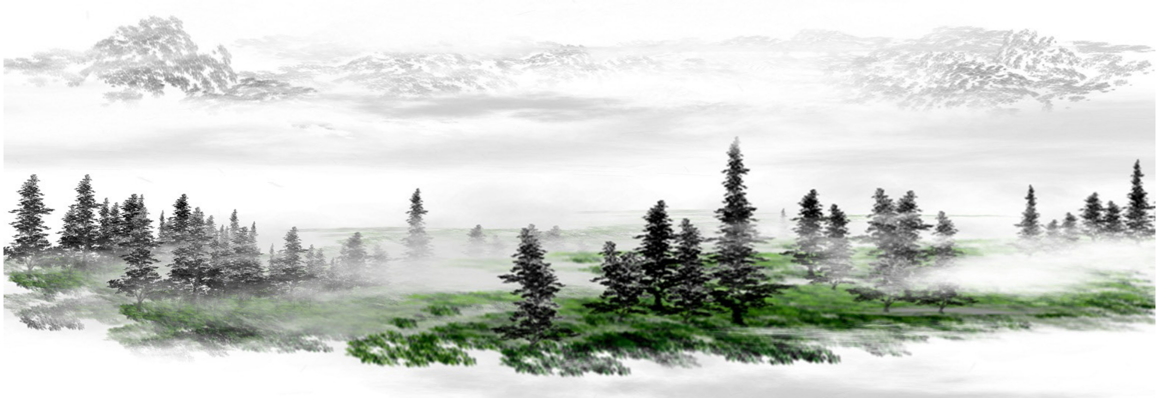


Unoccupied
12" x 25"
Digital print
2011



Stillness
12" x 25"
Digital print
2011

A new method by using Structural Cloning Method (SCM) and Leaping Iterated Function System (LIFS) to explore abstractor and landscape painting are presented in these artworks. SCM is a visual interface to define different combinations of geometry transformations and LIFS is an improved version of Iterated Function System (IFS) within SCM. Instead of exponential growing loading while iterating; LIFS takes only constant computing resources. From the viewpoint of visual design, SCM and LIFS together build a bridge between mathematic and aesthetic, and they then make fractals and landscape paintings more tractable. However, it is much more challenge to convey a natural feeling in such a painting without the feeling of mathematics.

Unoccupied, Stillness • Rocks, clouds, mountains, fogs, trees, etc are fractals in nature. And so you can find fractals everywhere in a landscape painting. To design these visual elements by a painting brush is easy, but by means of mathematics is very difficult and interesting. Using Structural Cloning Method and Leaping Itertions, chaotic patterns can be designed easily. This picture is a combination of these chaotic patterns and is compiled on PowerPoint by AMA. It is unbelivable!

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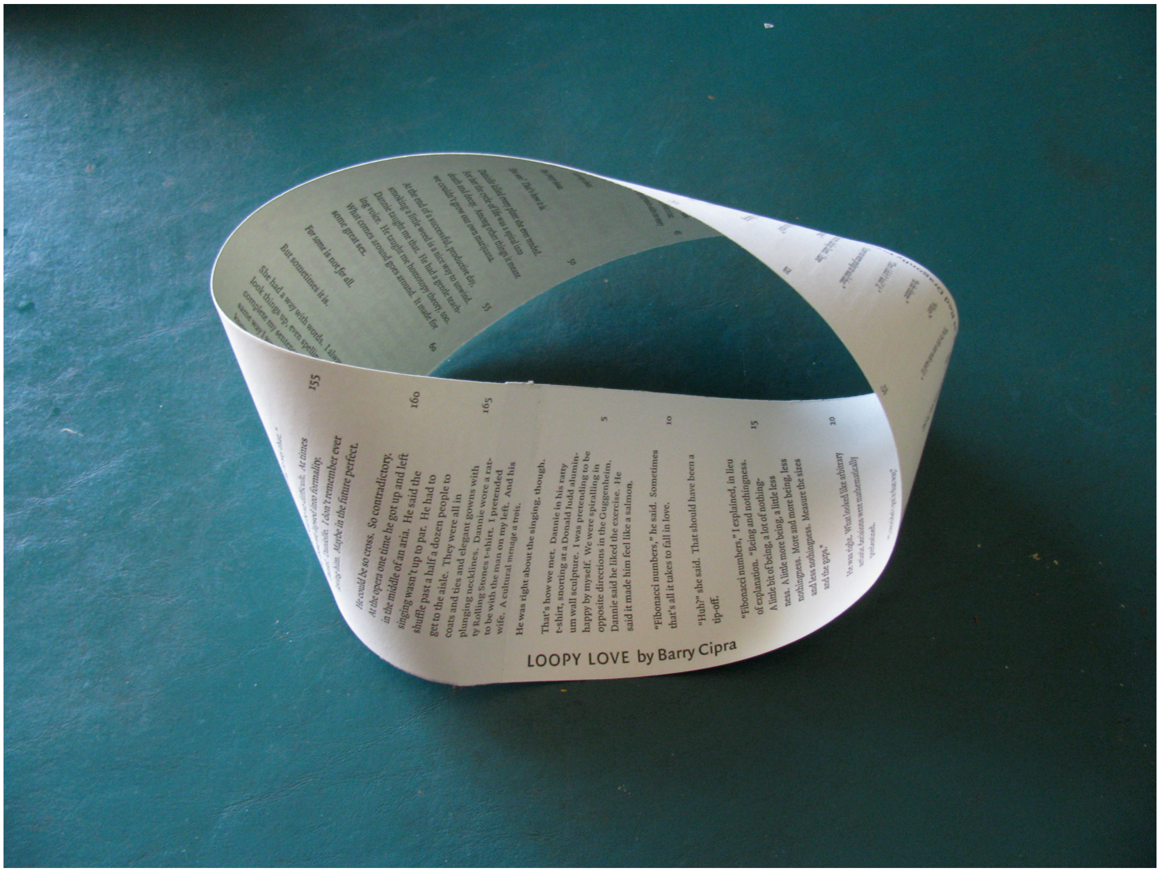

Loopy Love
11" x 6" x 5"
Letterpress print on paper
2010

I am primarily a writer, but I am fascinated by the relationship of mathematics and art. Each can inspire the other. Mathematical patterns are often visually arresting, and works of art often suggest interesting mathematical problems.

Loopy Love • "Loopy Love" was composed for a workshop on Creative Writing in Mathematics and Science, held at the Banff International Research Station (BIRS), May 2-7, 2010. The idea was to explore the implications of writing a short story on a möbius strip. The story, a dialog presenting both sides (or is there only one side?) of a twisting love/hate relationship between two characters named Daniel and Danielle, was letterpress printed by Red Dragonfly Press in Red Wing, Minnesota, on Fabriano paper using the font FF Quadraat. Assembled by hand with tape, the resulting scrollable sculpture retains its shape yet remains flexible, so that the reader can easily read the story without ever having to turn the page. Viewers are invited to pick it up, play with the paper, and read the story from start to finish -- except there is no start nor any finish!

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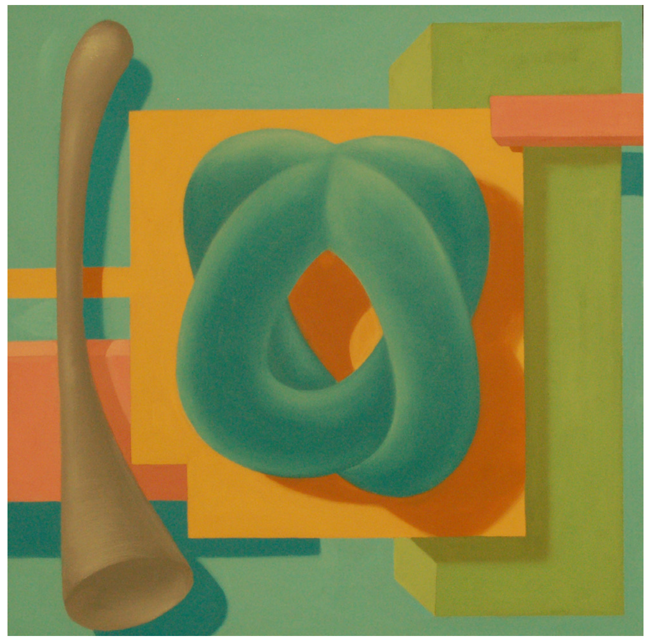
Duet
24"x24"x2.5"
Oil on canvas
2010



Gift
24"x24"x2.5"
Oil on canvas
2010

I use mathematical models as objects in an idealized world, a way of describing shape and space. From mathematics I have chosen topological shapes as the primary source for images. These shapes are defined by their qualitative features rather than by measurement of distance and angle. Using patterning, false-color images, popular graphic imagery, and my own drawings, I alter and manipulate shapes and their environments to reveal some of their unique incarnations. I see these images as describing a realm of highly-saturated painted form filtered through aesthetics

Duet • This work, "Duet", depicts a Boy's surface and a hyperbolic ribbon. This pair is placed on a ground inspired by a topographic false-color map. This painting is one of ten from the "FourSquare Series". Each painting format is a square of 24"x24", each title is a word comprised of four letters. Each painting depicts a topological surface in an invented environment.

Gift • This work, "Gift", depicts a blue unknot and a form often referred to as Gabriel's horn or Torricelli's trumpet. The title was inspired by the horn's 'gift' of infinite surface area. These objects are situated in a geometric environment. This painting is one of ten from the "FourSquare Series". Each painting format is a square of 24"x24", each title is a word comprised of four letters. Each painting depicts a topological surface in an invented environment.

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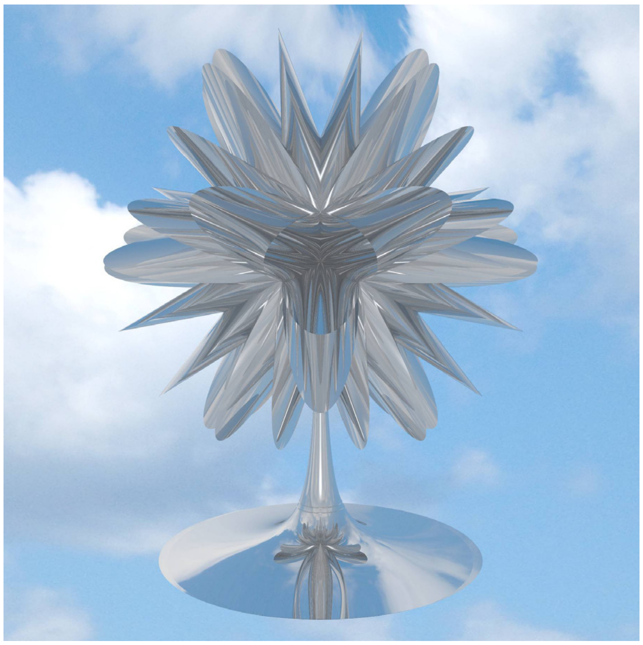
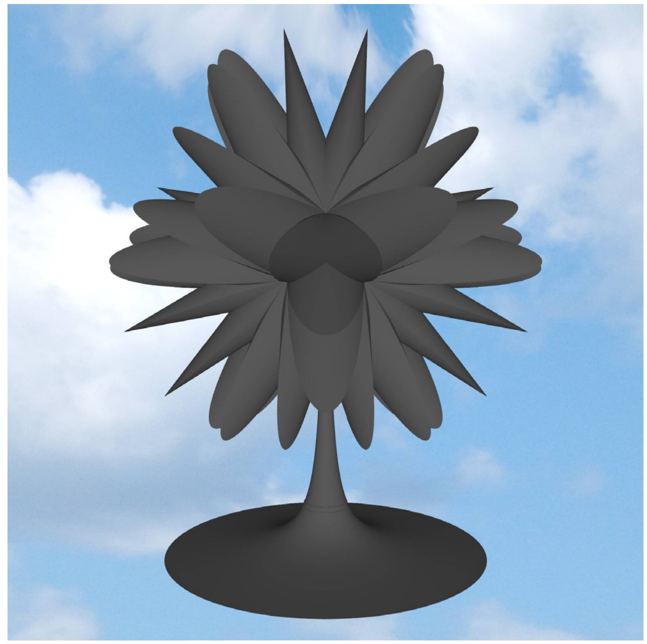


The Radix Universum Triplets-egression
18in X 12in X 12in (Sculpture) 36" X 13in X 12" (Pedestal)
Aluminum - mirror polish
2010



442, Variation II
24" x 20"
Archival inkjet print

The transformation and unity of all things begin with the connection & relationship between the physical and metaphysical duality of Universe.

All that is physical is energy, and all that is matter is the manifestation of energy.

All that is metaphysical are the instructions for behavior of transformations, connections and relationships defining the language for the manifestation between the physical and metaphysical.

As the physical and metaphysical make connection their relationship initiates a transformation of energy to take on a form that we can measure.

I seek to find the language expressing the rules and order in the manifestation.

The Radix Universum Triplets-egression, The Radix Universum Triplets-ingression • The polycylinderhedron IGIII_EF_C15,C10 is a sculpture of triplets, Radix Universum ingression, Radix Universum transition and Radix Universum egression. They represent the point of entrance and exit of Universe through a vortex of an evolutionary transformation support base titled Aphaia. GIII = Group III = 'stellated-polycylinderhedron.' Any symmetry axis set or combination of sets will define a 'stellated-polycylinderhedron' by the Boolean operations of the union of axis followed by an intersection of the combined axis sets. The polyhedron axis sets chosen for this sculpture are the Icosahedral-polycylinderhedron axis set F = F1 U F2 U F3 … and the Icosahedral-polycylinderhedron axis set E = E1 U E2 U E3 … [1, 2] Aphaia's profile was generated by a rotation of a hyperbolic function, $y = 0.1\ \mathrm{csch}(5x)$, about the y axis to create the vortex form used as the base of the Radix Universum triplets.

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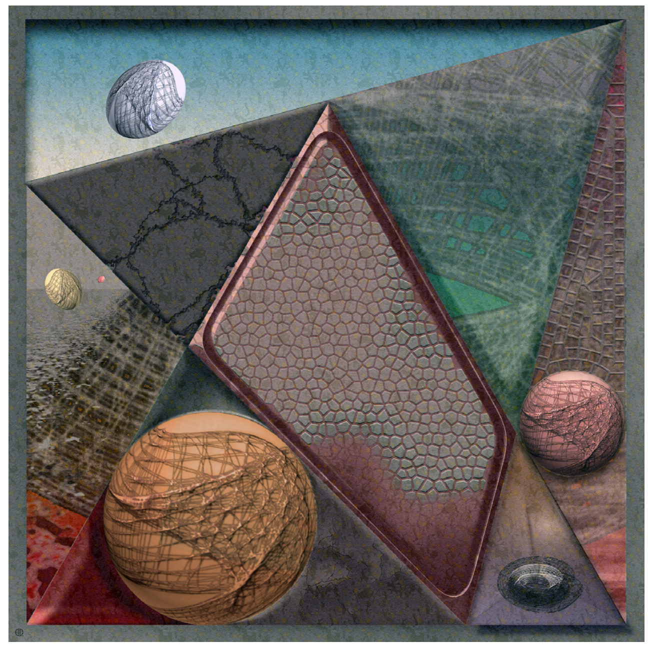
The shield of Ryoshun
20x20
Mixed media on canvas
2012

Mathematics represents universal abstract intelligence at its best and reaches for the most abstract expression of our collective consciousness. It is in itself a fertile ground to celebrate both our collective intellectual achievements and the unsurpassed qualities of its association with our more tangible environment. This selection of 3 digital Sangaku is submitted to the 2012 Bridges conference in conjunction with a short paper and an 8 minutes QuickTime animation on the making of this digital Sangaku series.

The shield of Ryoshun • From an original Sangaku, Iwate prefecture, 1842. If CB'A If ABC is a right triangle with right angle at A, then the circle touching the circumcircle of ABC internally and also touching AB and AC is twice the size of the incircle of ABC. (Okumura). Texture, color and depth were added to highlight the esthetic quality of the original composition - The contours of a Klein bottle wireframe is reflecting in the shield. (Tools: 3D-XplorMath, Pixologic-ZBrush, Adobe CS 5)

Klein Sangaku
20x20
Mixed media on canvas
2012



Sangaku in a square
20x20
Mixed media on canvas
2012

Klein Sangaku • From a Sangaku by Hirayama and Matsuoka, 1966. In a square PQRS, there are two circles touching SP and the incircle of the square, where one of which touches PQ and the other touches RS. Let A be the point of tangency of QR and the incircle and let the tangents of the two small circles through A intersect the segment SP at B and C. Given the inradius of the square, find the inradius of the circle in the triangle ABC The answer is that the medium circle is also half the size of the largest circle. The Klein bottle visualizations defining each circle enhances the r dynamic of components interaction in the composition.

Sangaku in a square • From an original Sangaku, Miyagi Prefecture, 1877. Two equilateral triangles are inscribed into a square. Their side lines cut the square into a quadrilateral and a few triangles. Find a relationship between the radii of the two in-circles. Elements of a Klein bottle wireframe have been added on the circles and ellipses to add optical depth to the flat surfaces.

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"Pythagorean Proof" Universal Language Series
20"x20"
Hand dyed wool weft, cotton warp
2012

Color is a source of constant joy for me and I delight in the full range of its use - bold and surprising color combinations and the subtle gradations of a single color. The colors and the unique quality of light in the Southwest, and the diverse forms of its land and sky scapes, make up a rich and diverse palette.I love the materials used in the weavings,from the strong smooth cotton warp to the luster of hand-dyed wools and the sparkle of silks, I continue to be enraptured with the feel and look of textiles. The very act of weaving has become metaphor – the web of life, weaving a tale - and is entwined with my choice of imagery and the use of the window set within a frame, a view to another place, another reality as a motif in my work. I try to achieve a blend of the representational and the abstract and to keep a geometrical contemporary feel in the frames.

"Pythagorean Proof" Universal Language Series
This is one of the many Pythagorean proofs out there. The Landscape triangle is the ABC triangle. It's graphic appeal is hard to resist. The application of this proof to a unit square and the derivation of irrational numbers and the root rectangles that are so much a part of design in art and nature continue to fascinate me and inspire my designs.

"Special Case Pythagorean Proof" Universal Language Series
20"x20"
Hand dyed wool weft, cotton warp, Handwoven Tapestry
2012

"Koch Snowflake Fractal"
68"x40"
Hand dyed Handwoven Wool on Cotton Tapestry
2012

"Special Case Pythagorean Proof" Universal Language Series • Another Pythagorean proof, (a2+b2=c2) where the landscape triangle is a special case triangle, not 90 degrees by itself but made up of two right angled triangles. The basic triangle pattern changes remarkably through different colorways. In this piece I experimented with creating the illusion of transparency. I am hoping to depict more of the many Pythagorean Proofs in my work in the future.

"Koch Snowflake Fractal" • The graphic appeal of the Koch snowflake was irresistible. Such a simple function made more so by creating it in a linear way. The bending each straight line successively : this is the reiterated function , which is constrained by the limits of the grid supplied by the loom. While the Koch Snowflake Fractal is usually represented in a circular format I have chosen to represent it linearly .

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Gentle Earthquake
17" x 15" x 12"
Mi-Teintes watercolor paper
2012

We explore many mediums, from sculpture (particularly paper folding and glass blowing) to performance art, video, and magic. Our artwork explores connections to mathematics, with the goal of inspiring, understanding, and ideally solving mathematical open problems.

Gentle Earthquake • The sculpture is a modular combination of nine interacting pieces. Each piece is folded by hand from a circle of paper, using a compass to score the creases and cut out a central hole. This transformation of flat paper into swirling surfaces creates sculpture that feels alive. Paper folds itself into a natural equilibrium form depending on its creases. These equilibria are poorly understood, especially for curved creases. We are exploring what shapes are possible in this genre of self-folding origami, with applications to deployable structures, manufacturing, and self-assembly.

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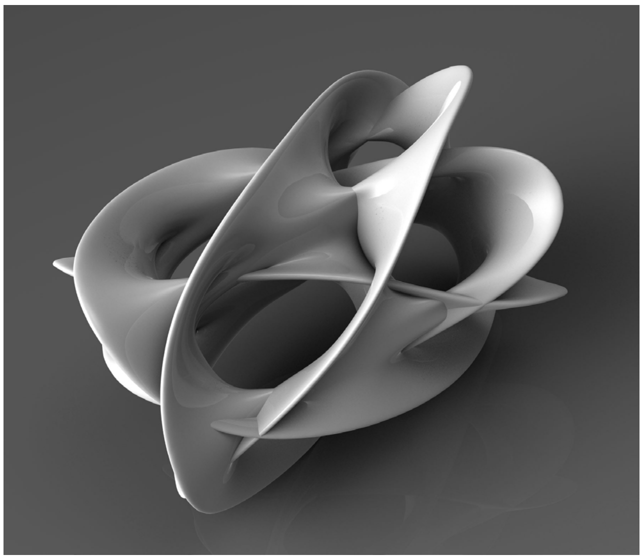
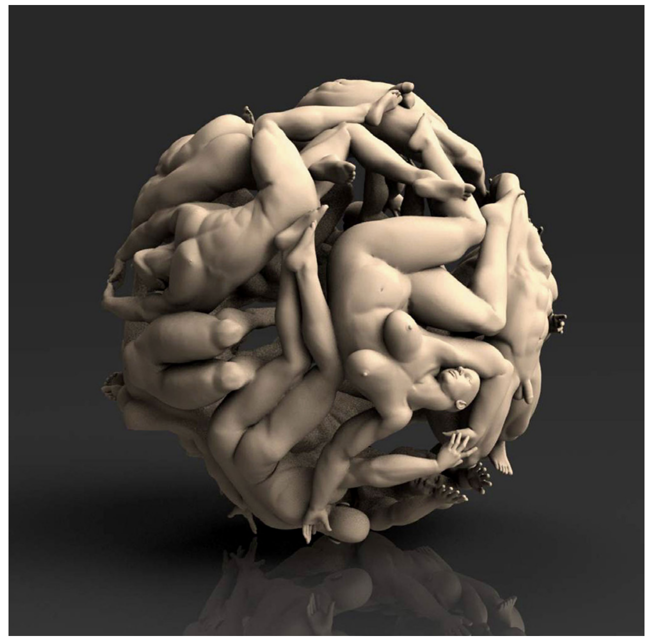


CY-N=5
24" x18" x 20"
Hydro-stone FGR
2011



Anthrosphere
12" Diameter
stainless steel bronze
2008

Within the past fifteen years, Duffy has been investigating 3D computational graphics to define and represent the underlying forms in nature. Through observation, developing a new series of intuitive mathematical sculptures, Duffy uses a hybrid of differential geometry and algebraic equations to define minimal and complex surfaces. Mathematica is one of the software programs Duffy uses to generate these 3D digital surfaces for parametric plots such as Calabi-Yau spaces. To generate mathematical sculptures he uses mainly implicit, parametric, equations in the form of source-code programming in Mathematica, Surf-X, K3DSurf, and an array of additional CAD-CAM software in order to prepare 3D files ultimately, to fabricate sculptures by using rapid prototyping and CNC-milling techniques. Duffy's forward thinking belief that the new wave of computational 3D graphics in the arts and sciences will bridge the imminent field of information and nanotechnologies.

CY-N=5 • Mathematica is the software program I used to generate this digital sculpture by way of a 3D parametric plot of Calabi-Yau space of an equation in the form of source-code programming. An array of additional CAD-CAM software was used in order to prepare the 3D file to fabricate this sculpture by using rapid prototyping techniques. This is the first in a new series of larger scale rapid prototyping of 3D computational graphics thus bridging fine arts and sciences.

Anthrosphere • "Anthrosphere" is the seminal link between the digital world and traditional techniques. The process of physical creation of Anthrosphere epitomizes contemporary manufacturing technologies such as direct metal rapid-prototyping and exemplifies the merging realms of information and nanotechnologies with fine art.

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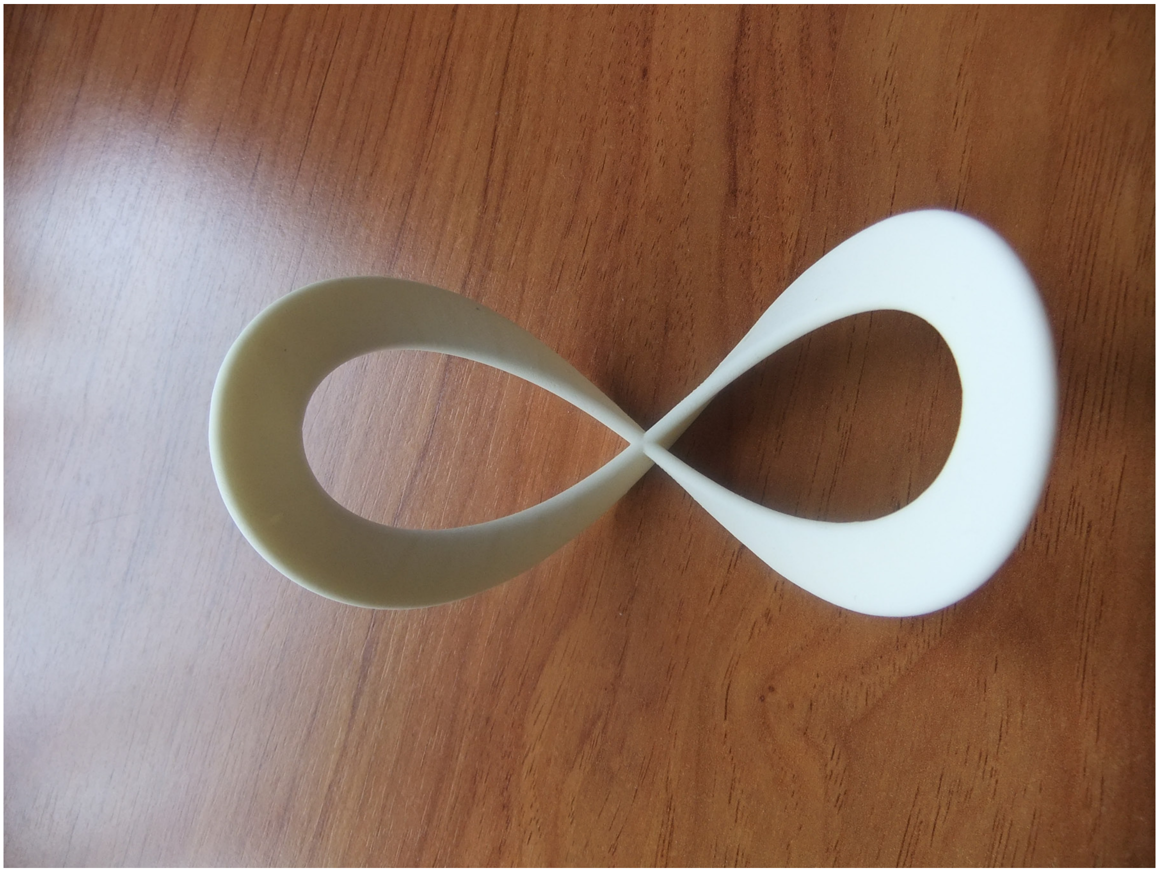


Infinite on the sphere lemniscate
102x52x52 mm
3d printed on UV Resine
2012

My 3d art is currently formed by a set of several hundred figures, most of them "wire sculptures" with axial symmetry given abstract and beautiful objects. Finding rules governing objects and beauty is one of my goals. Finding distinguished and / or spectacular copies, one of my hobbies.

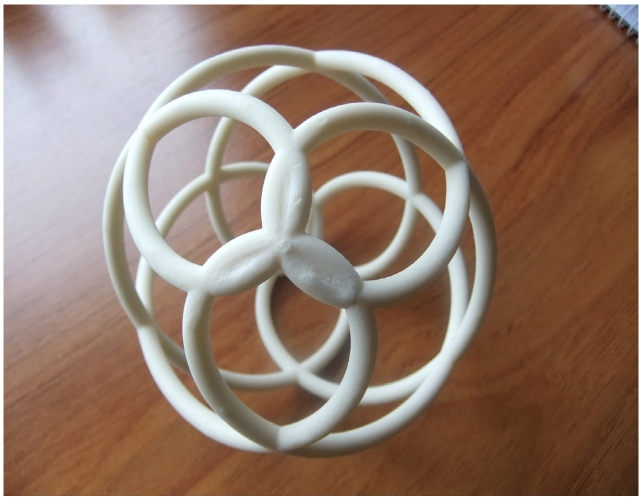
In this occasion the theme is about the spherical curves that are represented in three examples:

· Infinite on the sphere lemniscate: a curve related to the Viviani curve that is completed by extending the lines between two points giving place to the infinite symbol or the spherical version of the lemniscate curve.

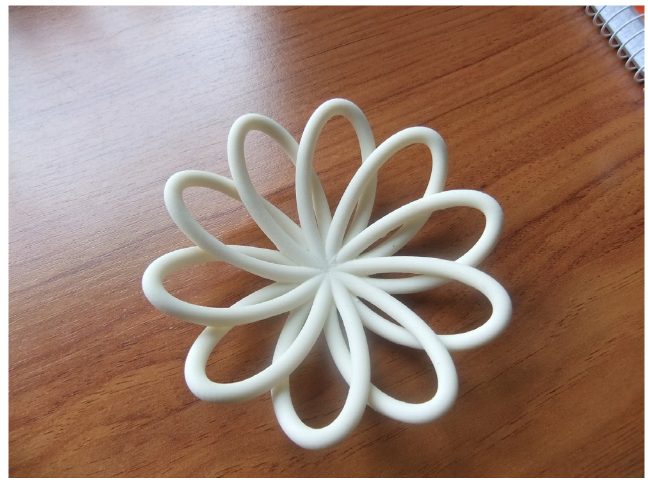
· Triskel in the spherical Lissajous world: This other spherical wire sculpture is formed by an own variant of the 3d Lissajous curve.

· The third one is, again, a combination of cosine and sine functions completed with a 3d program to result a Rose.

Infinite on the sphere lemniscate · All of them, in this kind of 3d curves, have in common that we can see a 2d rhodonea in the z axis direction. In this case, too. Related to both the Viviani and the rhodonea curves, this one is completed extending the lines between two points giving place to the infinite symbol or the spherical version of the lemniscate curve.



Triskel in the spherical Lissajous world
100x103x96.6 mm
3d printed on UV Resine
2012



Rose
100x104x24.8 mm
3d printed on UV Resine
2012

Triskel in the spherical Lissajous world · Triskel in the spherical Lissajous world: This spherical wire sculpture is formed by my own variant of the 3d Lissajous curve, a Lissajous pattern on a spherical surface. It`s possible to create spherical artistic designs with Lissajous 3d curves that are 2d curves but generated using spherical coordinates. Azimuthal and polar angles undergo oscillations while the radius is kept constant. Well, this is one of the multiple 3d curves possible in the sphere, but very many others, even no spherical curves, are related. You can see some of these spherical and not spherical Lissajous curves in shapeways.com searching for regueiro.

Rose · There are many 2d curves with flower form like many cases of rhodonea, of equation r=a*cos(k*theta) An example is r=a*cos(5/6*theta) But there are no examples of the same curve in 3d. Until this curve with simple equation with cosines and sines. Which are the equations? A problem to resolve. In fact, the equation allows us to construct many other similar 3d curves.
If you visit shapeways.com site and search for regueiro you will see many other variants of rhodonea 3d curves, which have as a characteristic that we can always see 2d rhodoneas in the z axis direction.

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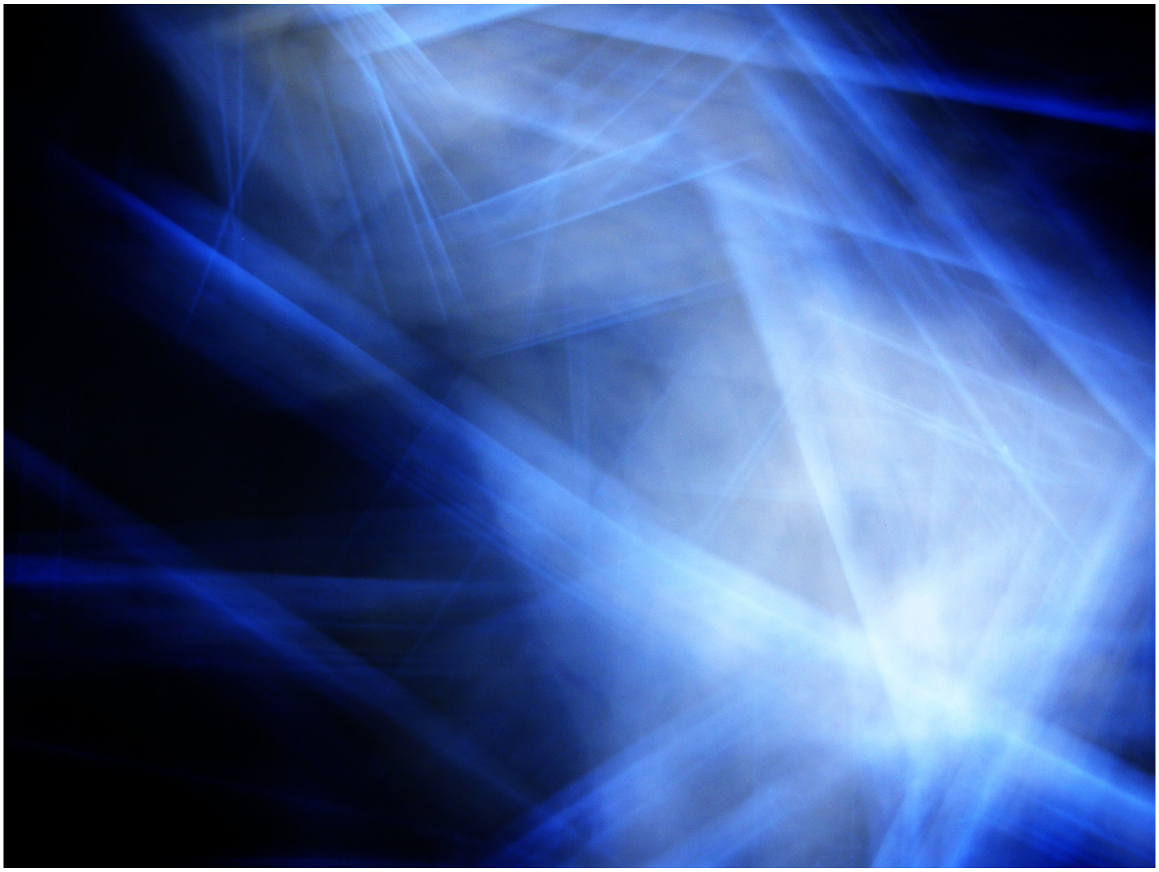

Digital Camera Pattern Painting #1: My Kitchen Door
5" X 7"
Straight Digital Photography:no computer graphics/special effects added
2009

A photographer for over 40 years, my work with geometric digital camera pattern painting is an extension of my work that I wrote about in my book Experimental Digital Photography, Lark Books (Sterling Publishing), New York/London, 2010. I had studied the microscopic images of snowflake crystals as photographed by Wilson A. Bentley and the wonderfully varied geometric tiles at the Alhambra Palace in Granada Spain. Their patterns became the inspiration for these images.

I discovered that digital photography made this kind of geometric pattern creation work now possible with photography since the immediate feedback of the LCD monitor was essential for learning and achieving these patterns. Although I was a film photographer for decades and experimented widely, this kind of imagery was extremely difficult if not impossible due to the lack of feedback with film.

So digital camera pattern painting is a relatively new and exciting art form where there is much to be explored.

Digital Camera Pattern Painting #1-#3: My Kitchen Door • The geometric pattern in this image was creating by moving a camera in a precise manner during a long photographic exposure of about 10 seconds. The photograph was of a crack of light coming through my kitchen door. I then turned the camera in a controlled manner to overlay the light to create a pattern. Other than adjusting contrast this is a straight photograph with no special effects added. I had studied the microscopic images of snowflake crystals as photographed by Wilson A. Bentley and the wonderfully varied geometric tiles at the Alhambra Palace in Granada Spain. Their patterns became the inspiration for these images. I created it using my own digital camera pattern painting techniques—a new way to use digital photography.

Digital Camera Pattern Painting #2: My Kitchen Door
5" X 7"
Straight Digital Photography:no computer graphics/special effects added
2009

Digital Camera Pattern Painting #3: My Kitchen Door
5" X 7"
Straight Digital Photography:no computer graphics/special effects added
2009

TERESA DOWNARD

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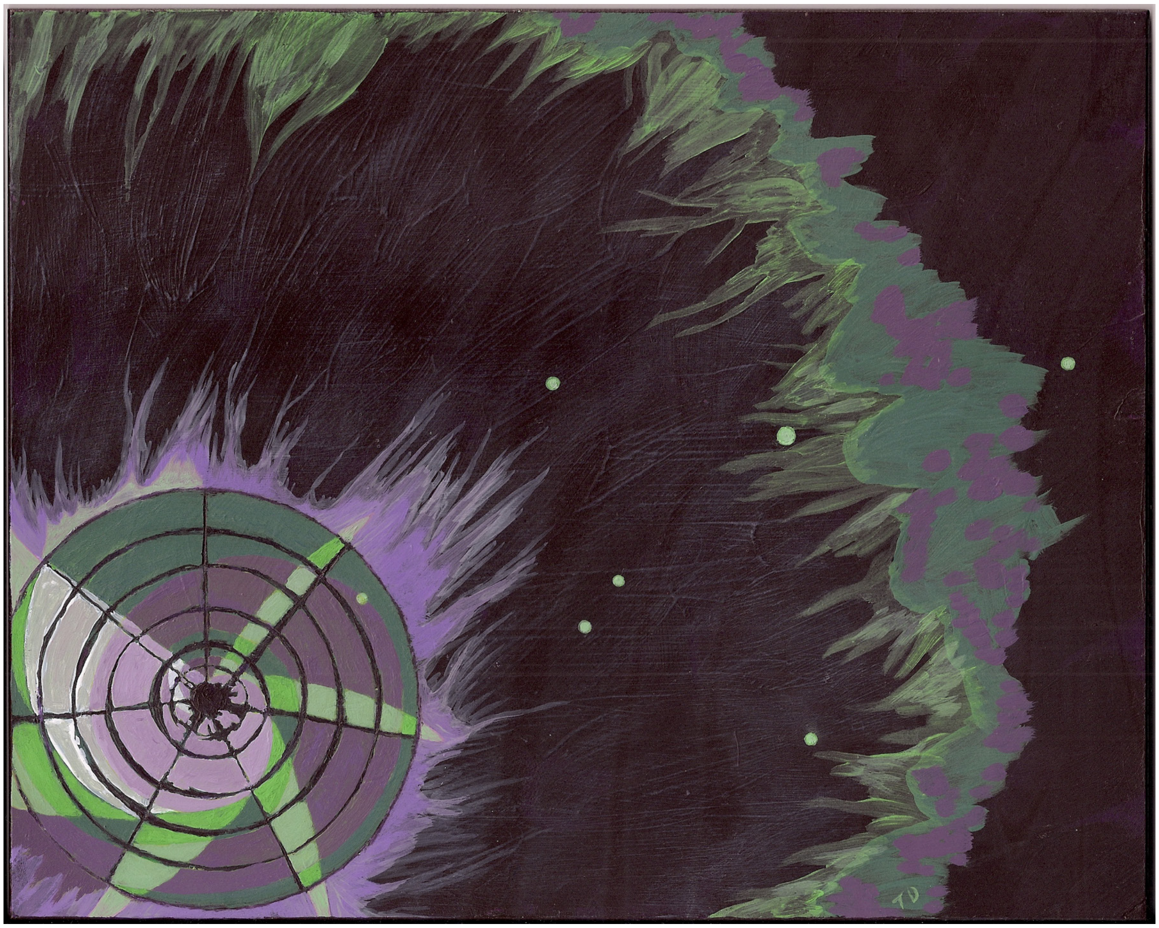

Z_7
8 x 10 inches
Acrylic on Gessoboard
2012

As an artist I am exploring the human aspect in mathematical art, issues in the mathematical community, natural textures, symmetry, and parallels between mathematical abstraction and visual abstraction. I typically paint in acrylics and oils, and also enjoy doing ink and pencil compositions.

Z_7 • A depiction of the cyclic group Z_7 with addition modulo 7. The figure on the lower left can be seen as a coordinate grid. The zero map, identity map, and others are shown with colors that intersect the grid lines. This work was inspired by study of finite groups, and was created with the intention of using symbolism to communicate mathematical ideas.

Influence
6 x 6 inches
Acrylic on Gessoboard
2011

Neighborhoods
12 x 9 inches
Acrylic on Gessoboard
2012

Influence · I was motivated to make this piece after I found a mentor through the Association of Women in Mathematics and in response to some of the math and gender discussions in the last couple years. It is likely that each female mathematician inspires atleast two young women, in my opinion having these role models will attract women with aptitude to the field in a natural way.

Neighborhoods · The set of all neighborhoods using the distance function d(A,B)=|AunionB - AintersectB| where A and B are finite sets. Here we are defining a distance between sets by the number of unshared elements. If we think of the typical drawing of intersecting sets, we can redraw this with the 'outside' set as an annulus. They are arranged like a stack of coins that has slid over, where width of the border corresponds to the number of elements. When studying introductory analysis, a classmate came up with this interesting way to define distance. For my visualization I employed wet mixing to mimic natural texture, and hoped to imbue it with some of what I feel makes abstract art compelling: simplicity that emphasizes the beauty of relationships between color, form, and texture.

SCOTT DRAVES AND THE ELECTRIC SHEEP

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Generation 244
26"x34", 41GB, 1920x1080p, infinitely running, non-looping.
Animations made by custom genetic algorithm on a distributed supercomputer, custom software, computer, screen, aluminum frame
2011

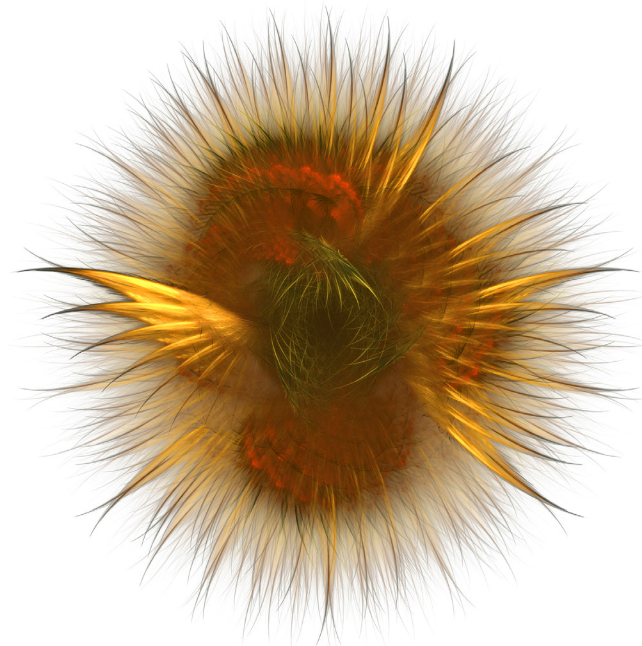
What is the relationship between man and machine? Can digital life have organic subtlety?

I run an internet-distributed supercomputer consisting of 450,000 computers and people. My algorithms date from 1992. Each image is a form of artificial life, with its own genome. I started this collective intelligence - the Electric Sheep - in 1999 with an open source screensaver that anyone can download and run. All the computers work together to render the animations, or "sheep". Users contribute via open source, crowdsource, and voting. Popular sheep mate and reproduce according to a genetic algorithm; the flock evolves to satisfy its human audience.

I use the screensaver as a design laboratory and factory to realize my museum-quality pieces. The final creations are like paintings. By applying supercomputer power and the techniques of artificial intelligence to image synthesis I create works beyond geometry and the limitations of a single human, with detail rarely seen in digital art.

Generation 244 • Scott Draves invented the Flame algorithm in 1992, and open-sourced it. Since then multiple applications have been created that allow designers to create their own flames. Draves is considered the first Open Source artist and his code has become widely used, for example on the cover of Paul Simon's last album and Stephen Hawking's last book. Scott started ElectricSheep.org as a way to get the processing power to render Flame animations and created a cyborg mind fueled by the interest of the users. The art evolves via crowd voting and genetic algorithms. Scott selected the designs in "Generation 244" as the apotheosis of the genepool in the fall of 2010; a custom algorithm runs 41 GB of 1080p abstract animations seamlessly and infinitely without looping. Generation 244, a limited edition of two, is in the private collection of Carnegie Mellon University and owned by an individual collector; this is the artist's print. It has been shown at Life/VIDA in Madrid and many galleries.

Blue Universe 243
15"x21.5", 1280x720, 21:34 loop.
Animations made by custom genetic algorithm on a distributed super-computer, computer, screen, lucite frame
2010



Dream 165.25305
24"x24"
custom genetic algorithm, chromogenic color print
2007

Blue Universe 243 • This piece tells the story of the birth, life, and transformation of a universe. The smoothly morphing animations are made by the Electric Sheep, an internet-distributed cyborg mind made up of 450,000 computers and people. The framework for the genetic material of all sheep is an open-source algorithm with thousands of parameters and millions of variables created by Scott Draves in 1992, called Flame. Sheep reproduce by Darwinian evolution, survival of the prettiest; viewers all over the Internet judge the art on the fly soon after it is generated by their computers. The sheep in Blue Universe 243 represent this story: singularity-the birth of the universe, strings, space, the planet and organic chemistry, life through photosynthesis and metabolism, sex (recombination), the egg, the womb, birth, being, consciousness, technology (society), transhumanism, singularity. The story represents Draves' artistic desire to explore and deepen the relationship between human and machine.

Dream 165.25305 • Scott Draves invented the Flame algorithm in 1992, and open-sourced it. Dream 165.25305, the "Golden Thistle", was created using the Flame algorithm and Scott's Electric Sheep project, an internet-distributed supercomputer consisting of 450,000 computers and people. Users contribute via open source, crowdsource, and voting. Popular sheep mate and reproduce according to a genetic algorithm; the flock evolves to satisfy its human audience. Although frequently mistaken for feathers or some other photographic image, this image is pure math. Each image is the result of a massive processing effort and a form of artificial life, with its own genome. Scott has a BS in Math from Brown and a PhD in Computer Science from CMU and been selected by the Prix Ars Electronica, Telefonica's VIDA 2.0 and 4.0, Art Futura, Japan's ACA Media Arts Festival, ISEA, and many more. Draves' code has become widely used, for example on the cover of Paul Simon's last album and Stephen Hawking's last book.

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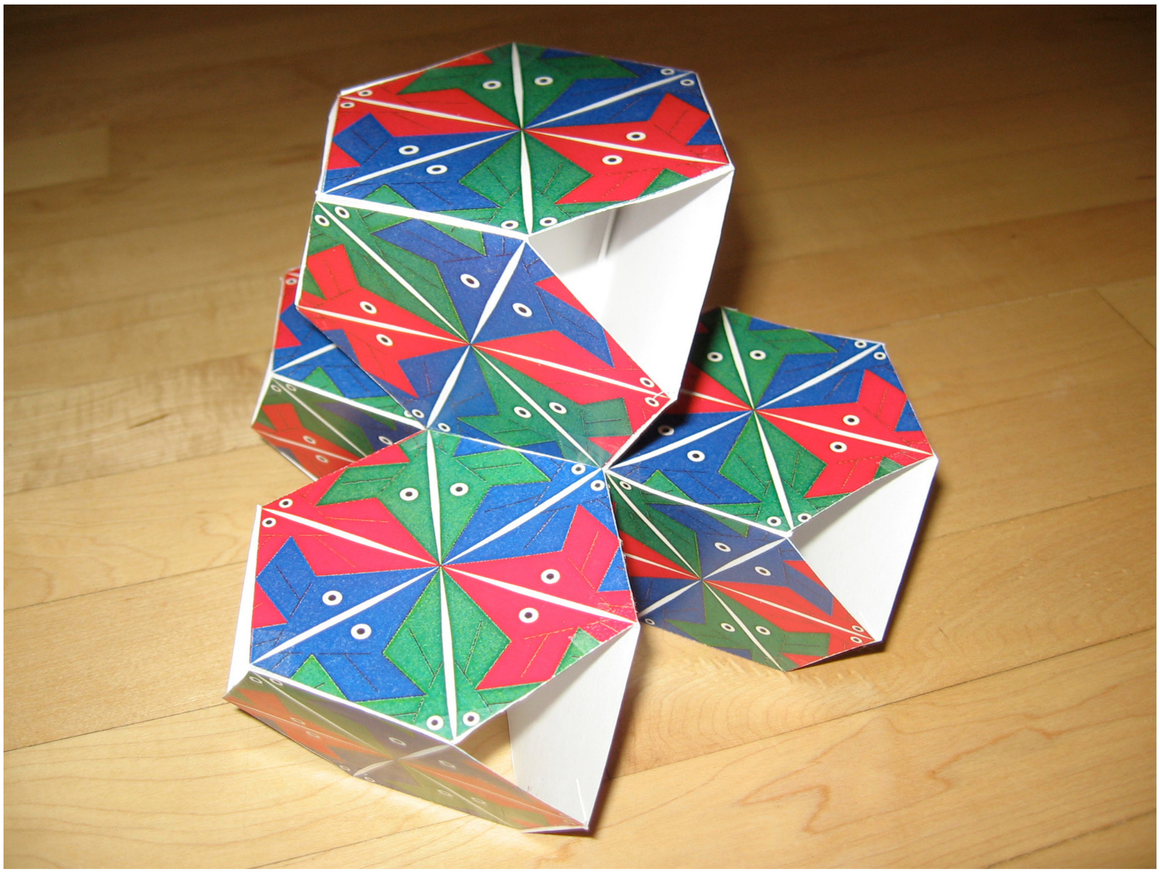

Angular Fish on the [6,6|3} Polyhedron
12x12x12 inches
Color printed cardboard
2012

The goal of my art is to create aesthetically pleasing repeating patterns related to hyperbolic geometry. In the past I have drawn patterns on the hyperbolic plane itself. But the pictures below are of patterns on triply periodic polyhedra in Euclidean 3-space, the first two of which are regular. The patterns are inspired by those of M.C. Escher, and like Escher's patterns, they have no gaps or overlaps. These polyhedra are related to the hyperbolic plane in two steps. First, the polyhedra are approximations to three triply periodic minimal surfaces (the vertices of the polyhedra all lie on the corresponding minimal surface). Second, since the minimal surfaces have negative curvature, the hyperbolic plane has the same large scale geometry as their universal covering surface.

Angular Fish on the [6,6|3} Polyhedron • This is a pattern of red, green, and blue angular fish on the regular triply periodic polyhedron composed of regular hexagons meeting six at each vertex, which is denoted by the modified Schläfli symbol {6,6|3} (the 3 indicates that there are 3-sided holes in it). The white backbones of the fish of any one color lie along (infinite) Euclidean lines that are embedded in the polyhedron. Three of these lines of fish, one of each color, pass through each vertex. The fish swim in one direction along the backbone lines, so the fish of one color enter a vertex from one hexagon and exit the vertex into the "opposite" hexagon. There are 3-fold color symmetries generated by 120-degree rotations about two kinds of axes of symmetry: those that go through the vertices and those that are perpendicular to the centers of the hexagons.

Angels and Devils on the {6,4|4} Polyhedron
10x10x10 inches
Color printed cardboard
2012

Fish on the {3,8} Polyhedron
20x20x20 inches
Color printed cardboard
2012

Angels and Devils on the {6,4|4} Polyhedron • This is a pattern of angels and devils (inspired by M.C. Escher) on the regular triply periodic polyhedron composed of regular hexagons meeting four at each vertex, which is denoted by the modified Schläfli symbol {6,4| 4} (the last 4 indicates that the polyhedron has square holes). The axes of bilateral symmetry of the angels and devils are colored red, green, and blue. Disregarding the pattern, the polyhedron has the same symmetries as the cubic lattice. The pattern of colored bilateral symmetry lines has 3-color symmetries about the 3-fold axes perpendicular to the centers of the hexagons. These are the 3-fold axes of the "body" diagonals of the corresponding cubic lattice.

Fish on the {3,8} Polyhedron • This is a pattern of fish (inspired by M.C. Escher's Circle Limit III) on the regular triply periodic polyhedron composed of equilateral triangles meeting 8 at each vertex, which can be denoted by the Schläfli symbol {3,8}. It is formed from octahedral hubs which have octahedral struts that connect the hubs; the struts are on alternate faces of the hubs. This polyhedron is an approximation to a minimal surface which is the boundary between two congruent, complementary solids, both in the shape of a "thickened" diamond lattice (the hubs are the carbon atoms and the struts are the atomic bonds). There are fish of four colors. The blue fish all swim around the "waists" of the struts. The yellow, green, and red fish swim along lines that approximate the Euclidean lines that are embedded in the minimal surface. In the image above the yellow fish swim right to left, the green fish swim from lower left to upper right, and the red fish swim from upper left to lower right.

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Bach's Jesus beliebet meine Freude—A four-point perspective
18"x18"x18"
Steel wire

The appreciation and demystification of mathematics is a common thread thata runs through my mathematical art. After using a variety of media including bronze, drawing, glass, and painting, I settled on quilting mathematics in the early 1980's. The quilts serve as a visual introduction that allow students to explore mathematics as they gain more insights.

As the number of quilts increased each year, I was able to write lesson plans for the quilts. The quilt topics were based on what I was teaching at the time—mostly geometry and algebra. From the beginning, Mathematical Quilts and More Mathematical Quilts were published. I have been able to share my love of mathematics with quilt groups, mathematics groups, museums, and various other interested groups. I am hoping to meet some of the mathematicians that have inspired me over the years at the Bridges conference in Baltimore.

Bach's Jesus beliebet meine Freude—A four-point perspective • Inspired by Dick Termes work on perspective, I decided to design my own four-point perspective! The harpist, Elizabeth Alhgrim, posed for this work along with playing Bach's beautiuful Jesus bleibet meine Freude. The fascinating tie between music, mathematics, and perspective are all exhibited in this creative work.

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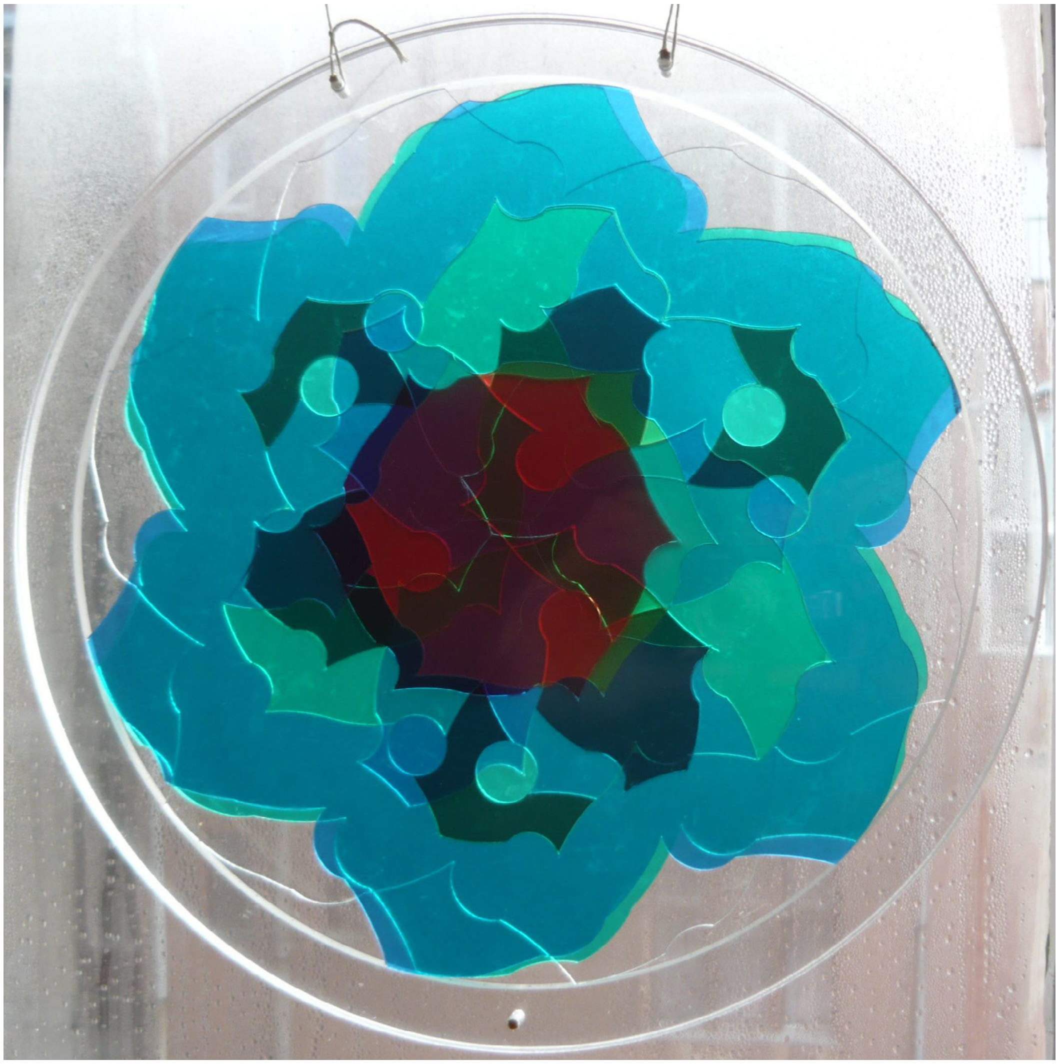

Whirling leaves
30 cm in diameter
plexiglass, colored transparent plastic wall-paper
2012

Originally I wanted to make special, form-breaking tiles, and first I made equilateral triangle tiles in my grandfather's oven. Soon I made tiles with curved shapes but the high possible variation of tiling of these tiles made me think that I should make special jigsaw puzzles instead, so I do. I make puzzles with curved puzzle peaces, there are many ways of assemble, and I try to make them esthetical.

Whirling leaves • Whirling Leaves is a three-layered, transparent jigsaw puzzle. The puzzle consists of three flower-shaped frames, one on top of the other, each of which can be filled by small puzzle-pieces. The three puzzle-layers can be assembled in several different ways. The set also contains a bottom and a cover circle-plate, as well as an annulus-frame into which the three flower-shapes fit. Each layer can be rotated 360 degrees around. When light shines through the differently tinted, transparent pieces, subtractive coloration can be observed: the player can explore this interesting phenomenon while positioning the pieces on each other. The completed puzzle, fastened by the plates and the annulus can be hanged up in a window. Mathematical basis: the hidden structure underlying the puzzle is a simple equilateral triangle web. The two smallest pieces symmetrically constitute a triangle, and the bigger pieces are in fact constituted by the two smallest pieces.

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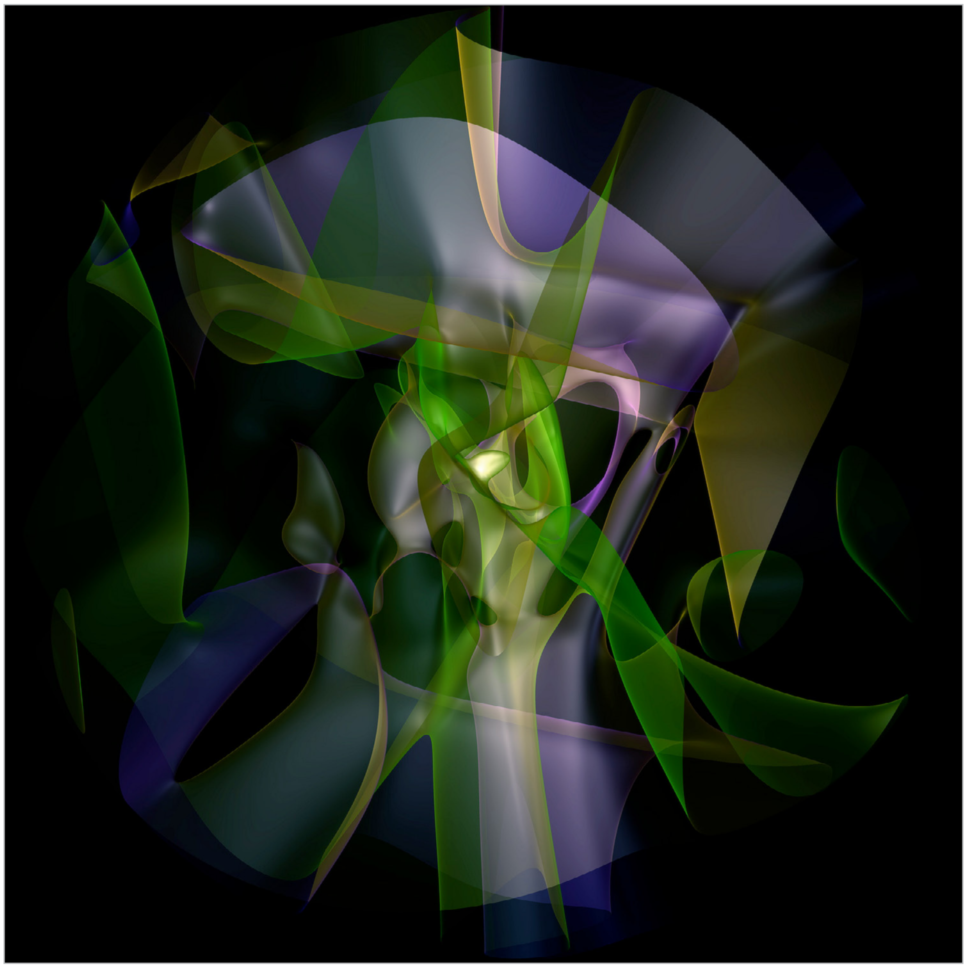
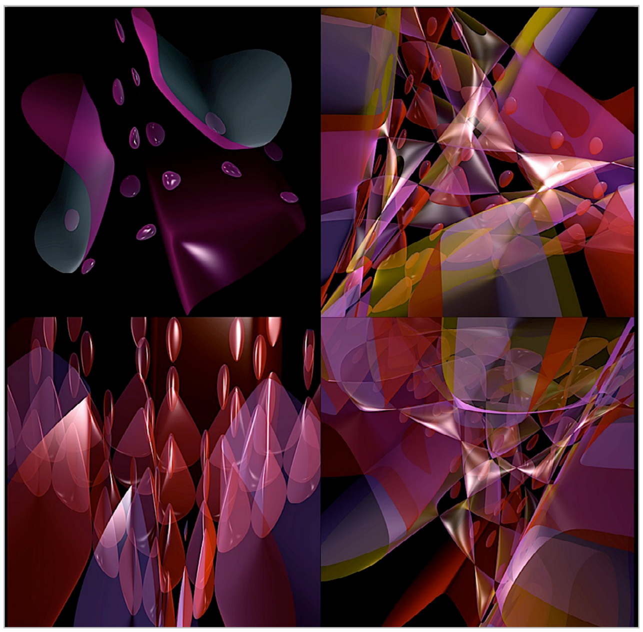


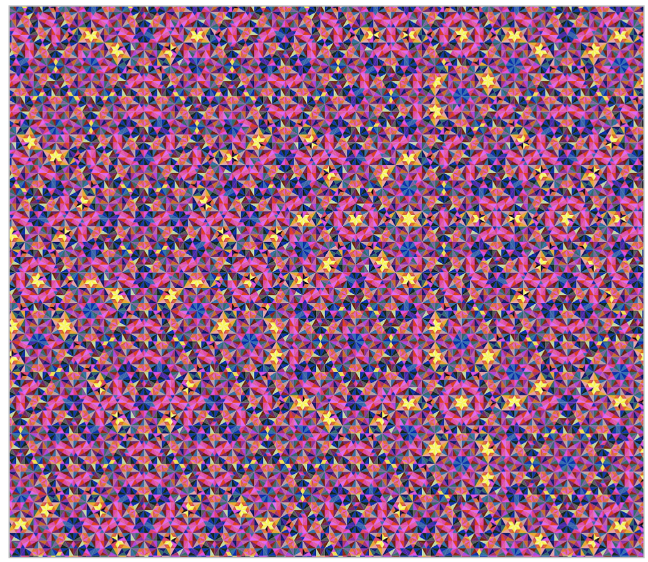
d12-4D-Dos-E
14x14 inches
Digital Print
2011

A possible way to remove the gap between the worlds of sciences and humanities, is the search for interconnections between mathematics and physics with the sound and visual arts. There are several prominent examples in the 20th century in the domain of the sound arts like the greek architect, engineer and composer Iannis Xenakis, who used tools ranging from statistical mechanics to group theory, and the spanish composer Francisco Guerrero, who felt a fascination with mathematics and physics which is reflected on his high quality music. In the visual arts there are also well known artists inspired by mathematics in the last century, but perhaps there is a lack of perspective yet to analyze their significance.

d12-4D-Dos-E • The basic geometric constructions for the generation of substitution tilings in the series of "Branched Surfaces" are simplicial arrangments of lines or pseudolines. Simple arrangements can be obtained either as subarrangements ("A construction of algebraic surfaces with many real nodes". http://arxiv.org/abs/1107.3401) or by rotations ("Substitutions with vanishing rotationally invariant first cohomology" Discrete Dyn. Nat. Soc., Vol.2012). One of the two subfamilies of simple arrangements produces real variants of Chmutov surfaces ("Real line arrangements and surfaces with many real nodes". Geometric modeling and algebraic geometry, Springer (2008)), and the other gives surfaces with a larger number of real nodes as those shown in previous works like "Nueve y 220-B" or "Quince y 1162-Carceri-B". The polynomials obtained as product of lines in the simple arrangements can be used to construct hypersurfaces. This work is based on a projection in 3D of a degree-12 singular 3-fold.



d6+12SA7
14x14 inches
Digital Print
2011



Branched Surface VI-fragment
24x28 inches
Digital Print
2011

d6+12SA7 • Surfaces with many singularities of type Aj can be obtained also by using the polynomials introduced in arxiv:1107.3401. Explicit constructions are possible by adding classical Jacobi polynomials to the polynomials obtained as product of lines. We explore here deformations of a sextic with 59 real nodes and a dodecic surface with 37 nodes and 66 singularities of types A3 and A7, all of them also real. Mathematica and Surfer computing and geometric visualization tools are used.

Branched Surface VI-fragment • Hexagonal substitution tilings were introduced in (Int.J.Mod.Phys.B, Vol.18 (2004), p.1595) by means of simplicial arrangements of pseudolines. The analysis of the topological invariants of the associated space of tilings ("Topological invariants and CW complexes of cartesian product and hexagonal tiling spaces". Numerical Analysis and Applied Mathematics. AIP. Conf. Proc. Vol.1389 (2011), p.1702) leads to the introduction of a branched surface. This work can be interpreted as a metaphor of a nomad place, a space in constant change where local configurations of a very small number of shapes always reappear, but in different surroundings. This "ritornello" type property is preserved when we extend the pattern to infinity. The basic hexagonal symmetry is continuously broken and has to be perceived in a dynamical way, as would be the case if temporal phenomena were embedded.

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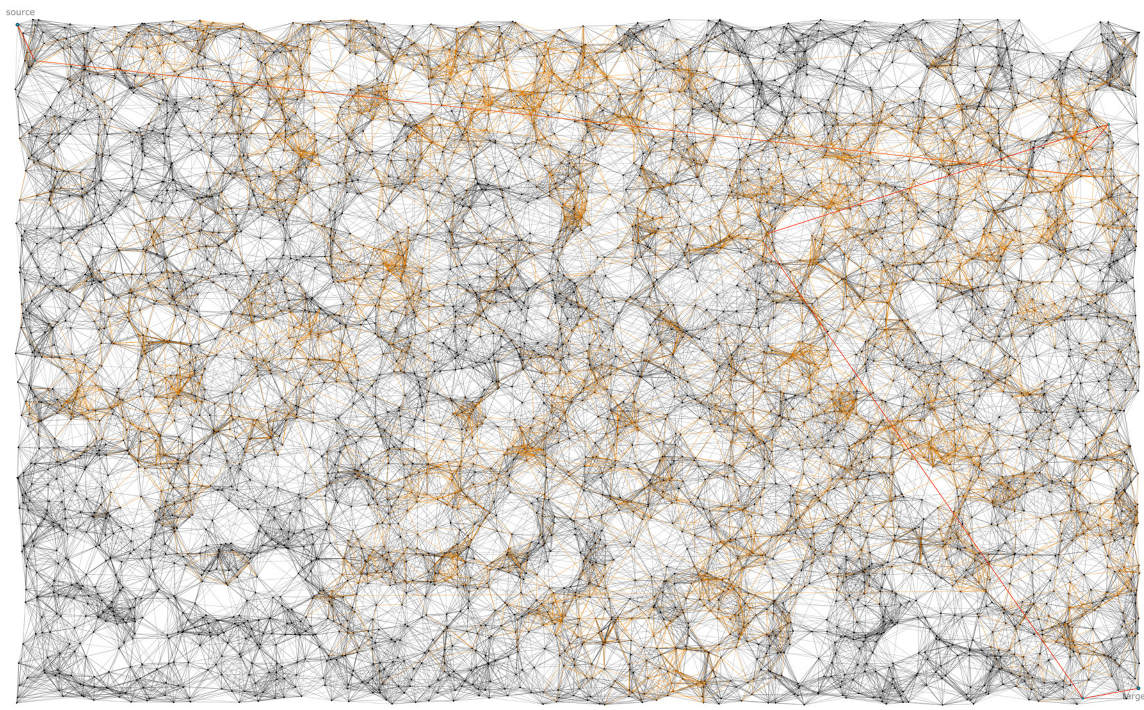


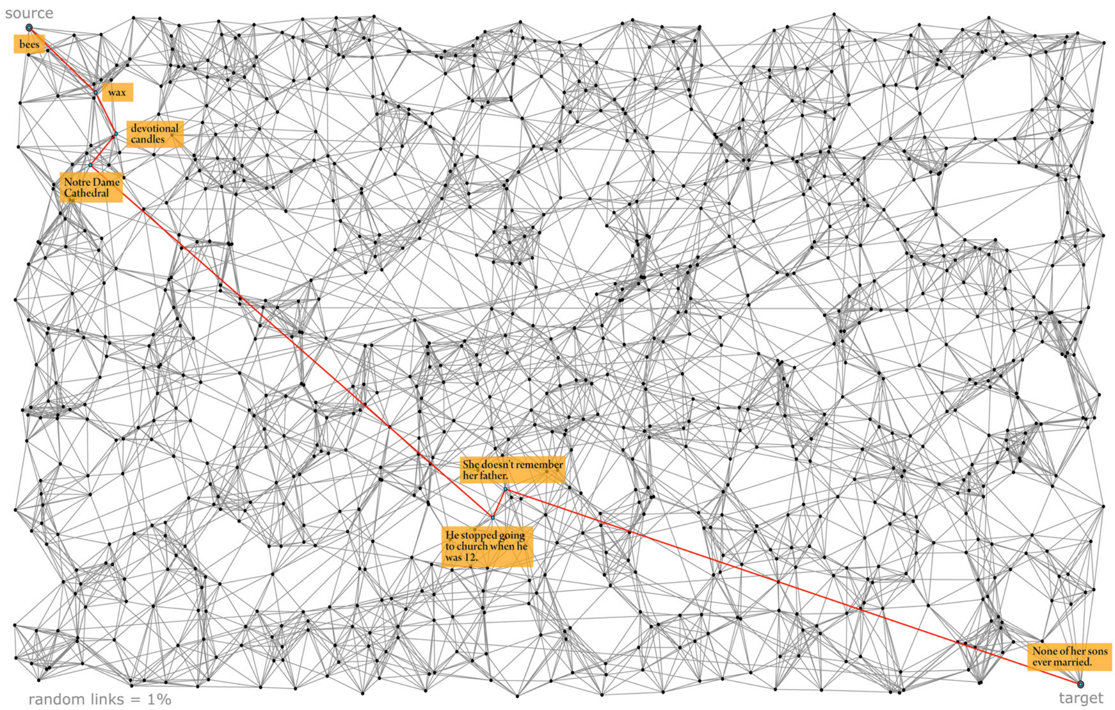
pensée perdu
17x24 inches (framed)
digital print
2011

We are order-seeking creatures. Through our senses we receive signals from the world around us. Our senses convert these signals into neural data we then interpret, thus creating all of our experience. We try to make sense of these signals. What endures? What repeats? What changes? We look for structure.

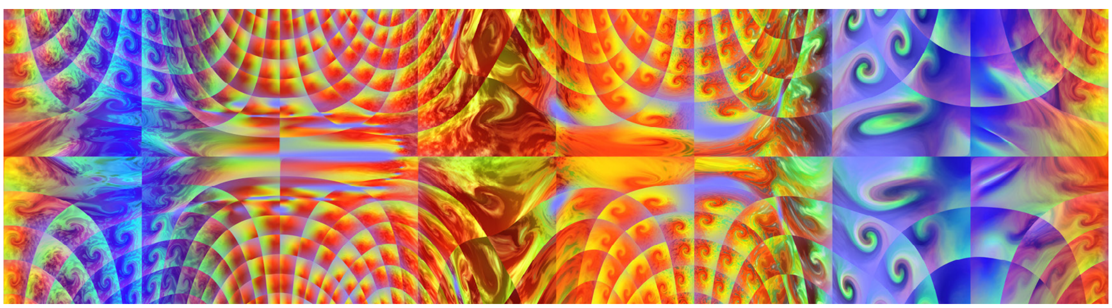
We recognize and compare patterns, trying to understand the sensory data. We build a basis from which we make choices. Living is the making of choices, based upon the received signals and perceived pattern within those signals. Finding pattern is the making of metaphors—mapmaking across conceptual domains.

As a digital artist I make maps that bridge the domains of number, sound, image and computation. I map experience to number and back into experience again. New patterns emerge. New knowledge is possible. From new knowledge a finer sense of order can be discovered.

pensée perdu • Here we are lost in thought, with one thought linking to the next. We see a stream of consciousness traced as a walk (in orange). Ironically there is a simple path from source to target, a creative leap, a short cut. But inside the network it's impossible to see. We are lost in the world without a map. Trying to fulfill a desire, or simply find our way home, we search not quite randomly for a destination, never really knowing how close it always is. This work is computational, visualizing topographies of networks that model the structure of our brains and the structure of our culture. Parsing a network from source to target is all about finding our way—from problem to solution, person to person, here to home. We find our way through a small world, a network of incestuous links and a little randomness. It's pathfinding through myriad maps. And as behavior follows structure, it's not surprising that the intricacies of our lives mirror the filagreed arbors of our neural forests.



melancholia
17x24 inches (framed)
digital print
2011



salia #2
13x31 inches (framed)
digital print
2011

melancholia • Thoughts move through our neural networks as little spikes of chemistry-induced electricity. Like pinballs bouncing from bumper to bumper; these spikes connect the most subtle of patterns, memories that traverse the small world linkages of our brain, axon to dendrite, axon to dendrite. We hear the buzz of a bee on a dry summer day and feel sad. Why is that? This work is computational, visualizing topographies of networks that model the structure of our brains and the structure of our culture. Parsing a network from source to target is all about finding our way—from problem to solution, person to person, here to home. We find our way through a small world, a network of incestuous links and a little randomness. It's pathfinding through myriad maps. And as behavior follows structure, it's not surprising that the intricacies of our lives mirror the filagreed arbors of our neural forests.

salia #2 • Here we see a slice, through the time dimension, of an abstract animation (a mathematical visualization). LIke a slit-scan photograph we see how a single scanline changes as a time-based visual object (a video animation) unfolds. This 2D slice of a 4D object is then mapped into sound, so the image is actually a graphical music score. I sonify the score to create music that correlates sonically with what we see unfold visually in the animation. We hear the colors. We listen with our eyes.

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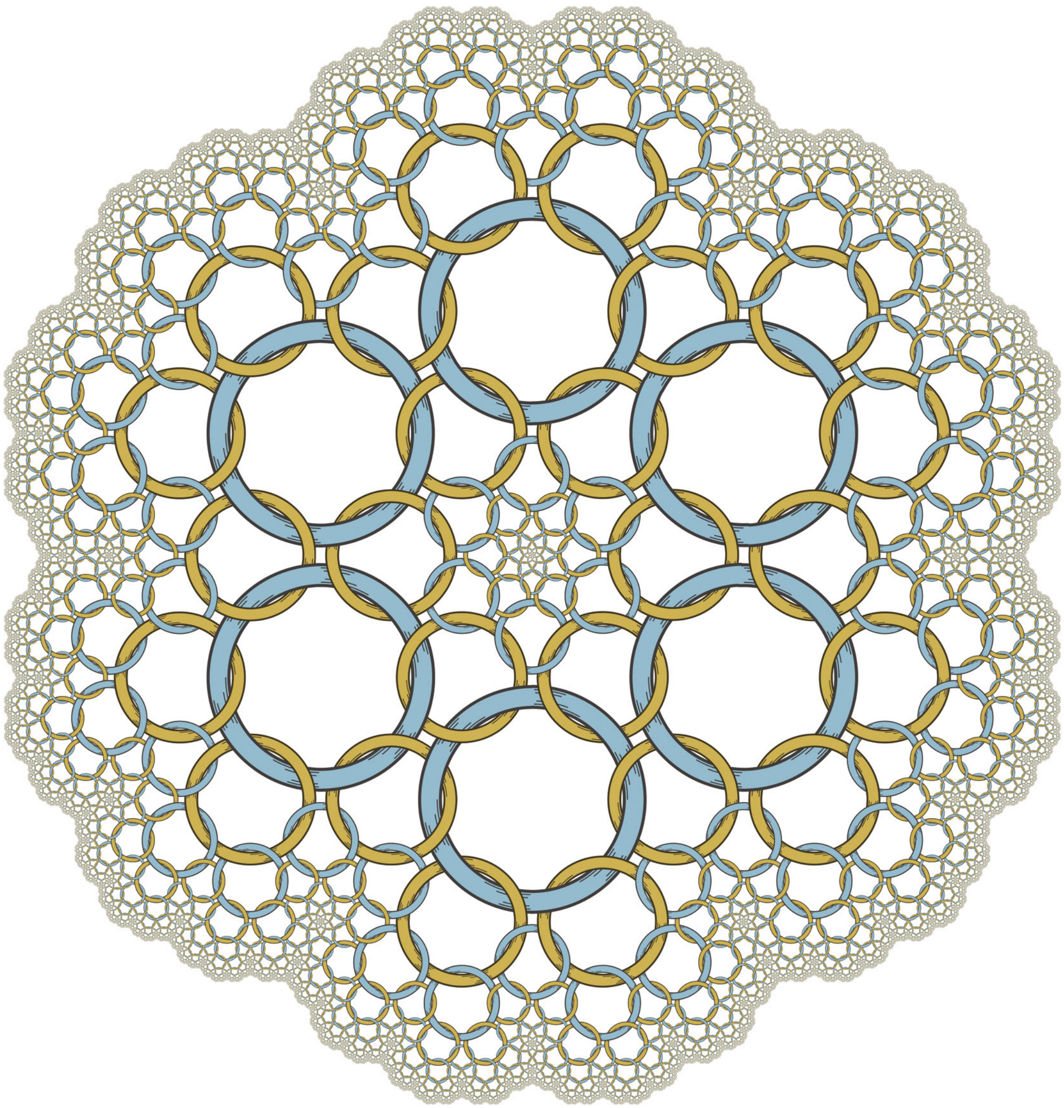


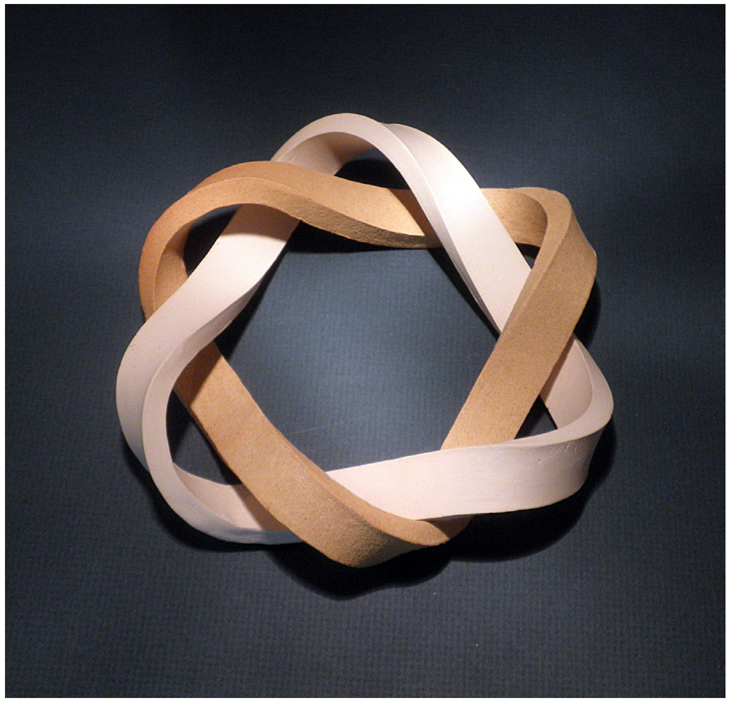
Six-fold Infinite Rings
18" x 18"
Archival inkjet print
2012

I'm fascinated by beautiful and complex forms both in mathematics and in the natural world. Combining mathematics with artistic creativity allows me to explore and express these ideas in unique images and forms.

Six-fold Infinite Rings • This design was created by decorating a fractal tiling with ring graphics. The design possess a fractal boundary, as well as singular points (at which the rings become infinitesimally small) at the center and other locations within the boundary.

Six-crossing Link • Two loops, made using two different types of clay, are linked together. Each loop has three half-twists, making each a sort of Möbius band. The strands cross in six places.

Six Half Cubes • The polyhedra in this sculpture result from cutting a cube in half with a plane perpendicular to the long diagonal joining opposing corners. The face revealed by this cut is a regular hexagon. In this work, six of these polyhedra are arranged with the cut faces down and forming a regular plane tessellation of hexagons, as seen in a mirror below the half cubes, which are set atop an acrylic box. From the top, the arrangement exhibits the uncut faces of the cubes. Two each of the cubes are formed from three different types of clay.



Six-crossing Link
7" x 7" x 2"
Ceramics
2012

Six Half Cubes
9" x 9" x 9"
Ceramics
2012

BARTNECK ET AL.

CONTACT

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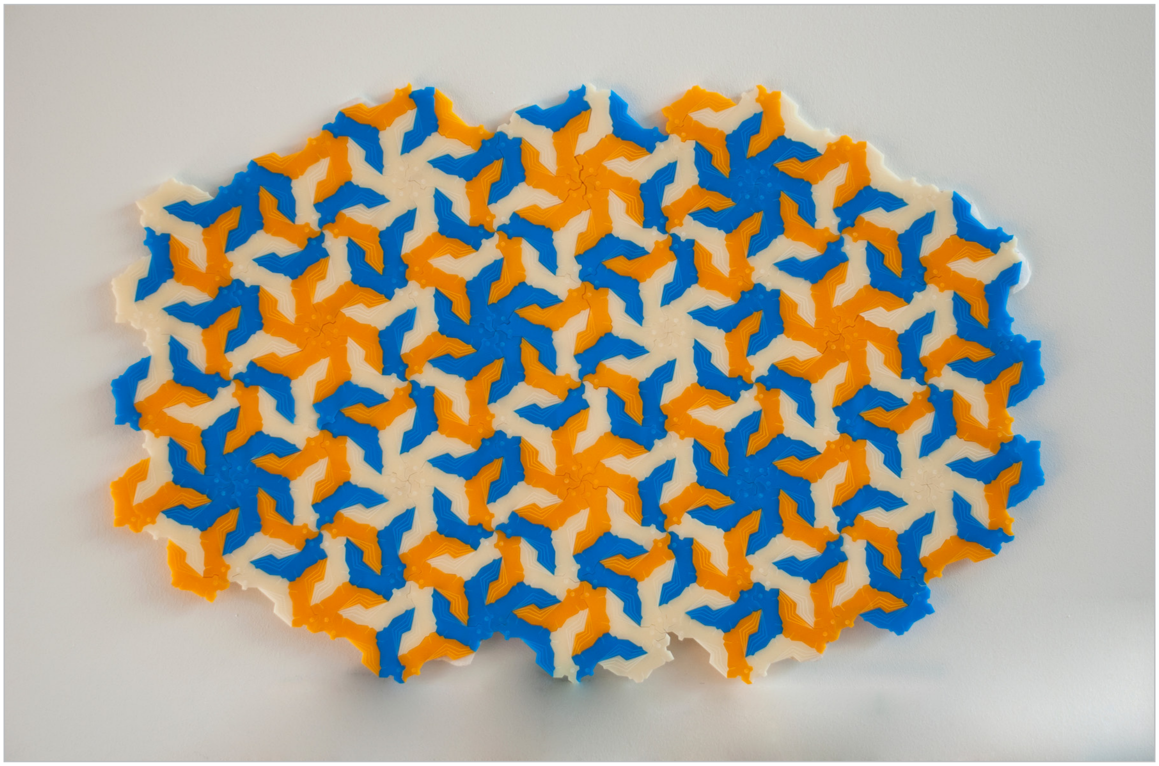
Man-shaped figures by Thomas van Lankveld
60 x 60 x0.5cm
laser cut wood
2011

The art works proposed are examples of results of a yearly workshop for industrial design students at TU/e. The workshop serves to teach mathematical principles to design students. The students defined tessellations in mathematical formulas, using the Mathematica software. But we do not stop at a digital representation of their tessellation design, we continue to cut their tessellations in Perspex (using vector graphics output from Mathematica). It moves the abstract concepts of math into the real world, so that the students can experience them directly, which provides a tremendous reward to the students. The pedagogics of the approach has already been described in [Bartneck, Feijs, 2009]. Now we selected three of the most interesting works for the exhibition. Two are in Perspex where pieces of different colours have been glued together. The third work also includes wood. In our opinion the works are visually interesting and the material qualities add to the overall aesthetics.

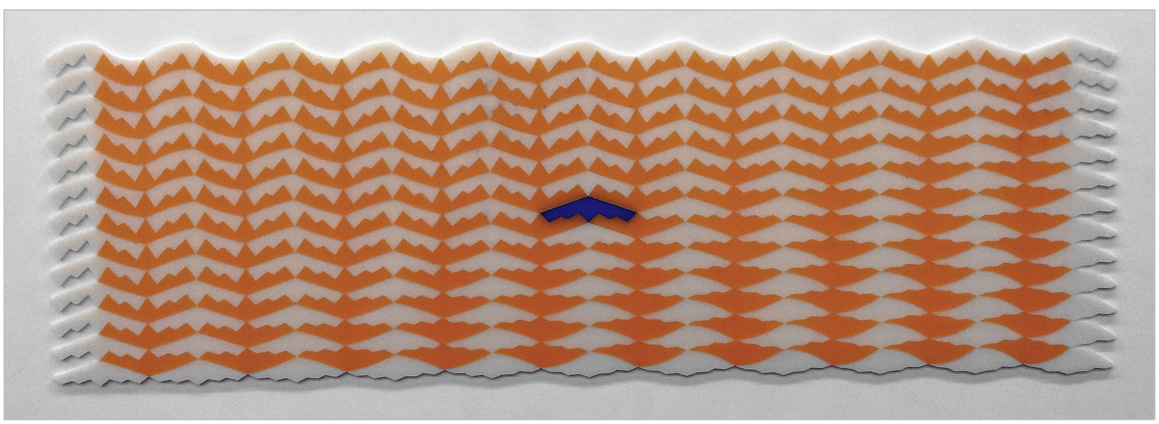
Man-shaped figures • Circular TTTTTT configuration of man-shaped figures by Thomas van Lankveld.

Skunks • Tesselation of Skunks by Wouter Kersteman.

Stealth • Gradually changing tesselation of stealth like figures by Rick van de Westelaken.



Skunks by Wouter Kersteman
58 x 36 x 0.6cm
coloured perspex, laser cut, foamboard background
2008



Stealth by Rick van de Westelaken
60 x 23 x 0.6cm
coloured perspex, laser cut, foamboard background
2008

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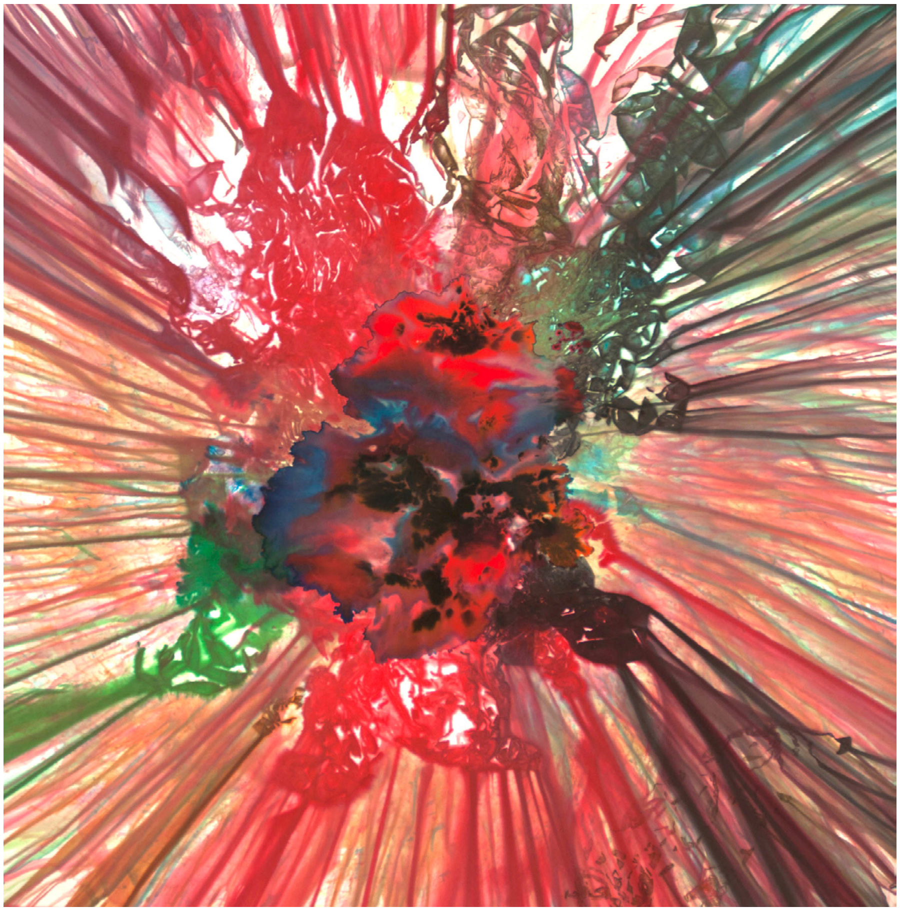

Spectra
33"x33"
Spinning Tissue Ink Monoprint
2012

In 2005 I discovered a stack of brightly colored tissue paper tucked away in my grandmother's basement. After unfolding the tissue, I noticed that water leaked onto the paper and left an intricate stain. This event inspired a shift in my creative process. A few weeks after I started working with tissue paper, Hurricane Katrina began bearing down on the Gulf Coast and I witnessed "water moving color" literally, the power of nature, and the neglect of a nation. The sheer magnitude of the destruction and the remaining marks of flooding struck a direct connection to my artwork.

Since then I have worked with "bleeding" tissue paper, witnessing its deterioration; in and out of water, ripped and pieced back together, thrown, stepped on, forgotten and remembered. The union of the tissue fragments is rooted in my familial quilt-making heritage and the tradition of preservation and resourcefulness. Each piece speaks to me as a memory of existence and resilience.

Spectra • I use "bleeding" tissue paper, water and archival pulp substrate to capture the chaotic movement of water and color blending on a spinning surface. By mounting my project on a potter's wheel, I'm able to stand above my work, and while in motion use the wet tissue like a brush. As the wheel turns at different velocities and intervals, the ink spreads and mixes with other colors while simultaneously the intricate stains are absorbed into the pulp substrate permanently. The distribution of ink undergoing circular motion evolves in such a way that the gradient of the paint density changes with time and regions such as attractors, islands or basins appear. The colors then escape to infinity forming chaos artwork.

Here & There
10"x17"
Spinning Tissue Ink Monoprint
2012

Time Lapse II
20"x20"
Tissue Paper Collage
2011

Here & There • I use "bleeding" tissue paper, water and archival pulp substrate to capture the chaotic movement of water and color blending on a spinning surface. By mounting my project on a potter's wheel, I'm able to stand above my work, and while in motion use the wet tissue like a brush. As the wheel turns at different velocities and intervals, the ink spreads and mixes with other colors while simultaneously the intricate stains are absorbed into the pulp substrate permanently. The distribution of ink undergoing circular motion evolves in such a way that the gradient of the paint density changes with time and regions such as attractors, islands or basins appear. The colors then escape to infinity forming chaos artwork. The two large dark basins in this work are remarkably similar to KAM islands in chaotic Hamiltonian systems.

Time Lapse II • Spirals represents the cycle of life, death and rebirth. Tiny scraps of tissue paper collaged together were used to create the undulating sculpture "Time Lapse II". Reflecting on Zeno's Paradox, I piece each tissue bit into the spiral meditating on the infinite possibilities of a single piece of paper breaking into minute fragments. I also envision this work evolving from the natural formation of the Spiral of Archimedes.

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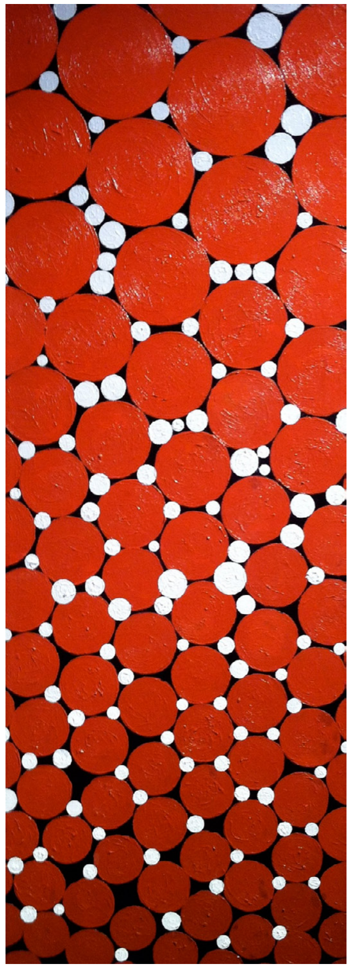

Circles
8" W x 24" H
Acrylic on canvas
2008

Geometric shapes intrigue me, especially overlapping ones. As do things composed of just a few elements. I don't know why. I can only speculate. I am also interested in things that are asymmetrical yet balanced. It's all very intuitive to me, and I'm comfortable with that. I think that we're aware of many things that we don't know we're aware of. For instance, I'm not a mathematician yet my work demonstrates many mathematical concepts. Upon reflection, this really isn't surprising. Math is everywhere and it's part of everything, including us.

Circles • [ROD FULTON] Movement created with a simple repeating shape. The orange cirlces get bigger as they rise, like bubbles. The white circles were added afterwards because the painting wanted them. [MATHEMATICAL ANALYSIS BY DR. TATYANA SOROKINA] Classical circle packing problem: given a container (e.g. a rectangle) find the best arrangement of arbitrarily sized circles inside of the container. The number of circles might be fixed, in which case a measure of quality of packing needs to be introduced. Alternatively, one could aim for an arrangement that would accommodate the most number of circles. This piece is a variation of the traditional circle packing problem where we are given circles of different radii, however, larger circles have higher weights in the final count. In general, this is an unsolved problem. Adding colors takes us to the three-dimensional analog of this problem called sphere packing . It is used in granular structure modeling, where colors reflect different grains.

Cityscape
30" W x 40" H
Acrylic on canvas
2011

Garden
48" W x 36" H
Acrylic on canvas
2005

Cityscape • [ROD FULTON] This is an example of interlocking geometric shapes and asymmetry and balance. The buildings are one of the things that overlapping rectangles suggest to me. When the buildings are taken as a whole, the whole piece has only three pieces: the skyline, the moon/sun and the sky. Nothing is centered, yet the whole thing feels right. [MATHEMATICAL ANALYSIS BY DR. TATYANA SOROKINA] Cityscape is an example of the approximation of a skyline of a city. It is a non-trivial problem since the skyline is discontinuous. Most numerical analysts agree that L1 norm should be used. The solution is given by piecewise linear discontinuous function, known as a discontinuous spline. Cityscape attempts to show a possible solution to a more general problem – approximation of a cityscape. It uses the idea of "multiple skylines", adding colors to bring out features of the cityscape. The non-centered source of light helps to "smooth" the corners of the cityscape.

Garden • [ROD FULTON] This is an example of overlapping geometric shapes, simplicity, and asymmetry and balance. There are only four "thingss" in the piece: the sun the tree, the land and the sky. They all seem to be in the right place. [MATHEMATICAL ANALYSIS BY DR. TATYANA SOROKINA] This is is an example of multicolored Voronoi diagrams of higher order. Traditional multicolored Voronoi diagrams consist of polygonal regions of different color. The boundary of each cell is a piecewise linear curve. Voronoi diagrams of higher orders as well as Voronoi diagrams based on a non-Euclidian metric allow using curves of higher order. Second order curves have been used, along with the coloring of each Voronoi cell to reflect sophisticated shapes and color modes of nature.

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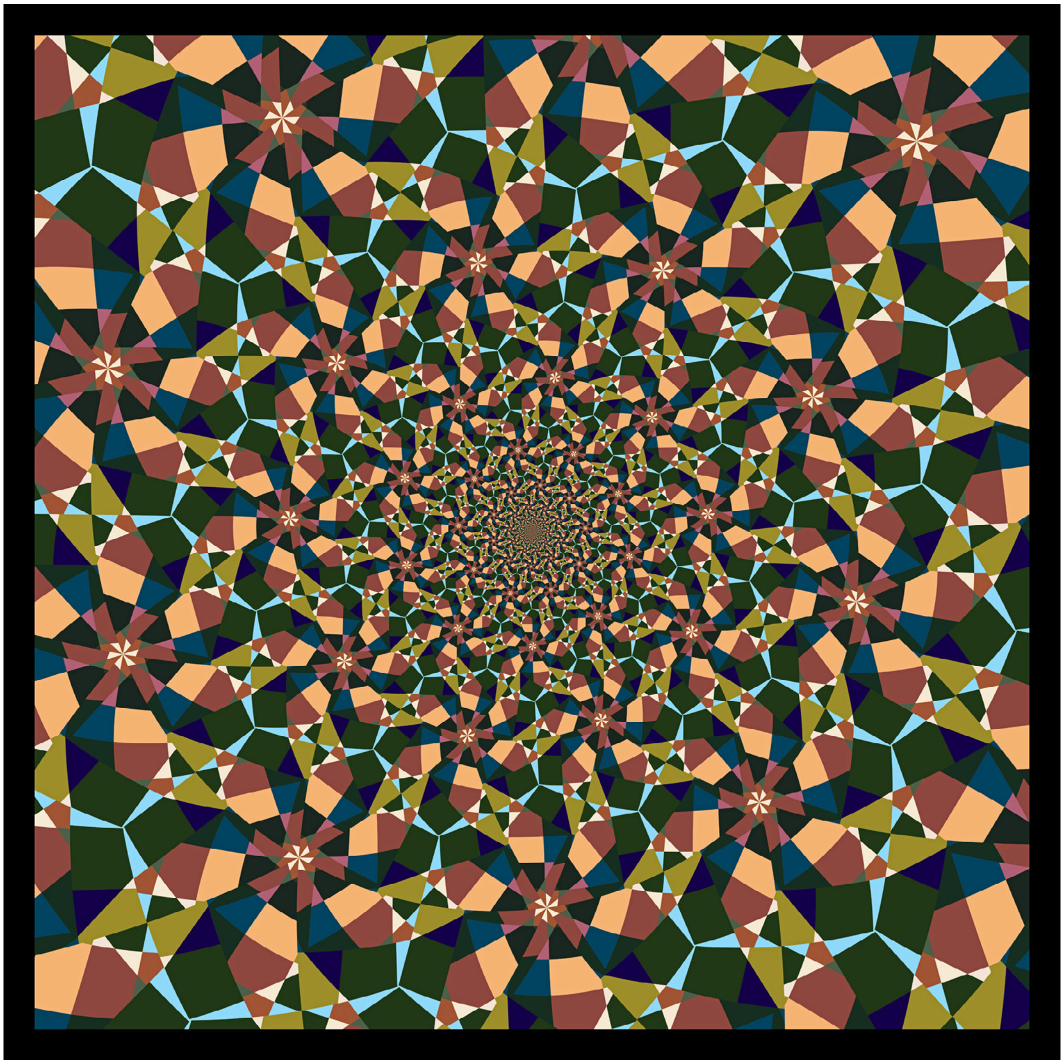
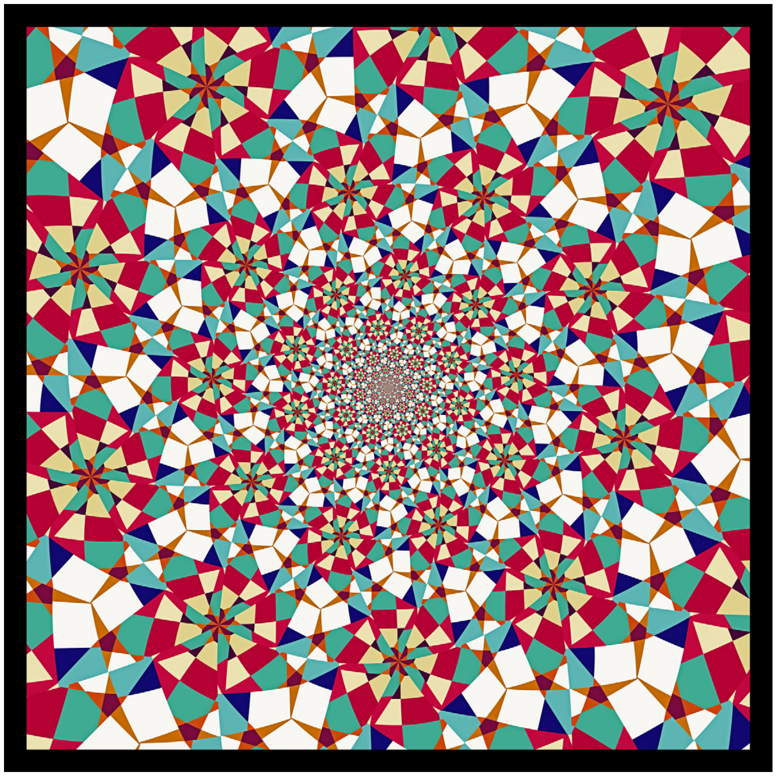


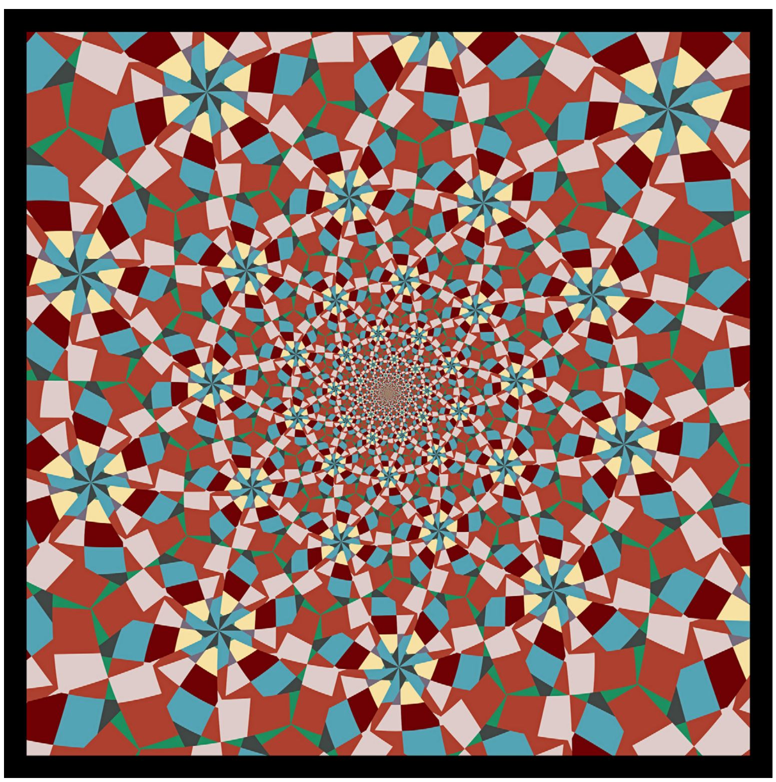
Domination of Colors #1
20" x 20"
Digital Art Print
2012

Coloring, along with patterns and layouts, is one of the most important parts of designing tileworks. Due to the repetition of tiles with similar shapes and colors throughout the tiling, colors can play important roles in giving more meanings to the patterns. Actually, in a thoroughly white tiling the form and geometric arrangement of tiles do not show off properly. It is the coloring which by distinction or integration of adjacent tiles creates geometric patterns in form of color territories. It is actually where colors create diverse geometric beauties. With this explanation, I am, here, presenting three fractal tileworks with exactly the same geometric arrangements but different coloring methods.

Domination of Colors #1, #2, #3 • In these examples, the role of color configurations in creation of diverse patterns is clearly evident. Each of these examples is a result of trying hundreds of color gradients, manipulations, and adjustments. Color layering was another useful technique I used which does not have any equivalence in the world of traditional coloring. All these processes of experimenting hundreds of possibilities might take even months in traditional techniques; however, with the aid of computers I could see the result of changing the colors of a lot of tiles at once with a simple click. It might seem like some tiny tiles are added or removed from one work to another, while it is just because of the similarity or difference of the colors of those tiles and their neighbors in each work.



Domination of Colors #2
20" x 20"
Digital Art Print
2012



Domination of Colors #3
20" x 20"
Digital Art Print
2012

S. LOUISE GOULD AND FRANK GOULD

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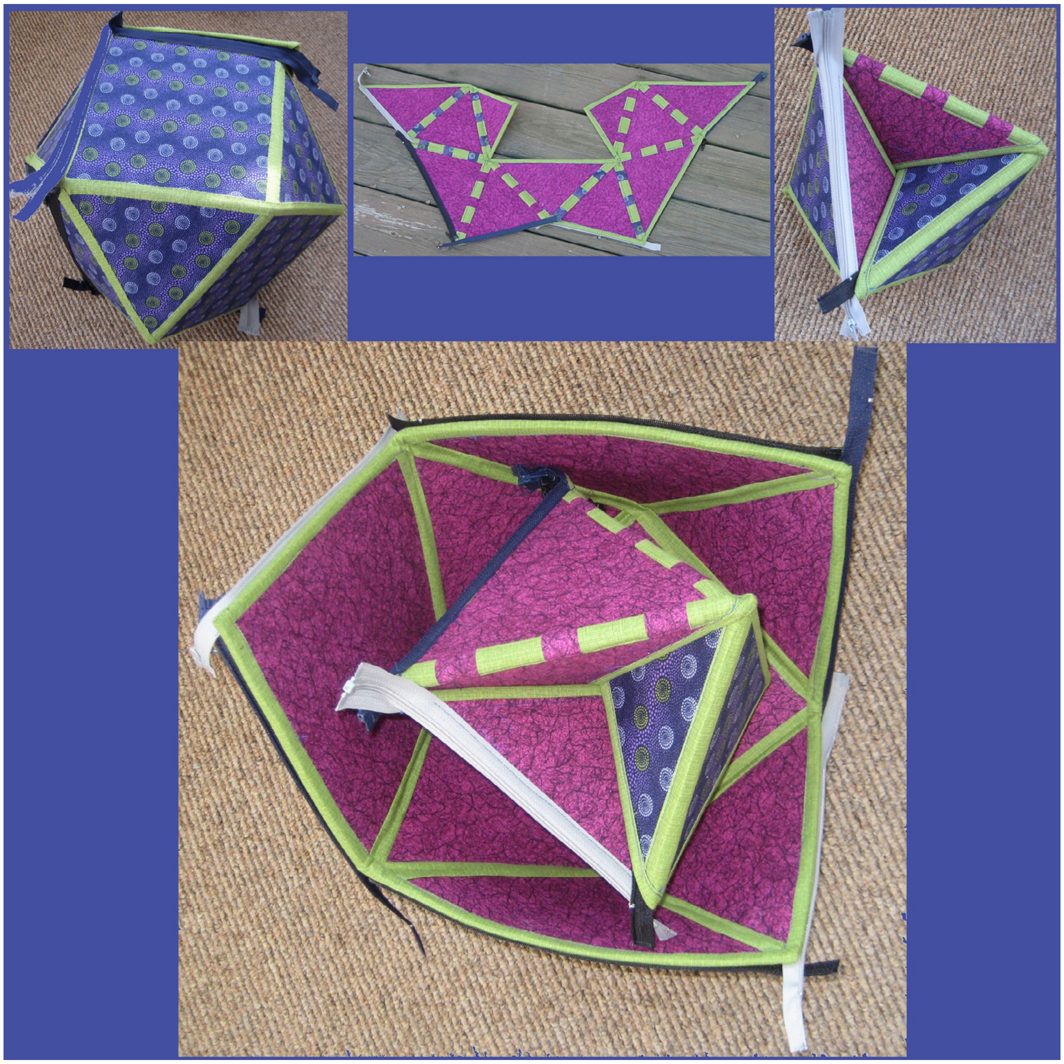

Zipping is Believing–Cuboctahedron to Faceted Octahedron Model of the Projective Plane
12" x 12" x12"
Fabric supported by very stiff stabilizer, separating zippers, velcro for rigidity
2011

My mathematical art grows out of my experiences with my students and my explorations of mathematics, textiles, paper, and technology. I enjoy working with computer controlled machines such as the computerized embroidery sewing machine and the Craft Robo (plotter cutter) as well as traditional looms and knitting machines.

Zipping is Believing--Cuboctahedron to Faceted Octahedron Model of the Projective Plane • This interactive three-dimensional piece consists of a cuboctahdron that can be unzipped into two congruent halves. The exterior of the cuboctahedron is blue the interior red. One of these halves can be folded in such a way that three of the square faces intersect each other in the center of a faceted octahedron. Opposite edges of the half "sphere" are twisted and zipped together forming a model of the projective plane shown on this model as blue meets red. Clues to the folding are marked as valley (blue and green stripes) and mountain folds (red and green stripes) on the red side and the color of the zippers. The inspiration and mathematical motivation is to better understand the projective plane by examining this particularly symmetric polyhedral model.

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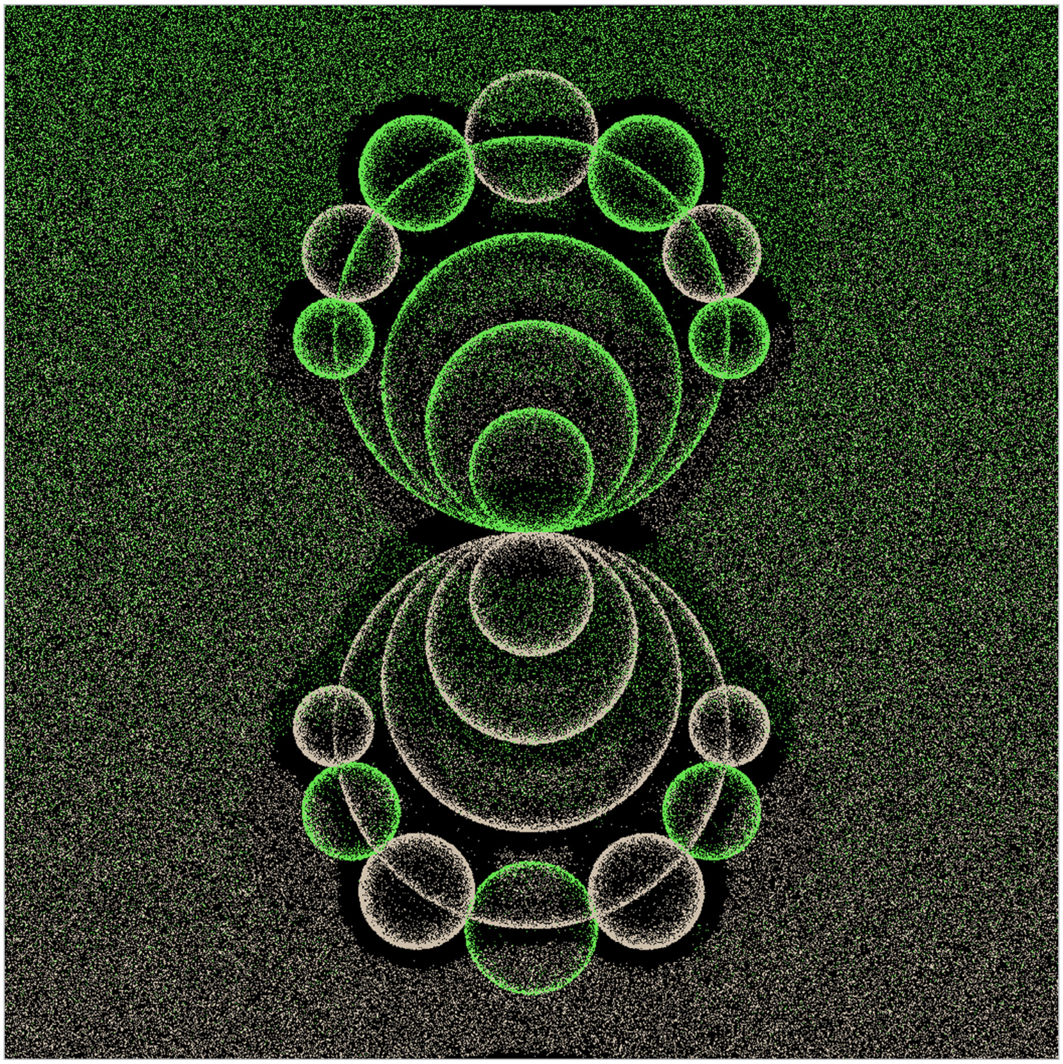

Stigmmetry Print #28235
10.5" x 10.5" (unframed)
Digital Print
2012

Many of my computer generated algorithmic art works are based on visualizations of simulations based on mathematical models of natural processes. Examples include cell morphogenesis, swarm behavior, and diffusion limited aggregation. By controlling various drawing attributes, I try to focus the viewer's attention on the complexity underlying such processes.

Stigmmetry Print #28235 • Stigmergy is a form of self-organization that is brought about by indirect coordination of agents or actions. I consider a model based on stigmergy for simulating the nest formation of ants from the species T. albipennis. The ants collect dispersed grains of sand to form circular nests. My stigmmetry prints are designed by assigning centers, radii, and colors to virtual nests of ants in such a way that a uniform density grid of virtual sand grains self-organizes into a pattern which, up close, has no color symmetry, but from a distance is perceived of as either color preserving or color reversing under various symmetry operations. The pattern for this print was inspired by a crop-circle image I chanced upon, because it required devising an algorithm for solving an elementary problem I had never considered before: Given a finite sequence of radii, how do you construct a sequence of centers so that the resulting circles both lie on a common circle and are succesively tangent.

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Erosion
6x10x8 inches
Wood: cherry
2010

My profession as a research chemist laid the foundation for my enjoyment of the substructures that define the shapes we see in nature. For me mathematical patterns, especially topological surfaces and fractals, have always been intriguing and inspirational. In my designs I seek to achieve balance and motion through structural tension.

The 3-D shapes of molecules were one of several reasons that drew me to the field of chemistry. After leaving research, I have found designing and fabricating furniture and sculpture affords me the same excitement I experienced in a laboratory: problem solving, hands-on work, 3-D visualization, high tech materials and computers. By presenting the essence of a form found in nature I hope to remind the viewer of those shapes found in the cosmos.

Erosion • I wanted to create curves using straight lines and to suggest the strata that define sedimentation patterns in the earth. Included on part of the surface of this piece is a "landslide" where I show how the idealized geometry of strata can change over time. My art has been described as celebrating "truth and beauty," but here I include a dark indentation on the surface, one that might be created by the forces of entropy. The mathematics of contour modeling could inform the generation of this shape over time. As the triangular slats fan away from each other their length becomes the time axis.

Celtic Trefoil Table
17x21x21 inches
Wood: cherry
2009

Cosmos
7x13x10 inches
Wood: cherry
2011

Celtic Trefoil Table · The inspiration for this design came from Miranda Lundy's book "Sacred Geometry," where she describes the Euclidean geometry used to generate a trefoil. Lundy found this particular trefoil in the masonry of a church window near the Isle of Man, but trefoil geometry exists in many Christian church windows. I have incorporated the essence of the elegant Isle of Man design as the stretcher in this glass top table.

Cosmos · The processes found in tree growth and in the evolution of the cosmos have similar patterns. Energy and mass interconvert during both galaxy and cell formation; emergence can result in self-organization. Where growth rings intersect in the wood grain one is reminded of colliding galaxies and a black hole. I have added a worm hole in space by drilling through the log. The rending of the fabric of the universe appears in the natural splitting of the wood where the tension of expansion exceeded the force holding the grain in alignment. For me this cross section of a cherry tree at the point of branching suggests chaos and complexity mathematics frozen in time.

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Squares within a square
100cm x 100cm
cotton fabrics and thread
2012

I am interested in linking Mathematics with art using different mediums. Presently I am using patchwork and quilting techniques to reproduce mathematical ideas. Some of my work is inspired on the Wolfram Demonstrations Project site. Recursions, tiling of the plane and Voronoi diagrams are some of the mathematical topics that I've used in my works. I am very happy that the Bridges conferences exist and provide the opportunity for artists and mathematicians to meet.

Squares within a square • This work is a simple yet delightfully elegant fractal obtained from a square. Halving the sides of the square to obtain four equal squares and repeating the procedure over the up-right square, produces a fractal which is characterized by a visual convergence of stair-shaped lines towards the up-right corner of the larger square. This work is a recreation of the fractal using strong coloured cotton fabrics. To enhance the effect of the recursion, blue and red colours alternate along the iterations.

SUSAN HAPPERSETT

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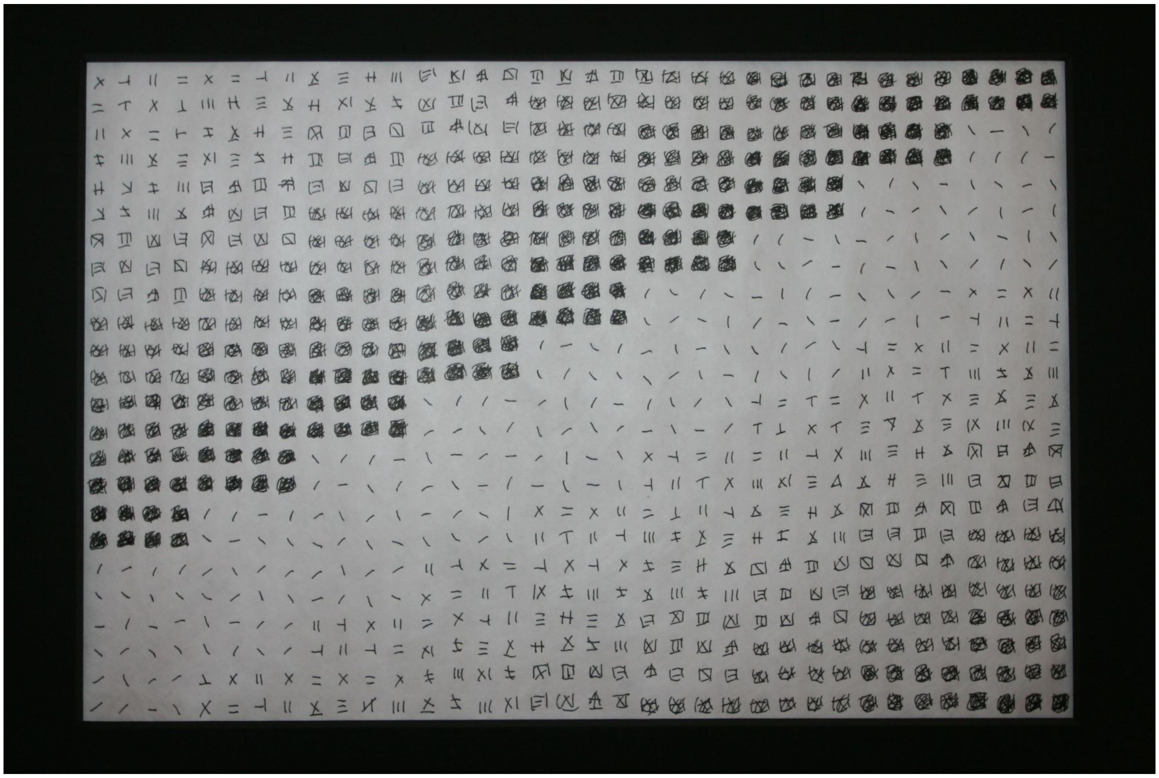

Fibonacci Staircase
26" by 19" by 2"
Tyvek, Ink, Board, Frame and Dowels
2012

My fascination with mathematics and my love of visual arts has led me on a journey to build a link between mathematics and drawing. It has become my mission to express the intrinsic aesthetic value of Mathematics in a purely visual language. I use a number of graphing and geometric plotting techniques to examine the aesthetic characteristics of functions, sequences and series in a visual language. My drawings are an intense accumulation of lines and mark making resulting from my predisposition to counting.Through the years my drawing has become a type of meditation.

One of my drawing methods involves the development of a hand made grids and a mapping process for each drawing. I decide on the proportions of the grid and then make a plan for the number of markings or strokes in each square. Many of the mathematical sequences in my work involve growth patterns.Some drawings are based on the Fibonacci Sequence. My drawings take the form of books, scrolls, videos and paintings.

Fibonacci Staircase • An interactive scroll in a viewing frame, allowing the viewer to scroll though a long drawing, mimicking my stop-motion video technique.The scroll is based on the Fibonacci Sequence and step progression. Hand drawn with ink on Tyvek. Hands-on art work.

GEORGE HART

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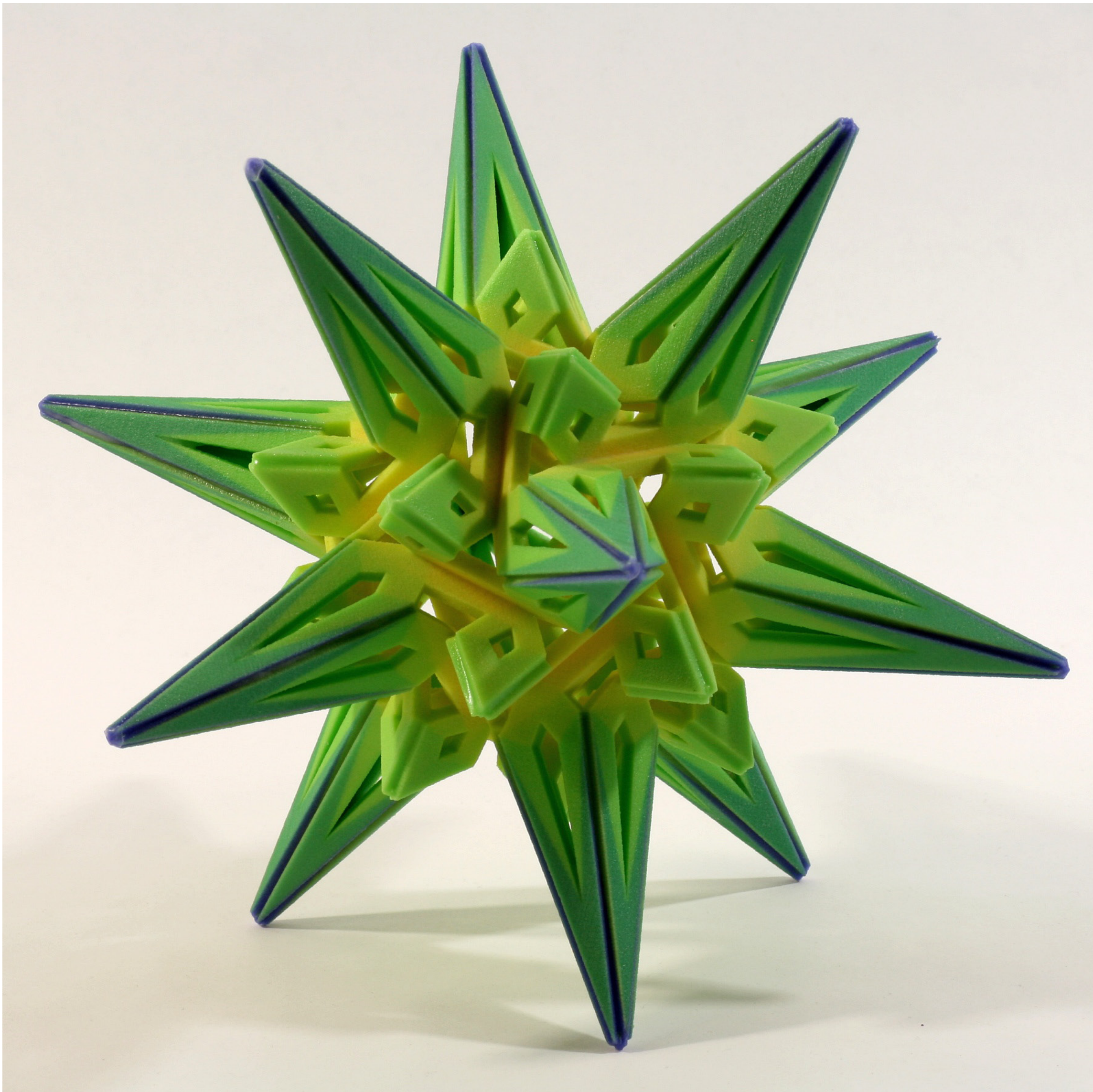

Star
9x9x9 inches
3D printed
2012

Math is cool!

Star • The underlying geometry of this twelve-pointed star is based on a stellation of the regular icosahedron, but I've adapted it with openings and small geometric modifications into a sculptural form. The coloring varies from yellow near the center through shades of green to blue in the outer crevasses.

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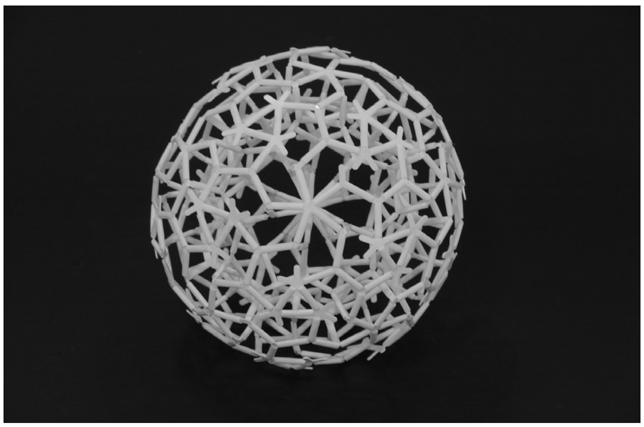


A spherical harmony of horizontality and verticality
7.9"x7.9"x7.9"
Handmade, 4D-frame
2011

Figure1.

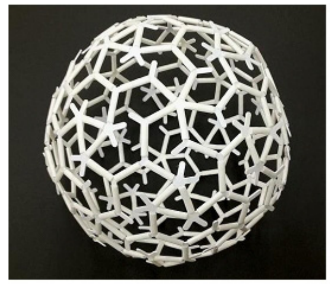


Figure2.

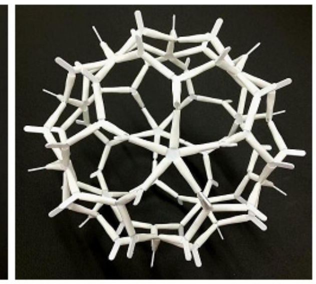


Figure3.

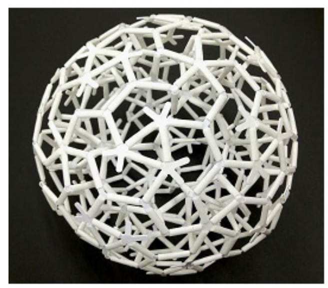
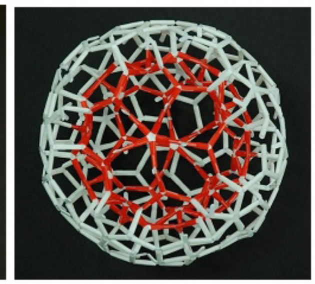


Figure4.



Explanation of "A spherical harmony of horizontality and verticality"
24"x24"
Handmade, 4D-frame
2011

I enjoy creative math-culture activities on the boundary between Mathematics and Art. Sometimes I create artwork with geometrical tube design; at other times I enhance a mathematical visualization model to the point where it becomes a piece of art. I have designed "Stars over the Alhambra's Palace", "Islamic Solid Tessellation", "The Wall of Our Math Classroom We Design", and etc. with tubes.

We define a polyframe by a collection of finite line segments which are connected. So, almost all artworks with geometrical tube design are polyframes as well.

We are developing the spherical versions of tube designs according to the following scheme: First, we observe and analyze the designs of the soccer ball "Telstar" and the "Park's sphere". Second, by mathematical thinking, we get various generalized imagination of the geometrical model of the Telstar. Last, through a series of tube design experimentations, we get the creative realities about the mathematically generalized imagination.

A spherical harmony of horizontality and verticality • For developing our spherical versions of geometrical tube designs, there are basically two types of tube designs. One is expanded horizontally and the other is expanded vertically. Our composition is a natural combination of these two different types of expansions. So it is called "a spherical harmony of horizontality and verticality".

Explanation of "A spherical harmony of horizontality and verticality" • The spherical version in the figure1 above is a polyframe consisting of 32 units of two types which are horizontally expanded tube designs. On the other hand, the spherical version in the figure2 is a polyframe consisting of 32 units of two types which are vertically expanded tube designs. Moreover, the polyframe "a spherical harmony of horizontality and verticality" mentioned above is a natural combination of the polyframes in figure1 and figure2. Figure3 is another view of the spherical harmony of horizontality and verticality above. Figure4 emphasizes interior of the spherical harmony of horizontality and verticality in the red color.

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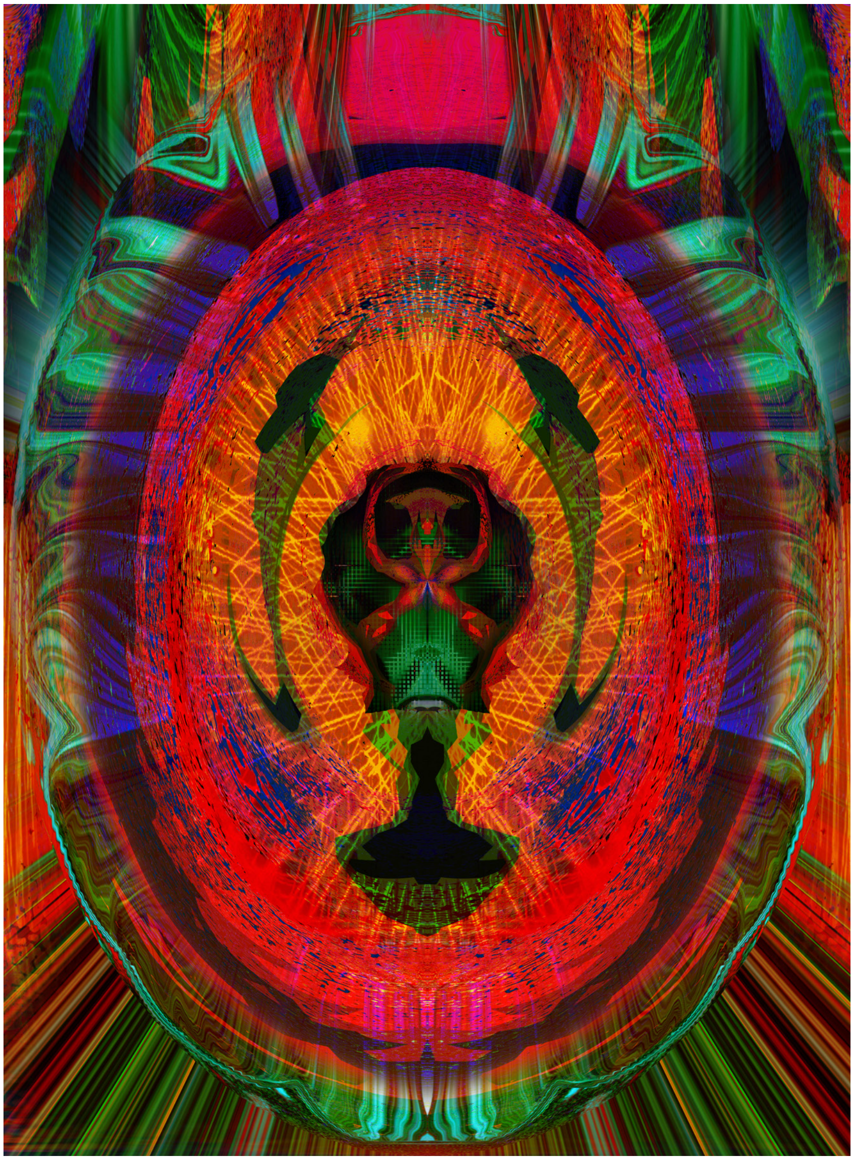
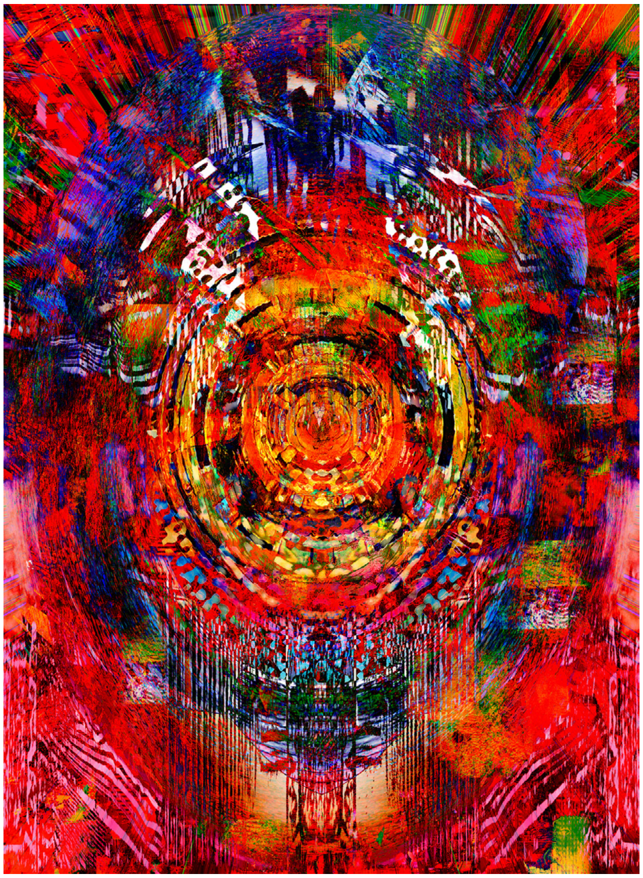


Source
24" x 18"
Digital Photogarphs, Mac Computer, Adobe Photoshop, Epson Print
2011

In the field of time, the nature as we know it is based on duality, black and white, day and night and so forth. Two parts of an equation to create an equilibrium, and in so doing there are moments of imperfection that create life. Math is the rule to measure what exists, and art investigates those timeless moments of imperfection.

These works are about the emptiness with potential. From unknown to unknown, and in between the array of events and incidents that is life. An action instantaneously leads to another and I choose to save or overwrite. From an existential point of view I paint therefore I am. It's about mystery of life, an enigma. My intent is to create metaphors and to depict images beyond what appears to be.

Source • This image was inspired from an imagination of Big Bang. It represents an explosion of light rays and expansion of gases as it may have happened.



Constant
24" x 18"
Digital Photographs, Mac Computer, Adobe Photoshop, Epson Print
2011

3 Dimensions
18" x 24"
Digital Photographs, Mac Computer, Adobe Photoshop, Epson Print
2011

Constant • The creative art stems from tree rings. It represents the cycle of constant energy.

3 Dimensions • The juxtaposition of colors and shapes in the outer circles capture an essence of scattered energy. The focus of three dimensions convergence in a central arena direct the eyes to a diminishing point of no return.

ANICET MIKOLAI HELLER

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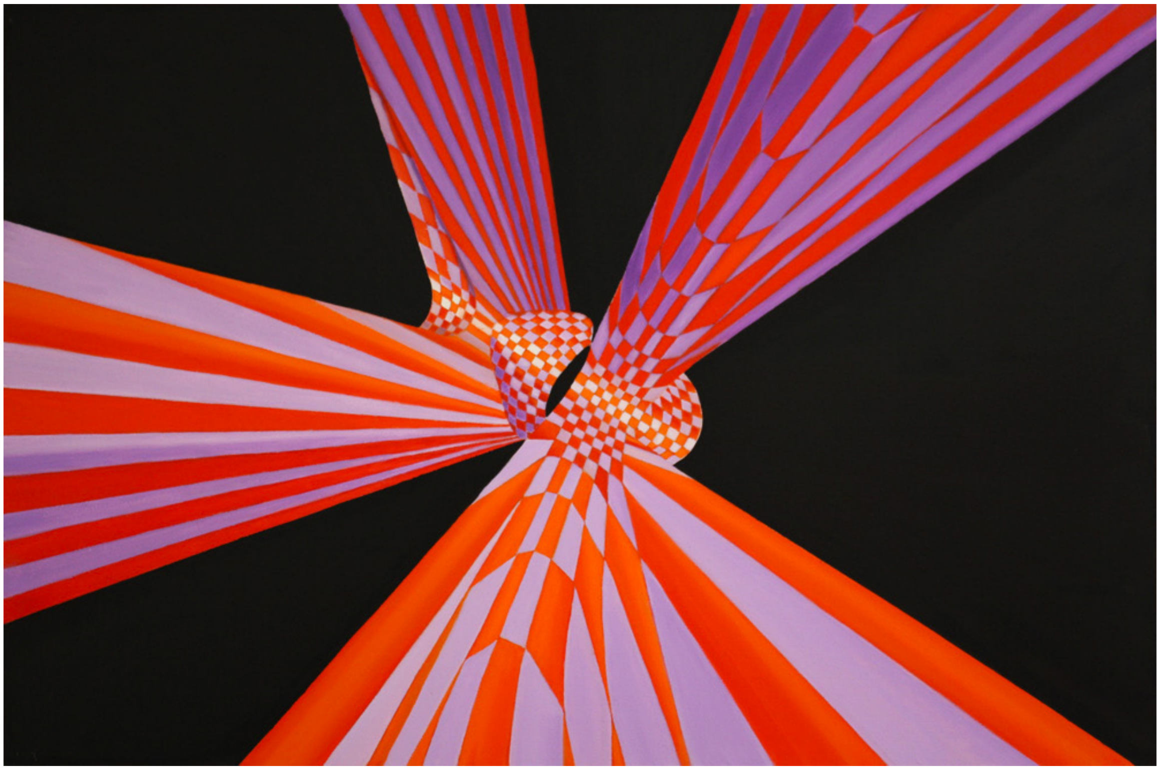
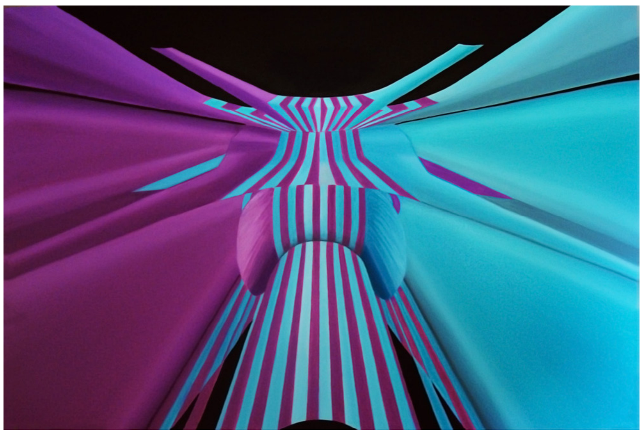


z = x^2 • csc(y) :: Harlequin
36" x 24"
oil on canvas
2010

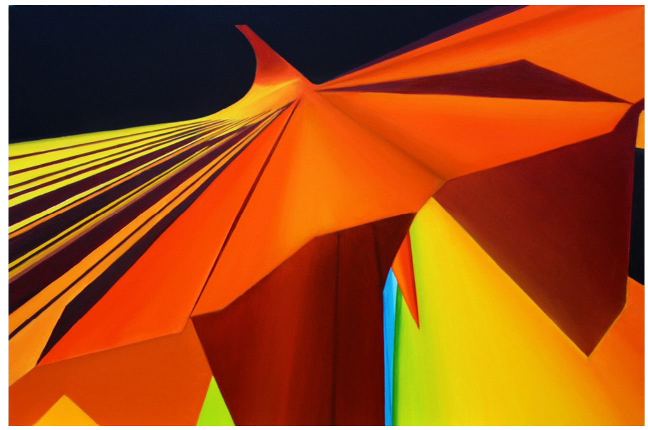
I have always seen math in everything. In music, languages, and nature, it has inevitably made its way into my artwork. My latest works, which I call 'geoscapes', are my oil on canvas interpretations of computer generated graphs of three-dimensional functions.

In our universe, there are universal constants that define how our universe behaves, and ultimately, our reality. These constants are so finely balanced that even the slightest deviation from their set values would yield a universe devoid of life. When I am formulating my subject, I think of each configuration as a universe of its own that I must fine-tune in the same way. The four universal constants for each universe I create are: the function, its frame limits, the resolution of calculation, and the imposed colors or patterns. After these are set, I must navigate the viewing angle, and in essence 'search for life' that will be reborn and have new life on canvas.

z = x^2 • csc(y) :: Harlequin • This playful character is seen from a top down view. Since the frame limit for the y-axis is set to 3ϖ, one can see a total of one and a half cycles of the cosecant function- one full cycle in the center, and two quarter cycles on each side.



z = tan(x^2) - tan(y^2) :: Samurai
36" x 24"
oil on canvas
2010



z = csc (x • y) :: Fireborne II
36" x 24"
oil on canvas
2011

z = tan(x^2) - tan(y^2) :: Samurai • Seen from below, the central saddle curve armors the core of this noble warrior, as his asymptotic aura radiates the type of charisma that can be felt for miles.

z = csc (x • y) :: Fireborne II • The second in its series, this function's viewing angle is positioned in a way that is dissected by the incoming asymptotes, revealing its faceted interior.

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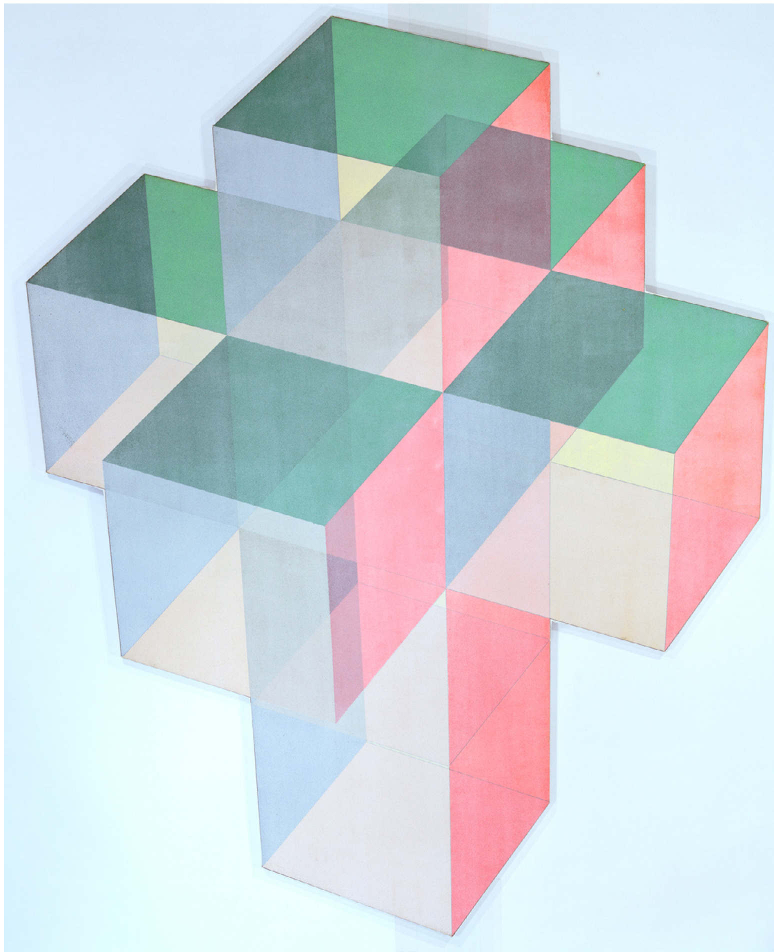
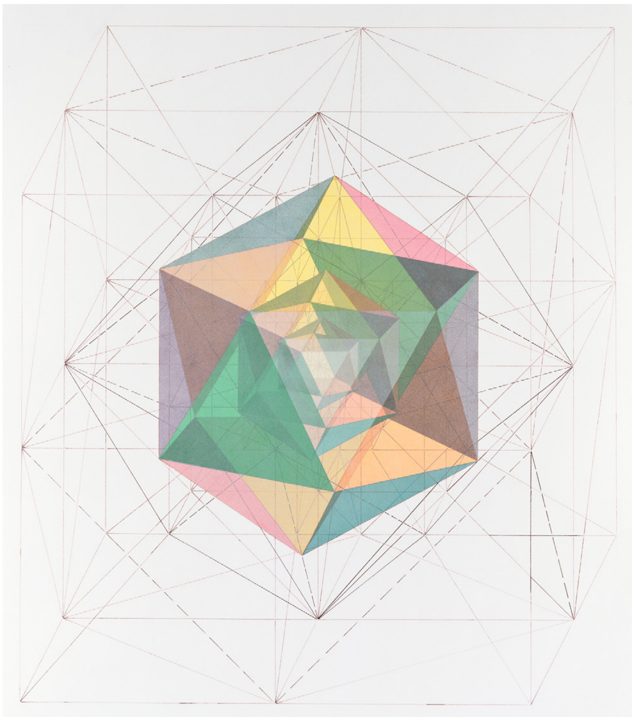


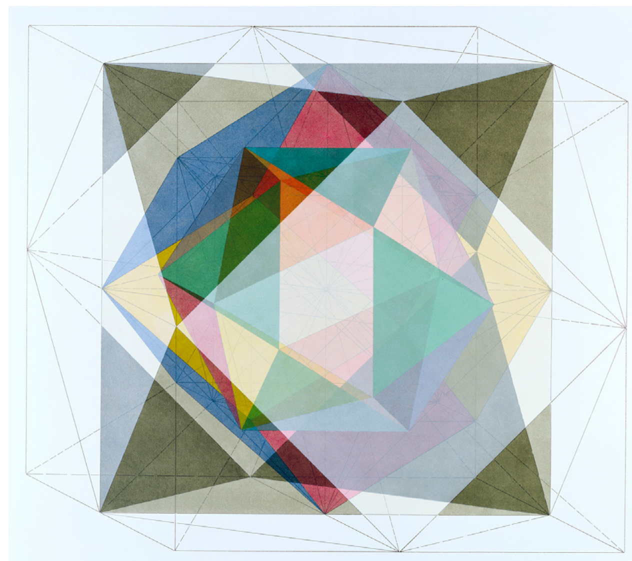
Chrome 184 : Hypercross II
80 X 66 inches
Transparent Oil on Canvas
2007-08

I am a transparent, geometric painter; the co-founder/co-director of Le Jardin a l'Ouest (the French-American Pre-school); I am the founder/president of Jardin Galerie (children's art gallery). I attended the University of Indiana in the early sixties, the New York Studio School of Drawing, Painting and Sculpture in the middle sixties, Empire State College in the middle eighties and Bank Street Graduate School of Education in the late eighties. I wrote my Masters Thesis at Bank Street on John Dewey, Jean Piaget and Richard Buckminster Fuller. I have been painting with transparent oil paint for over thirty years. . I endeavor to create certain images of totality, images that are optical and energetic—not a "signal" or transmitter, or point of reception of "something else"-but objects, states of mind, visions that stand for what they are in and of themselves.

Chrome 184 : Hypercross II • I first saw the hyper-cross in a Salvador Dali painting, where eight tesseracts are stacked together to build a hyper-pyramid. My friend Stephen Weil did a drawing of the structure in Mathematica. I had the drawing "blown up" at a graphics art studio and then transferred it to a canvas on the wall. In many sessions I painted the eight cubes, beginning with the surfaces farthest from the observer, working my way forward to the front surfaces, using a small roller. When the painted "hyper-cross" had dried I asked David Davis Art Supply to frame the canvas according to the principal of "shaped canvas," which I had become familiar with from friends in Budapest involved in MADI. Subsequently Janos Saxon & I created a similar, metal (aluminum) sculpture and exhibited it in the summer of 2011 in Slovakia. I was inspired to create the transparent hyper-cross in an attempt to disclose the beautiful symmetries of its very simple (x-y-z) structure.



Print of Chrome 190 :Three Icosahedra
24 X 20 inches
Transparent Oil on Canvas
2010-11



Print of Chrome 193 : Icosahedron
24 X 29 inches
Transparent Oil on Canvas
2010-11

Print of Chrome 190 : Three Icosahedra • Three skew icosahdrons are embedded in an Isotropic Vector Matrix. In Synergetic Geometry the Isotropic Vector Matrix is a "family" of polyhedrons united by a common edge-length: tetrahedron (V = 1), prime vector radius cube (V = 3), octahedron (V = 4), rhombic dodecahedron (V = 6), cuboctahedron (V = 20), system vector cube (V - 24). In Chrome 190 there are several cubes and several octahedrons. The twelve vertices of each of the three icosahedrons lie on the twelve edges of their respective (3) octahedrons. During my several decades long study of Synergetic Geometry I had painted the IVM many times. I used transparent paint in order to give the viewer a glimpse into the nucleus of this fantastic group of structures. Chrome 190 demonstrates change of scale, wherein the volume of subsequent polyhedra increases/decreases by a factor of 8 with each subsequent iteration. Thus we can suggest that change of scale in painting is equivalent to change in octave in music.

Print of Chrome 193 : Icosahedron • In Chrome 193 a single (skew) Icosahedron is embedded in a octahedron. I had become interested in recent years in using transparent black and white in an effort to communicate the gorgeous beauty of transparency in nature. We see transparency in nature mainly through the mysterious effect of fog on the plain, hovering in mountain and valley and coming off the waters of lakes, rivers and oceans. I wanted to create again the excitement of the icosahedron, with its 20 equilateral faced pentagonal symmetries, but this time using a single icosa hovering within the IVM complex with a few simple colors pushing out of a gray and white transparent mist!

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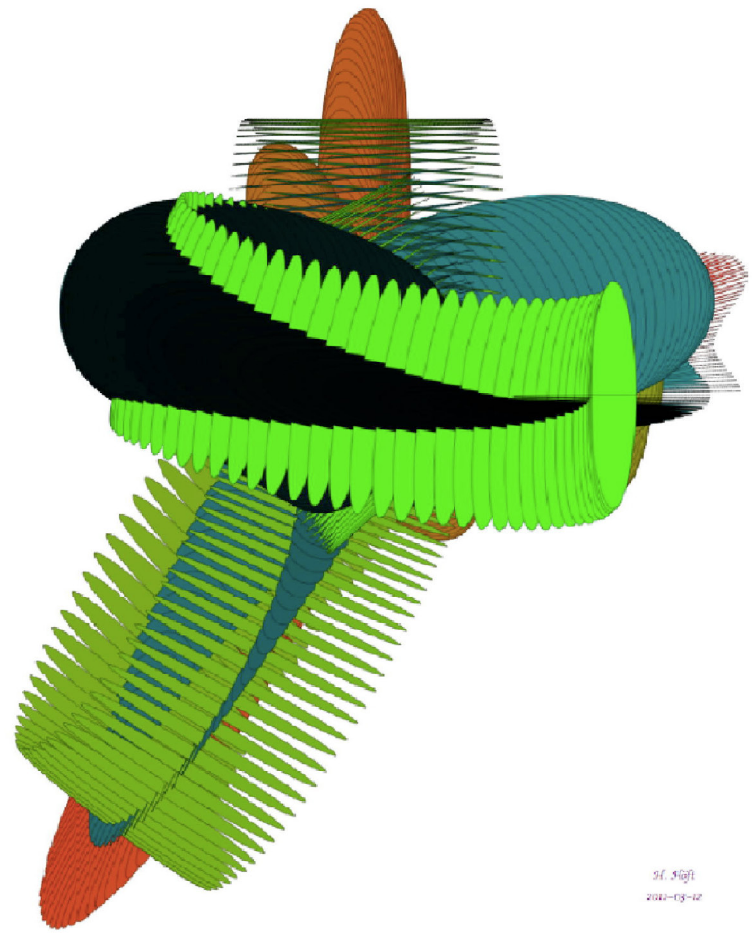
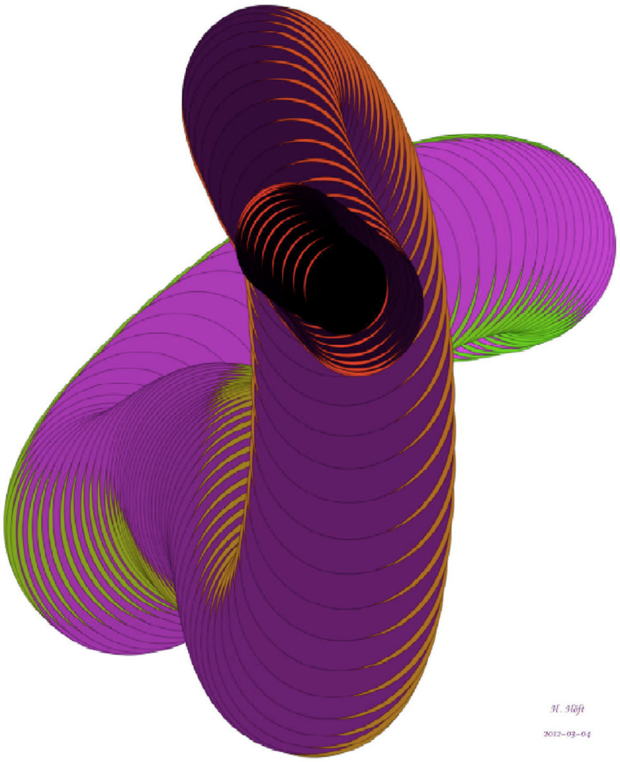


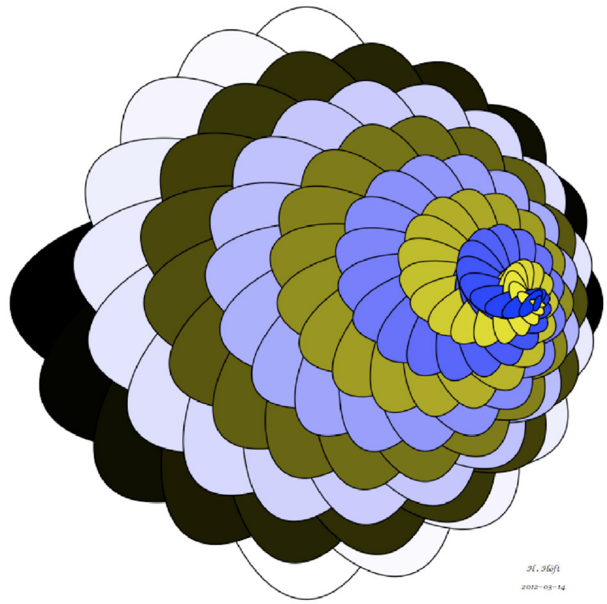
Spiked Monster
11 x 8.5 inch
print
2012

The sickle of the moon can be drawn with two ellipses in the plane and a pair of sickles with two orthogonal ellipses. I asked myself what other designs I might be able to create with such pairs as the only geometric element in the plane. With my images I want to demonstrate to the viewer the conundrum of the easy and the difficult, the simple and the complex. The images are based on two fundamental geometric elements: a curve in the plane that provides the "spine" of a figure in an image and pairs of orthogonal ellipses that are placed at regular intervals along the spine and that create the shape in the image. The spine is not drawn, only the ellipses are drawn. I render all images in Mathematica.
What surprised me most, however, is that many of the resulting images appear three-dimensional. Our visual system apparently gets fooled into seeing a three-dimensional object when we draw many ever smaller slices after larger ones in a single plane. All images are mathematically planar.

Spiked Monster • In this image 720 pairs of orthogonal ellipses are drawn in the plane along a closed planar curve whose loop structure has intrigued me for some time. The ratio of the semi-axes in one ellipse is 1.05 which is close to the ratio of the equatorial and polar radii of earth and moon; the other ellipse has a ratio of 1.25. Starting colors for the ellipses are red and cyan. The lengths of the semi-axes are modified countercyclically by f(t) = (sin^2 t, cos^2 t) and g(t) = (2 sin^2 t, 2 cos^2 3t), respectively. The underlying spine is given by r = sin^3(5t) + cos^5(3 t) in polar coordinates. This is a closed curve with five asymmetric loops and lobes. One of the lobes appears as the red part of the body in the "background" while another is represented by the black spikes on the right side. Since the entire spine is traced twice, its dominant loop appears in a multi-colored double overlay in the lower left of the image. The graphics were rendered in Mathematica 8.



Purple Tube Worm Rearing Up
11 x 8.5 inch
print
2012



Colored Shell
11 x 8.5
print
2012

Purple Tube Worm Rearing Up • In this image 180 pairs of orthogonal ellipses are drawn in the plane along a closed curve that belongs to a family that I used in the classroom when teaching polar coordinates. The ratio of the semi-axes in the ellipses is 1.05 which is close to the ratio of the equatorial and polar radii of earth and moon. Starting colors for the ellipses are green and magenta. The lengths of the semi-axes are modified synchronously by the Gaussian Bell Curve f(t)=e^ -(t^2) over the interval [-1, 1]. The underlying spine is a section from -pi/2 to pi/2 of the curve r = sin^4 (4t) + cos (3 t) rotated clockwise by 90 degrees. This is a closed curve symmetric about the x-axis with three loops and one lobe on each side of the axis of symmetry. The ellipses are rotated a total of 3*pi, but not all of that rotation is visible because of the large differences in the scale of the loops and the semi-axes of the ellipses. The graphics were rendered in Mathematica 8.

Many Worlds • In this image 36 pairs of orthogonal ellipses are drawn in the plane. This is one of the earliest images that I created and that at first sight appeared to me to be three-dimensional. It is an image that is only one step away from drawing a planar spiral with pairs of ellipses. The ratio of the semi-axes in the ellipses is 2.5 which makes large, paired portions of both ellipses visible rather than just paired slivers of one ellipse with the other ellipse dominating. Starting colors for the ellipses are black and white. The lengths of the semi-axes are shrunk linearly towards zero in steps. The pairs of ellipses are rotated two full turns in discrete steps while at the same time their center is moved along the horizontal axis to the right. The graphics were rendered in Mathematica 8.

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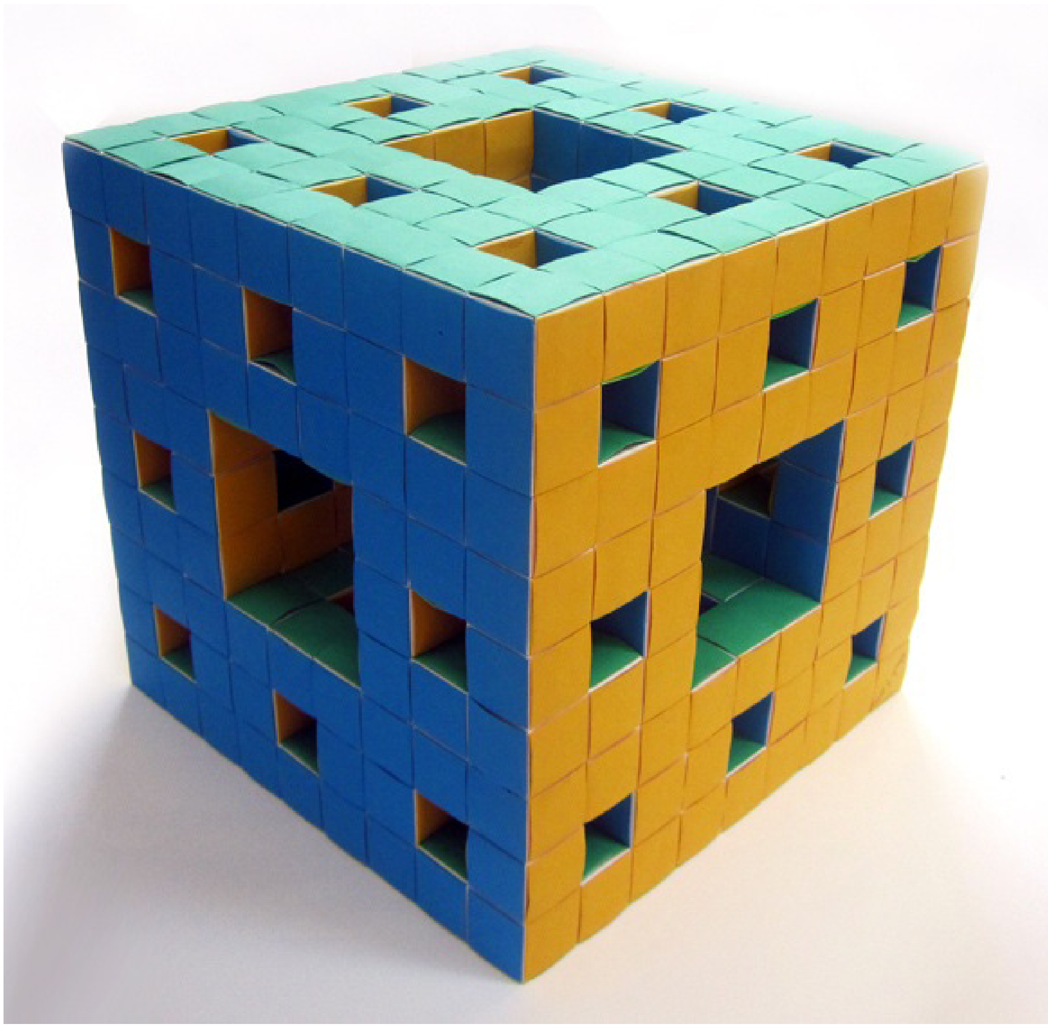
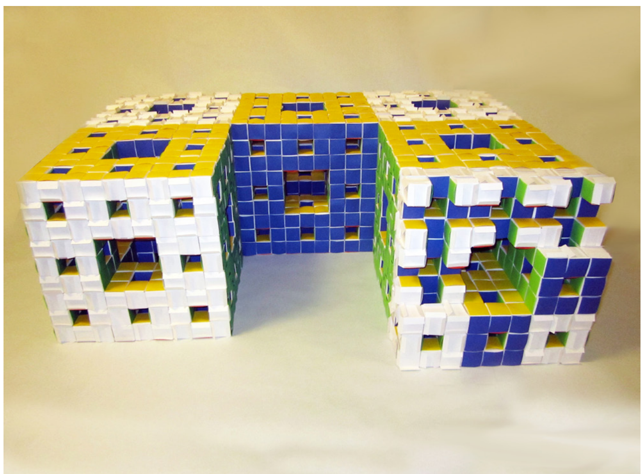


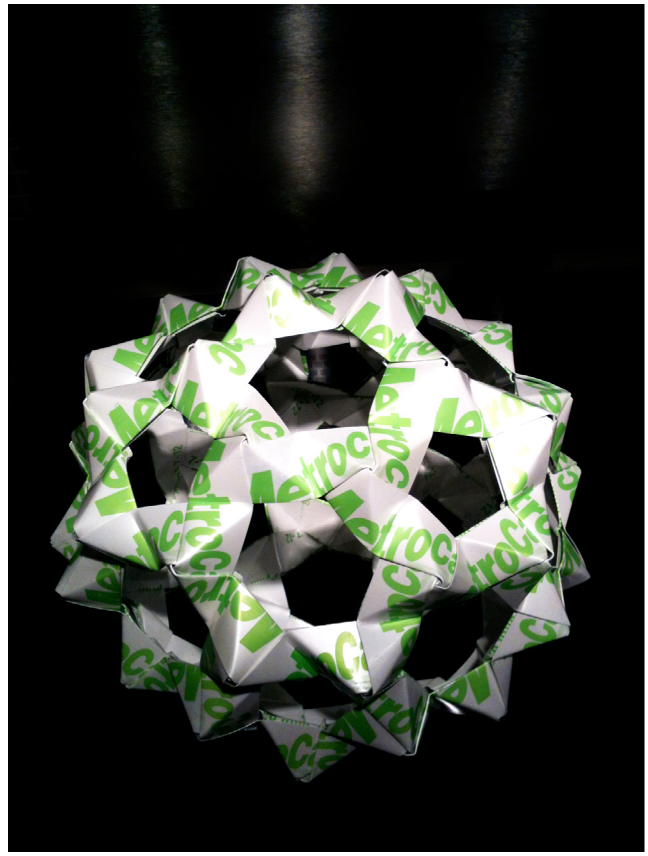
Menger Sponge Fractal - Level III
14"x14"x14"
card stock paper and color paper
2010

I have always enjoyed making origami as a child, but it wasn't until four years ago, when I started an origami club at school, that I got serious about origami and made several complex pieces. My motivation has always been my students. They make me want to learn more and know more so that I can be a better teacher. This is true in the mathematics that I teach as well as the origami that I create. Only the best for my students!

Menger Sponge Fractal - Level III • After learning how to make a Level II Menger Sponge at an origami workshop, I wanted to challenge myself to make a higher level Menger Sponge. The Menger Sponge is a 3-D analogue of the so called Sierpinski Carpet. The Sierpinski Carpet and the Sierpinski Triangle are both well known examples of fractals. A Menger Sponge has to be built as one piece, from beginning to end, rather than assembled from individual cubic units. Similarly, each color paper had to be applied along the way to the white card stock "core" as the construction expanded. As a result, it became especially interesting and challenging to monitor the developing construction. Constant checking was necessary to see where the square holes would be and which color should be applied to which surface. Mistakes were made along the way. I felt the full fractal effect. I had to think fractal, see fractal, and it was a lot of fun!



Menger Sponge Fractal - Level IV
12"x36"x29"
Card stock paper and color paper
2022?



NYC Metrocard PHiZZ unit Buckyball
7.5"x7.5"x7.5"
90 Metrocards (NYC subway and bus fare cards)
2012

Menger Sponge Fractal - Level IV • The process of making a Menger Sponge is meditative and addictive (no kidding!) Students from both Bard High School Early College in Queens and Brooklyn Technical High School contributed to the making of this level IV Menger Sponge which at this time, is one-fourth done.

NYC Metrocard PHiZZ unit Buckyball • Brooklyn Technical High School has over 5,000 students. This spring my Origami Club collected and recycled student Metrocards with the help of the Green Leaf Recycling Club at our school. This Buckyball is a product of this collaboration. It unites my love for mathematics and origami. The large student body certainly helped make it possible to acquire all of the necessary construction materials. We actually could obtain 90 green-colored Metrocards in one day! The technical aspect of our school is also reflected in the design of the truncated icosahedron.

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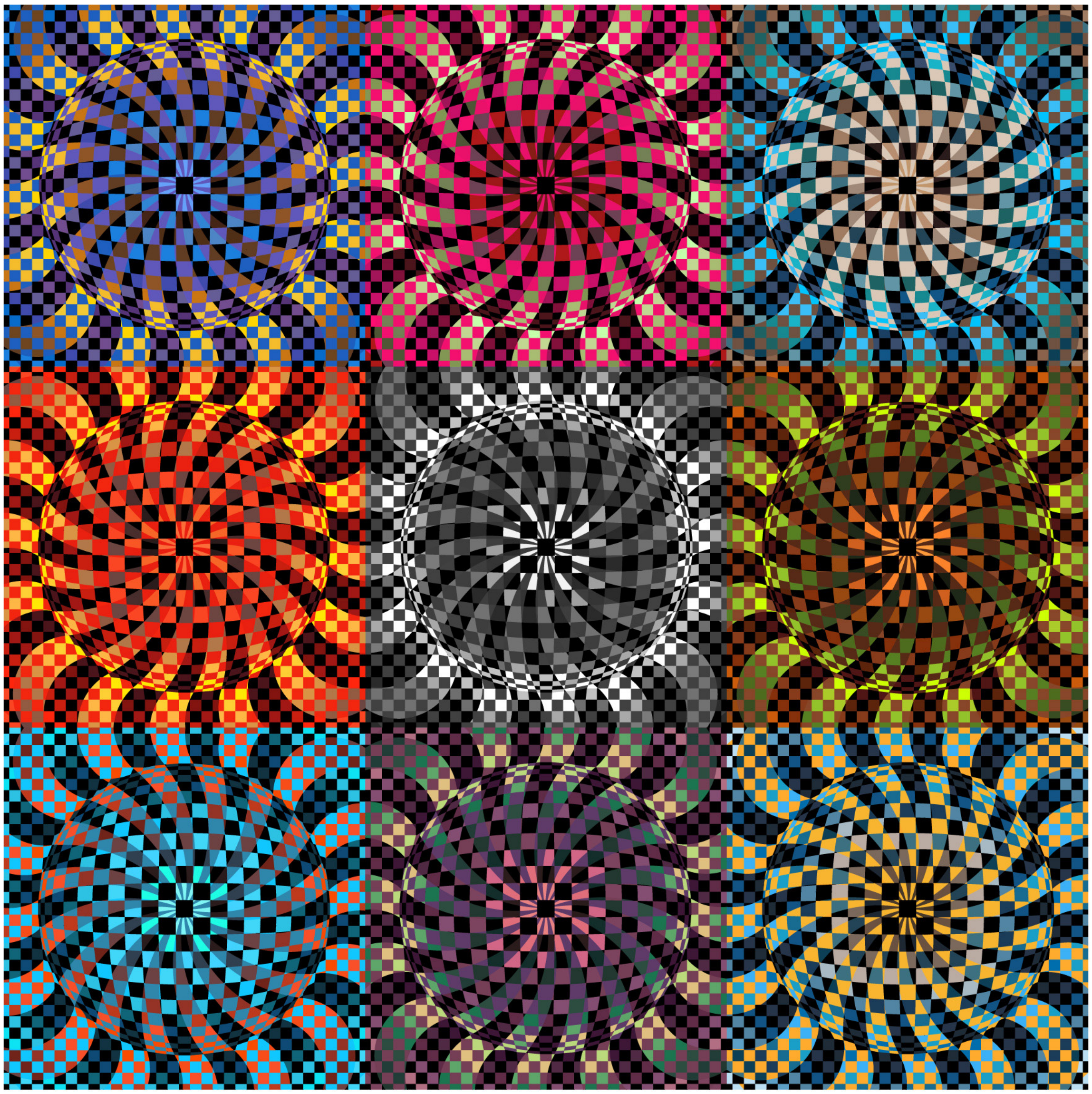
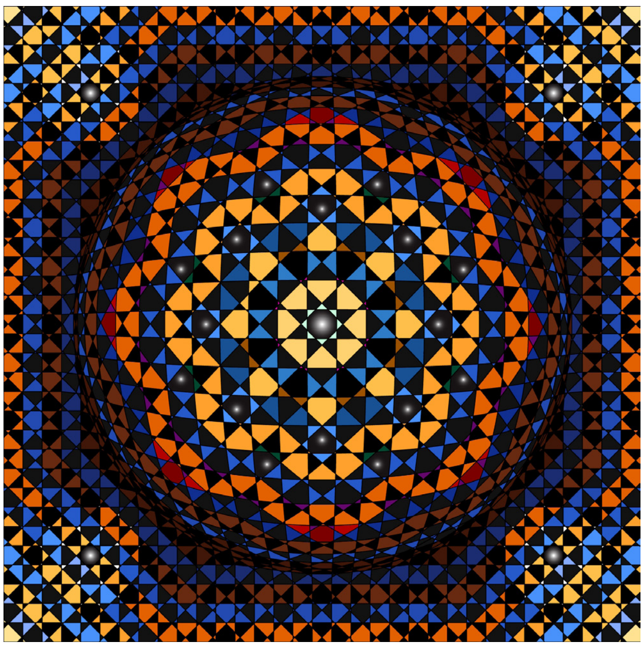


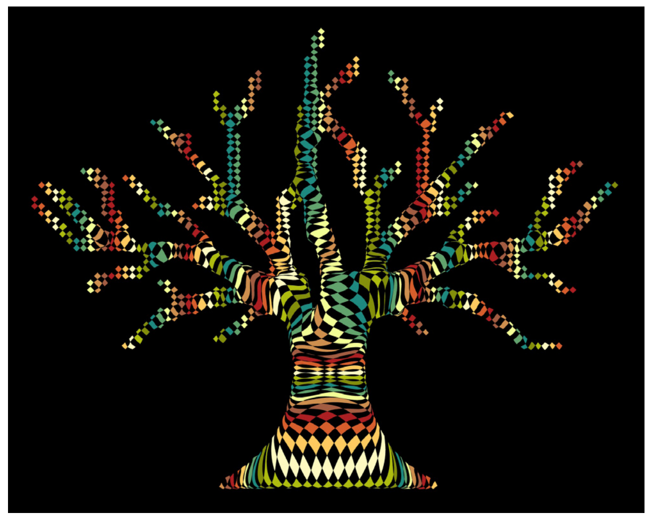
Nine Suns
40cm x 40cm
Digital print
2012

My interests lie in traditional art forms such as painting and sketching, but through computer graphics, I have gained to exposure to various styles of art including Op Art, pixel art, and comic creation. I enjoy exploring shapes and colours; my recent work usually involves mathematical structures as a basis plus hand-drawn elements.

Nine Suns • This design was inspired by Victor Vasarely's 'Vega' series which consists of spherical distortions on polychromatic grids. Each of the nine suns was created by superimposing a radial pattern on the warped grid. The different colour schemes draw the viewer's attention to different parts of the suns.



Jewelled Dome
40cm x 40cm
Digital print
2012



Op Tree
40cm x 40cm
Digital print
2012

Jewelled Dome • This design was inspired by Victor Vasarely's 'Vega' series which consists of spherical distortions on polychromatic grids. The decorative jewel-like pattern was created by interlacing two warped grids.

Op Tree • The outlines of this design were generated by an algorithm that uses heat-flow simulation to create a particular style of Op Art similar to Victor Vasarely's 'Zebra'. The algorithm creates a grid pattern that conforms to the input tree silhouette.

BJARNE JESPERSEN

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Asa Link
5 x 5 x 5 cm
Mahogany
1972

Flexus
5 x 5 x 5 cm
Mahogany
1971

I use creative geometry to bring new life to old traditions of "magic woodcarving", i.e. the art of carving a piece of wood into parts that are loose, but cannot be separated. Traditional examples are wooden chains and balls in cages, as seen in such items as Welsh love spoons and European wool winders. My book "Woodcarving Magic" is now available from Fox Chapel Publishing Company. It explains my carving technique as well as the geometric methods I use to develop new models.

Asa Link • Three four-sided hosohedral edge frames weave together.

Flexus • Four three-sided hosohedral edge frames weave together.

REBECCA KAMEN

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Magic Circle of Circles
12" x 12" x 10"
Acrylic and graphite on mylar
2008

Matrix 1
8 1/2" x 8 1/2" x 2 1/2"
Acrylic and graphite on mylar
2008

As an artist, I am fascinated with the challenges that scientists face in rendering scientific phenomena in dynamic ways. Using static, rare scientific book images as a muse, I create dynamic interpretations of scientific and mathematical observations.

Magic Circle of Circles • "Magic Circle of Circles" is an exploration and meditation on the concept of magic circles and is directly influenced by Ben Franklin's engraving of the same name. Technically, the sculpture turns Franklin's flat engraving into a three-dimensional, dynamic representation of his mathematical observations about magic circles. The process of layering graphite and acrylic on mylar, visually portrays the significance of pages in a book. Each layer like the page of a book, when viewed together creates a complex visual story, giving meaning to form.

Matrix 1 • "Matrix 1" is influenced by the geometric and mathematical structural of all forms in the Universe. It also references scientific models such as astrolabes and globes, created to assist in making the invisible, visible to the viewer. The process of layering graphite and acrylic on mylar, visually portrays the significance of pages in a book, as well as references the dynamics of scientific phenomena. Each layer like a book page, when viewed together creates a complex visual story, giving meaning to form.

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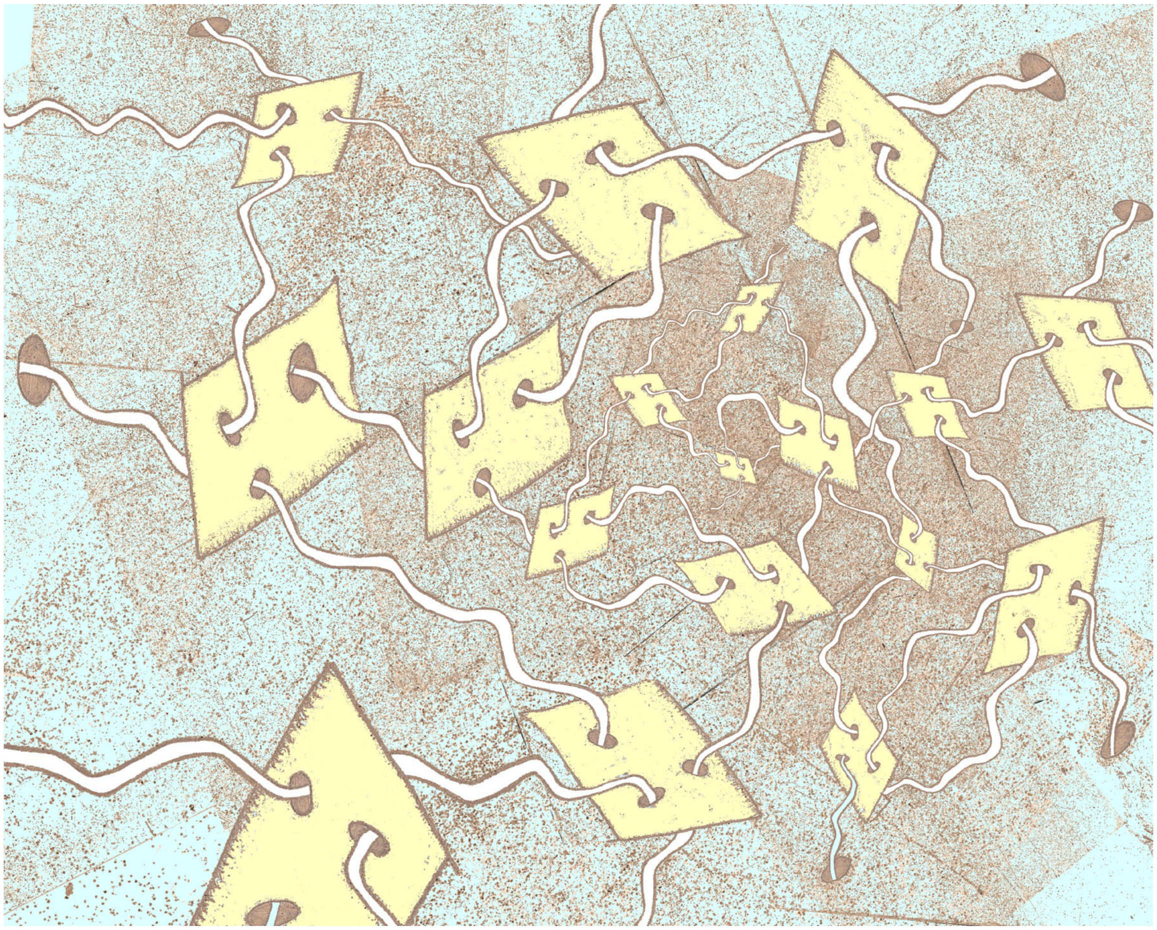
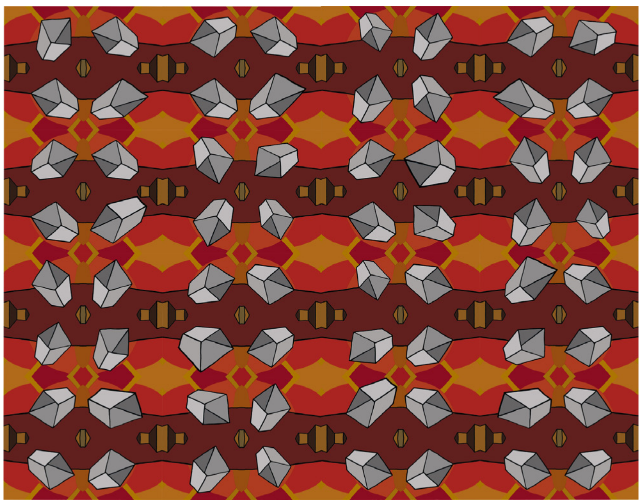


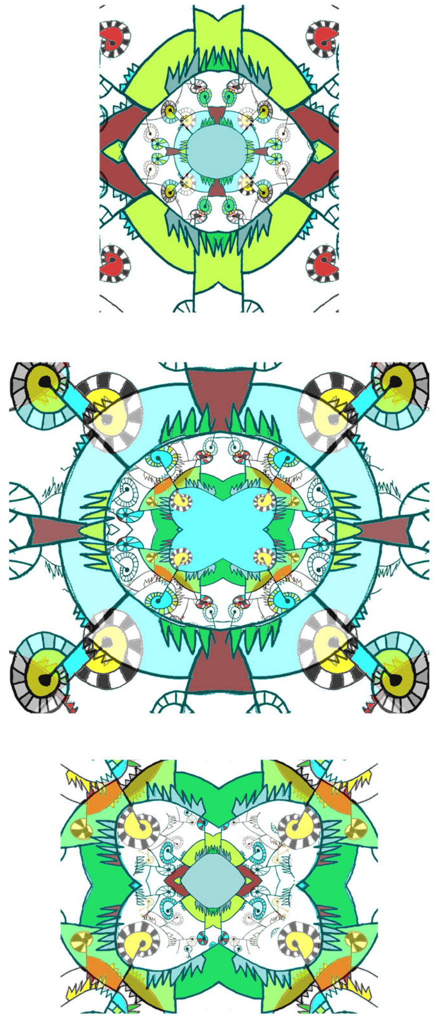
Habitat
16 x 20
digital print
2011

I use pencil, pen, pastel, paper, cardboard, scanner, camera, computer, and printer to achieve my desired effects. I usually think of mathematics as just another part of the creative process, even though there usually is a mathematical way of looking at the finished product.

Habitat • This piece began as a pencil sketch on cardboard. There are 18 copies of that sketch in this image, and they are all interconnected. In the end, we have a view of 18 vertices of a graph, all but three having degree 4. There is also a vertex at infinity whose degree is at least eight.



Boxes #2
14 x 18
digital print
2011



Three Strange Dreams
24 x 12
digital print
2010

Boxes #2 • This piece began as an oil pastel drawing on paper. I thoroughly deconstructed it and then systematically reassembled the pieces to form the resulting image. There is an 8x8 array of boxes in the foreground. Although the process of arranging the boxes was done very carefully, no pattern is intended. Do you see one?

Three Strange Dreams • This piece began as a doodle sketched on the agenda for a math department meeting. I implemented an algorithm involving rotations, reflections, a tiling scheme, and cropping. Finally, I incorporated a Strange Loop in the sense of Hofstadter. The viewer is invited to attempt retrieving the original sketch or to visualize a looping animation composed of the three frames.

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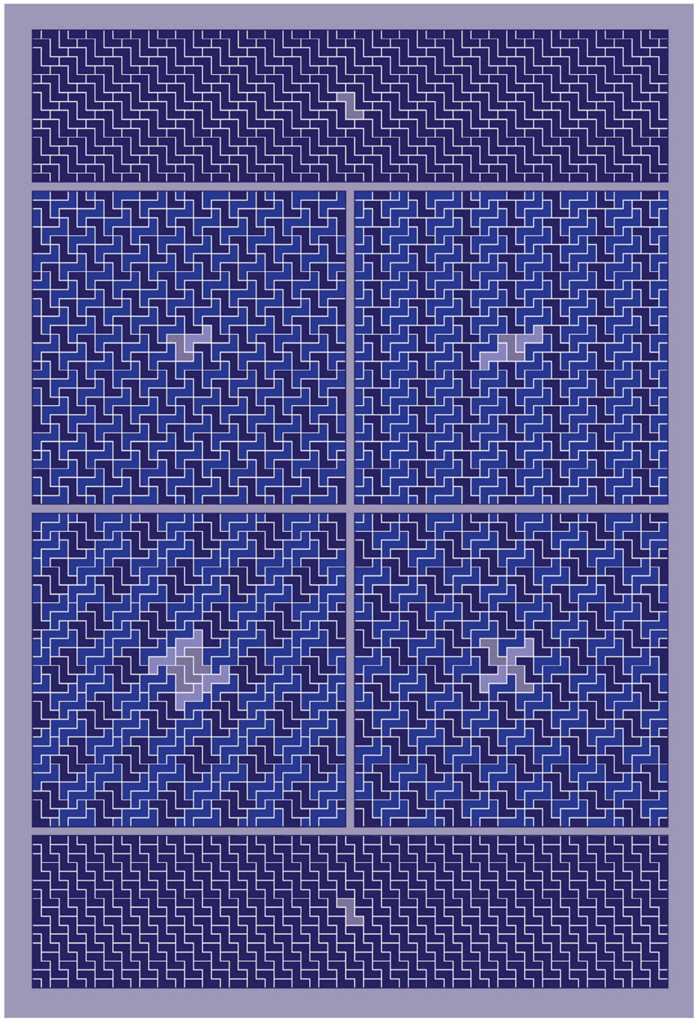
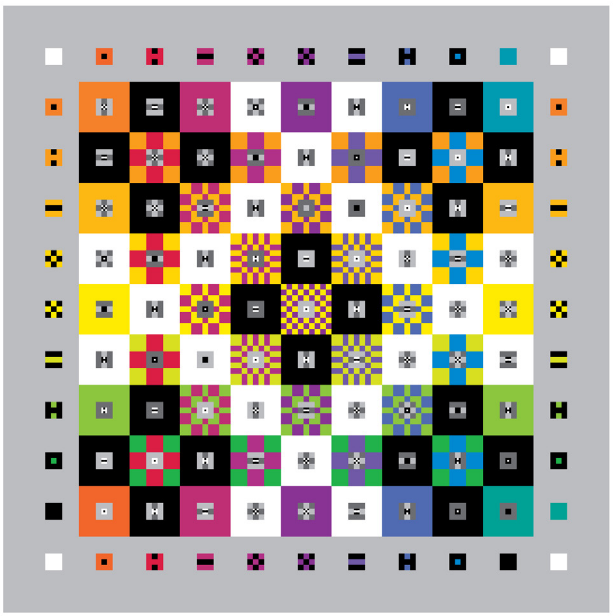


The Zen of the Z-Pentomino
16" x 11"
Archival Inkjet Print
2011

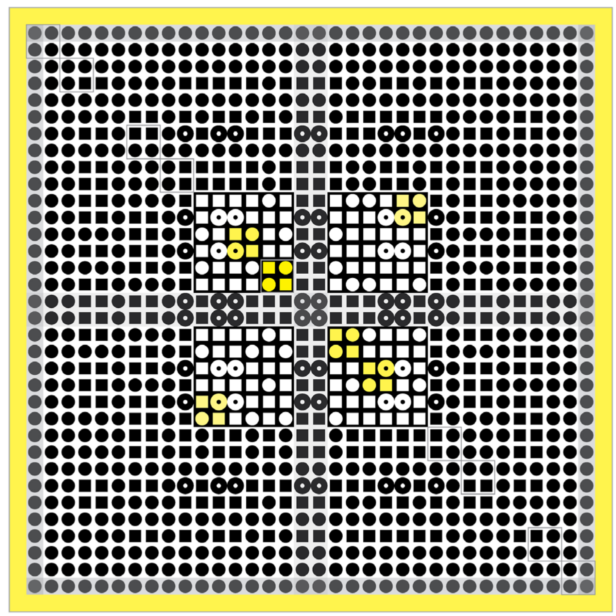
I enjoy exploring the possibilities for conveying ideas in new ways, primarily visually. I have a background in mathematics, which provides me with a never-ending supply of subject matter. My lifelong interest in art gives me a vocabulary and references to utilize in my work. I particularly like to combine ideas from seemingly different areas.

Some years ago I coined the term "visysuals" to describe what I do, meaning the "visual expression of systems" through attributes such as color, geometric forms, and patterns. My creative process involves moving back and forth between a math concept that intrigues me, and the creation of visual images that interpret that concept in interesting ways. I intend to continue to explore the expression of my ideas in a range of media including prints, books, and textiles.

The Zen of the Z-Pentomino • This piece is based on six different tilings of the Z-pentomino and is influenced by traditional Japanese patterns. Each of the 12 pentominoes will tile the plane -- all but one of them in infinitely many ways. If, however, reflections are not allowed and only directly congruent tilings are considered, the Z-pentomino tiles in six, and only six, distinct ways. The resulting tilings are reminiscent of Japanese sashiko pieces, which typically feature white stitching in geometric patterns on indigo-colored cloth. This piece presents the six tiling patterns in "sashiko style" blocks, using color differences to emphasize the various roles the Z-pentomino plays. For example, examination of the darker "stand-up" Zs and their immediate neighbors reveals intrinsic differences among the six patterns. In addition, at the center of each block a minimal group of Zs is highlighted that will tile by translation alone.



Patched to the Nines
16"x16"
Archival Inkjet Print
2012



MaMuMo2 - Study in Yellow
16"x16"
Archival Inkjet Print
2012

Patched to the Nines • The traditional quilt pattern "Nine Patch" is based on a 3x3 grid of nine squares, usually colored in a checkerboard fashion. This piece uses the pattern as a point of departure and includes other references to "nine-ness." The basic 9-patch pattern is generalized to produce additional "odd" patch formats including one-patch, 25-patch, 49-patch, and 81-patch squares. These in turn are displayed in an overall 9x9 grid. The small outer squares provide the key for determining the coloring of each patch square. For example, the central 81-patch square is in the yellow row and the purple column, resulting in a pattern of small yellow squares against a purple background. The 9-patch structure can be found at several different scales in this piece. It is the basis for 9 symbols that are used to represent the elements in the order-9 group tables for C9 and C3 x C3. These tables are displayed via small monochrome squares that float in front of the overall grid of patch squares.

MaMuMo2 - Study in Yellow • There are sixteen 2x2 matrices composed of the elements zero and one. These matrices are closed under matrix multiplication modulus 2. This piece is a visual representation of the multiplication table for these 16 matrices. Circles are used for zeros and squares represent ones; initially the shapes are black on white. A "super" zero resulting from reduction modulus 2 ($1+1 = 2 \rightarrow 0$) is shown larger than a simple zero, and has a dot at its center. Six of the 16 matrices have inverses, and this subset forms a group. The portion of the table representing the product of these six matrices is shown with black and white inverted, and falls into four sections at the center. This order-6 subgroup is non-abelian, and therefore must be isomorphic to the dihedral group D3. The yellow shading of the shapes in the subgroup table highlights the identity elements. The intensity of the shading relates to cycles and reveals the mapping of the six matrices to the elements of D3.

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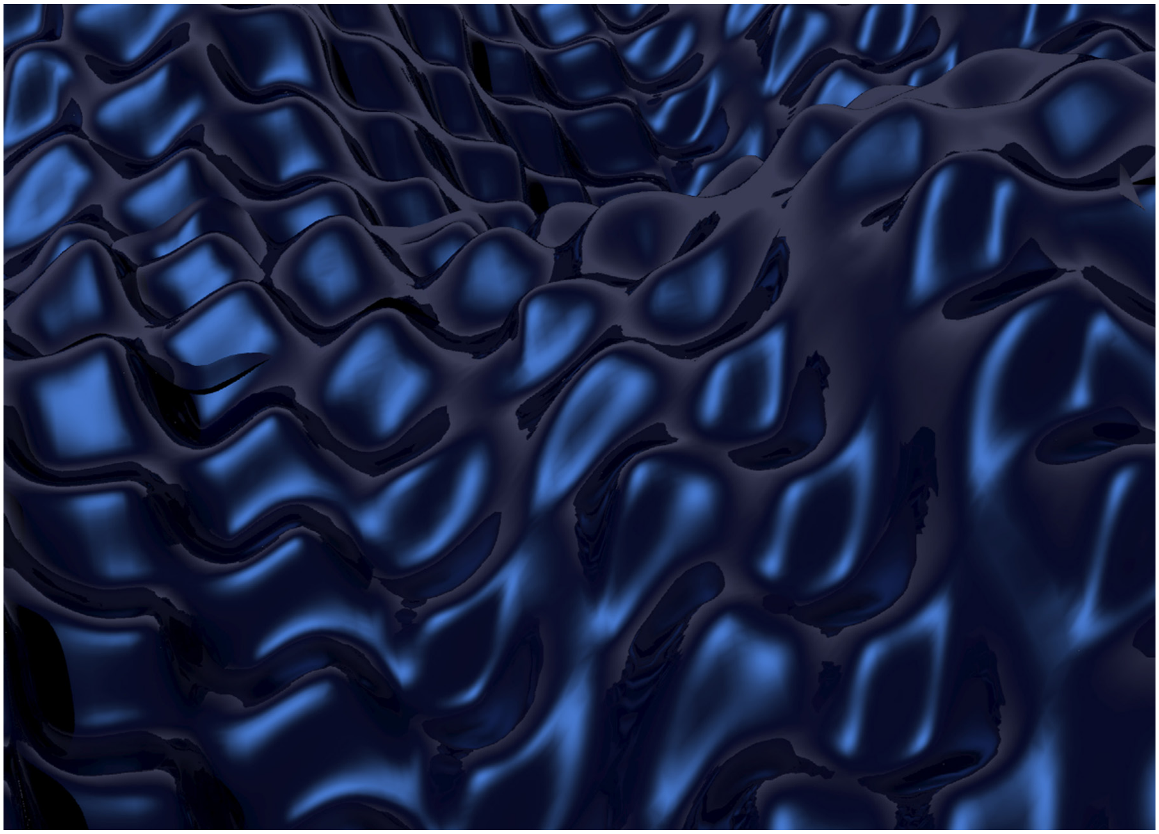


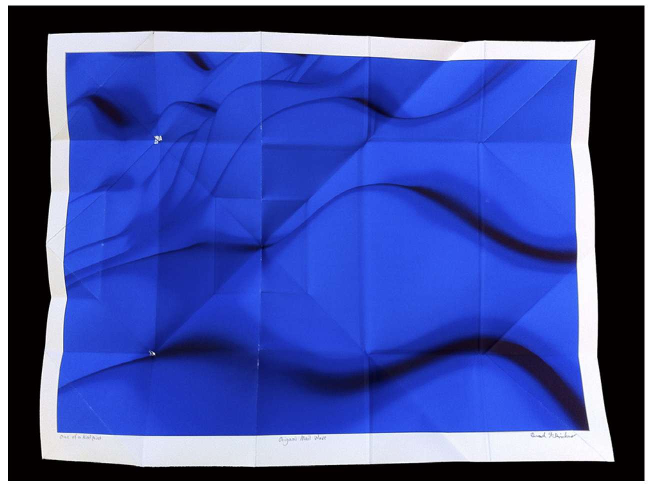
blue 14
24" by 36" framed
Computer rendered Giclee' print
2012

I have an obsessive nature and I am drawn to certain forms because I feel they can express a multiplicity of information yet in an abstracted way. I often use complex curves, waveform shapes and undulating recursive patterns as references and metaphors to physics and psychology. Waves are a spatial form that can relate to thought as in states of emotion, rhythm, and the cycle of life and it can relate to matter as in water waves, hills and valleys, radio waves, electrical waves, wave probability theory, and etc. It is a place where matter and thought can meet.

Math is inherent to the art. My interest in recursion, scalability and tiling combined with the process of computer modeling allows me to manipulate nurb surfaces into complex curvatures to discover interesting spacial qualities.

blue 14 • Print from computer rendering of waves on waves. Inspired from the duality of waveforms (the crest and trough are approximately the same) and influenced from watching water waves and noticing the seeming infinite recursion of smaller and smaller waves riding on the larger waves riding on the larger waves. Self similar repeating piggy-backing on each other yet remaining on the same single surface.

bluewaveforms
31" x 31" x 4"
powder coating paint on pressed stainless steel with polished stainless steel bases
2007



Origami MailWave
18" x 23.25"
giclée prints on quality archival paper of computer 3D waveform rendering folded as origami envelope and sent as postal mail
2012

bluewaveforms • 16 hydraulically pressed tiles. Each tile is identical and asymmetrical in 90 degree rotation while symmetrical in 180 degree rotation and symmetrical front to back with 90 degree rotation. Inspired from complex curvature, saddle shapes and bowl shapes, repetition and waveforms.

Origami MailWave • limited edition of 11 giclée prints on quality archival paper of computer 3D waveform rendering folded as origami envelope and sent as postal mail. Unfolds to 23.25 by 18 inches.

TEJA KRASEK

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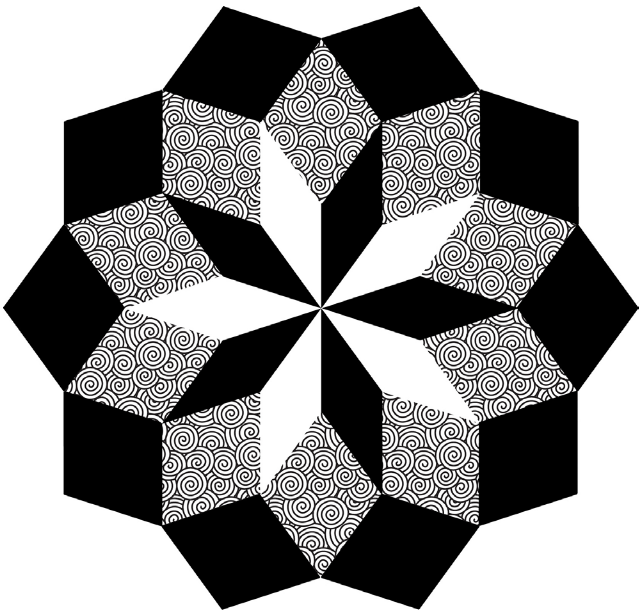
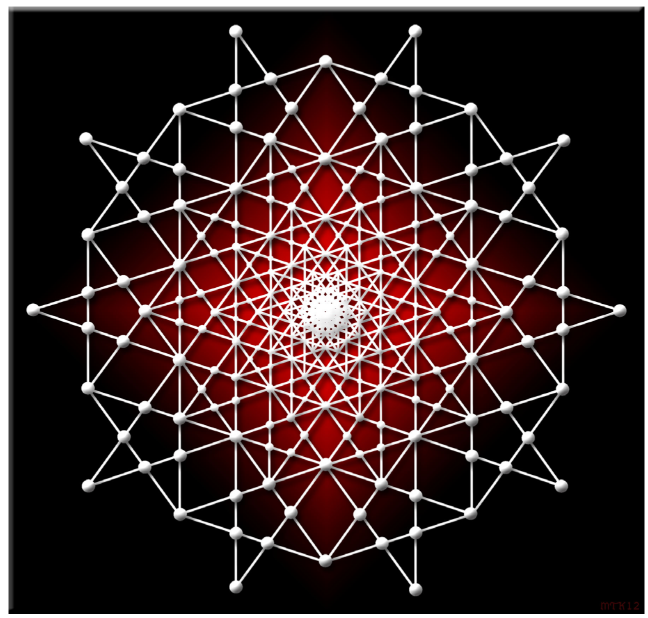


Rosette for Martin
10.8 x 11.4 in
Digital print
2012



Stars for Donald 3
10.8 x 11.4 in
Digital print
2004/12

Teja Krasek's theoretical, and practical, work is especially focused on symmetry as a linking concept between art and science, and on filling a plane with geometrical shapes, especially those constituting Penrose tilings (rhombs, kites, and darts). The artist's interest is focused on the shapes' inner relations, on the relations between the shapes and between the shapes and a regular pentagon. The artworks among others illustrate certain properties, such as golden mean relations, self-similarity, fivefold symmetry, Fibonacci sequence, inward infinity, and perceptual ambiguity… Krasek's work concentrates on melding art, science, mathematics and technology. She employs contemporary computer technology as well as classical painting techniques. Her artworks and articles are exhibited and published internationally. Krasek's artworks are among the winners of the 2nd, 3rd, 4th, and 5th International NanoArt Online Competition.

Rosette for Martin • The composition is created with the two Penrose rhombs as we find them in a Penrose tiling (P3). It shows five- and ten-fold rotational symmetry in structure, and antisymmetry in colour. We can observe a playful combination of straight edges and organic spirals. The image can cause in the observer's mind an interesting (double) optical illusion. The artwork is dedicated to Martin Gardner, the great popularizer of mathematics, science, and magic.

Stars for Donald 3 • The image expresses five- and ten-fold rotational symmetry. In an implicit decagonal space we can observe a net of dots and lines that shows interconnectedness of Penrose tiles from P2 and P3 Penrose tilings (kites and darts, and rhombs), interlaced pentagons, pentagonal stars, and triangles. Self-similarity is evident, and golden ratio is used as a scale factor. I dedicated this artwork to the great geometer, H.S.M. (Donald) Coxeter.

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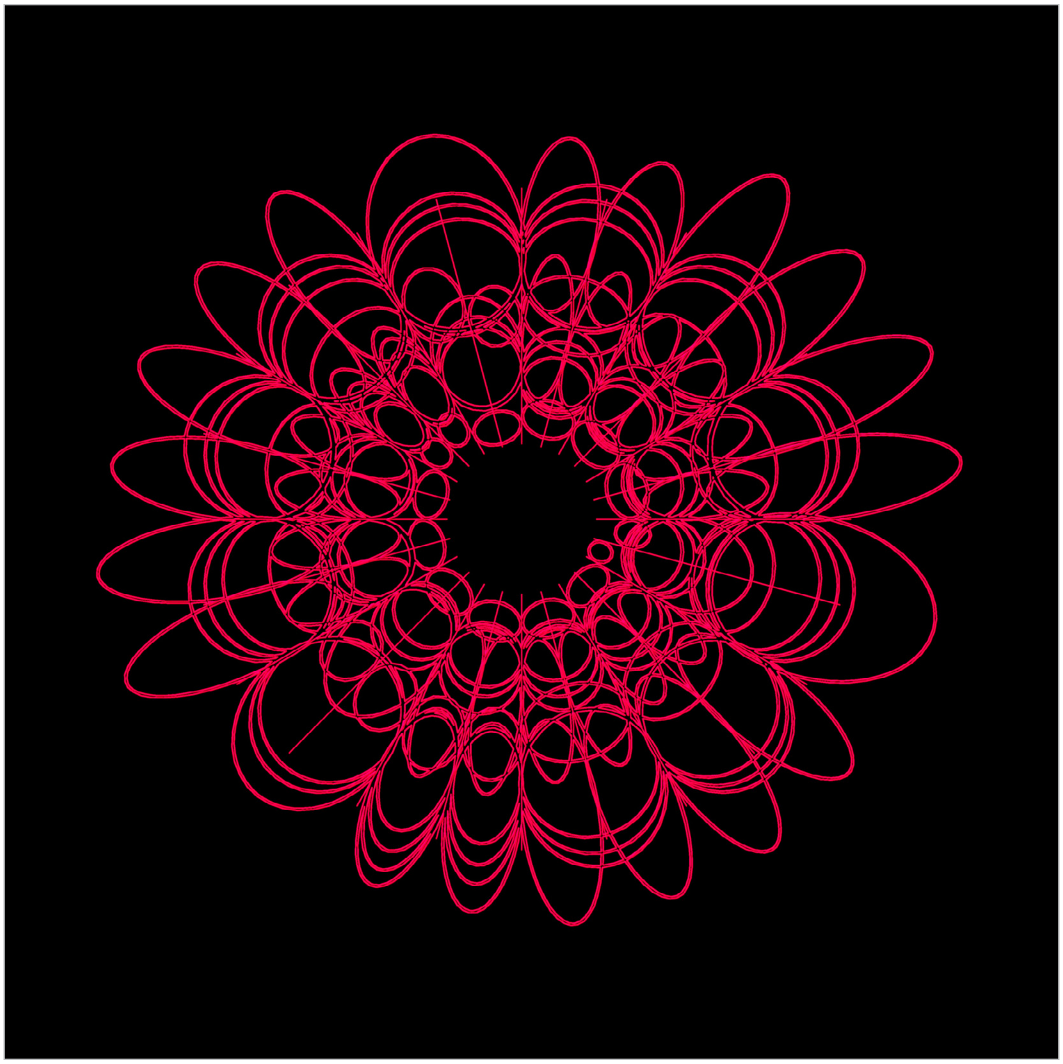

Twinkle Twinkle Little Star CII
20 x 20 inches
framed canvas print
2011

The Art of Music: Exploring the Visualization of Music

The relationship of data to physical form is at times very subtle and abstract. The challenge is to attempt to extract the beauty in the data itself. Music can be expressed digitally in a MIDI file format; each individual instrument each note played including its frequency, timings, and velocity. A large rich set of physical forms is possible using such simple data. This begins to explore this data in the form of drawings, laser cuts, 2D and 3D sculptural constructions. This effort will result in a body of work that covers a number of different forms and interpretative explorations and a number of different musical types; from simple children songs to jazz, rock, country and western, and classical. Each may suggest a unique interpretation based on its inherent structure and complexity. The underlying question explored is "What can music look like?"

Visualizing music explores another dimension to an already rich art form.

Twinkle Twinkle Little Star CII • Twinkle Twinkle Little Star is represented measure by measure, each note, in a concentric circular form. Each note is represented by an ellipse; size based on note length and frequency.

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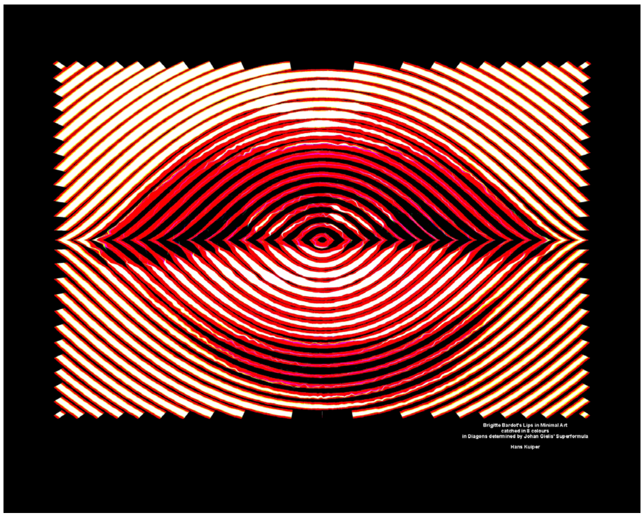

Brigitte Bardot's lips in Minimal Art
40cm x 50cm
Digital Print
2010

Brigitte Bardot's Face in Minimal Art
50cm x 40cm
Digital Print
2010

Hans Kuiper's Art for this exhibition can be characterized as Optical Minimal Art. It is Optical because nearby one sees other things than from a distance. It is Minimal because Kuiper reduces the colours of an input image from up to 16.777.216 (256x256x256) colours to a piece of art with only 8 colours. In stead of 256 values in each RGB-colour component he uses only 2: all or nothing. The colours are concentrated in strips. But the amount of colour within a strip remains the same as in the original image. He uses the colours: red, green, blue, black, white, magenta, cyan and yellow.

The shape of the strips can be straight lines, but also circles or a spiral. Recently Kuiper discovered Johan Gielis' Superformula as an extremely useful tool to create different shapes of the strips. It gave him an endless number of possibilities to vary his art.

In his other art pieces Kuiper creates Minimal Art Objects, Regular Divisions of the Plane and Photiles as one can see on his website.

Brigitte Bardot's lips in Minimal Art • Optical Minimal Art creation with Brigitte Bardot's lips as a subject. By using Johan Gielis' Superformula, I created strips in the shape of a "diagon" (a shape with two curved lines and two angles). I chose the formula parameters in that way that the shape of the diagon is very simular to the shape of the lips itself. I developed my own software to create my art.

Brigitte Bardot's Face in Minimal Art • Optical Minimal Art creation with Brigitte Bardot's face as a subject. This piece of art is built up with strips in the shape of a circle. I chose an eye as the centre of the circles. I made the choice to stop drawing the strip as soon as there is not enough space for the full width of the strip. This causes the jagged edge of the image and gives the image a special effect.

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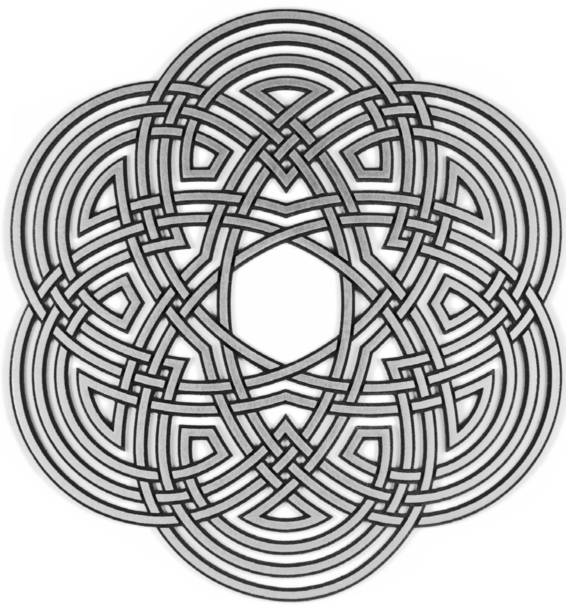
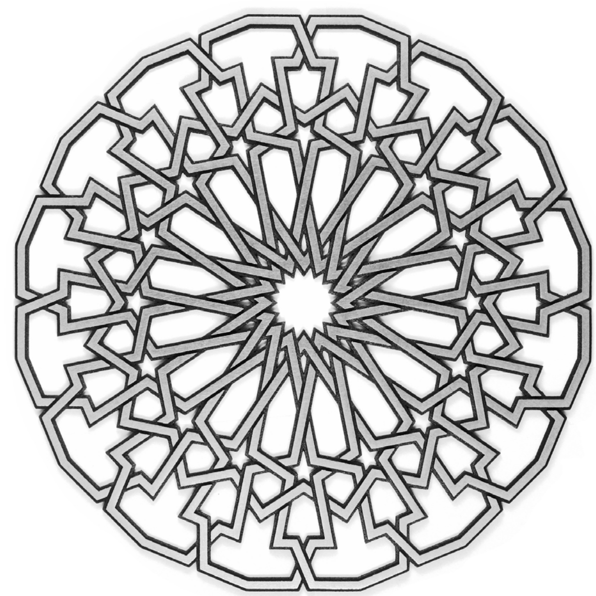


Nucleus
9" x 3/16" thick
Stainless Steel & Bronze (Direct Metal Print)
2012



Starburst
9" x 3/16" thick
Stainless Steel & Bronze (Direct Metal Print)
2012

I'm interested in geometric ornament from various historic cultures. Specifically, designs that include symmetry and interlacing. By utilizing 3D CAD software, I am able to create designs with a high degree of accuracy and perfect symmetry. My designs are most often controlled by mathematical equations and geometric relationships (tangency, concentricity, etc...). I try to write the equations so that the overall look of the design is controlled by a single numeric variable. By changing the variable, I go through many iterations, until I arrive at a design that is aesthetically pleasing. My recent work attempts to adapt two-dimensional line drawings into three-dimensional objects through the use of CAD technology and direct metal print manufacturing.

Nucleus • Adapted from a book entitled "Ornament: Classically Composed Structures" by Russian artist Yakov Chernikhov. It consists of four concentric, interlacing bands in an openwork style. This design is built upon an underlying sketch of tangent and concentric arcs. I added features using rotational symmetry to give the illusion of interlacing. This design is controlled by a single numeric variable, through the use of geometric relationships and mathematical equations. I changed the variable, through iteration, until the desired aesthetic was achieved. Designed using 3D CAD software (Autodesk Inventor). Manufactured by direct metal print technology (ExOne Company), patinated and hand finished.

Starburst • Adapted from a book entitled "Pattern in Islamic Art" by David Wade. It consists of two sharp-angled, interlacing bands in an openwork style. This design, like most Islamic geometric art, is built upon an underlying sketch of circles and lines arranged in a symmetric pattern. I terminated the bands to transform the pattern into an ornament. I added features using rotational symmetry to give the illusion of interlacing. This design is controlled by a single numeric variable, through the use of geometric relationships and mathematical equations. I changed the variable, through iteration, until the desired aesthetic was achieved. Designed using 3D CAD software (Autodesk Inventor). Manufactured by direct metal print technology (ExOne Company), patinated and hand finished.

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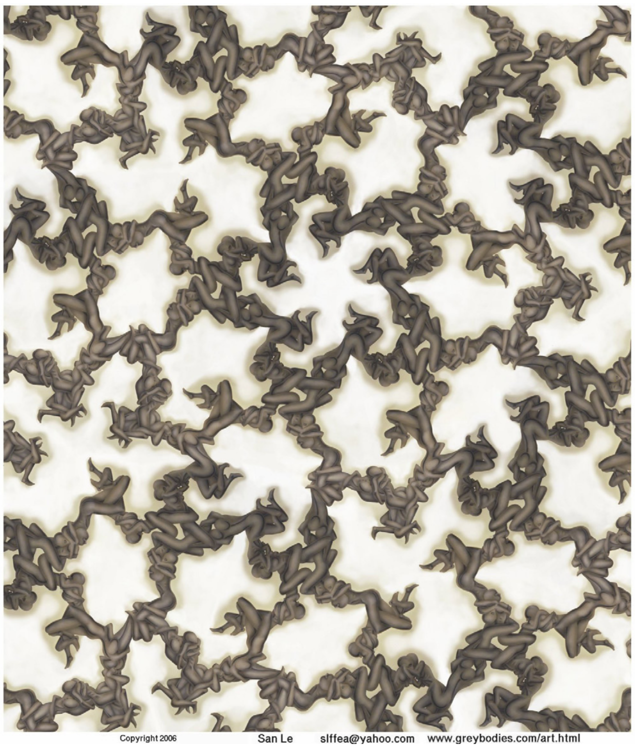
World Wide Web
30 in X 22 in
watercolors, digital
2003

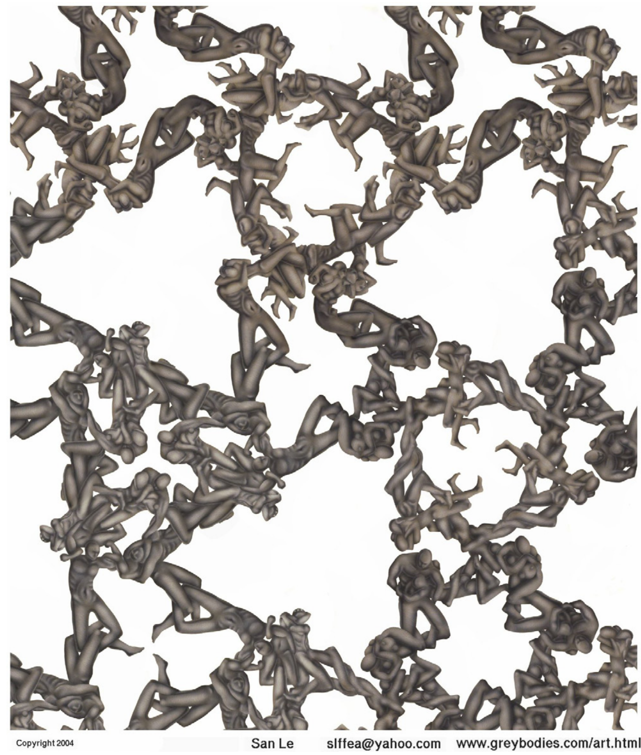
One of the advantages science has over art is the way new work builds upon the work that came before. By contrast, in the art world there usually is an innovator who advances the arts with a unique vision, but then his work is viewed as the pinnacle and creations by later adopters of the movement are often treated as simply imitations.

In 1997, when I began combining my work with the tessellation art that was popularized by M. C. Escher, I saw an opportunity to build upon what came before. In the art of space filling, I could use the geometry of Escher's time as well as the mathematics that have been developed since. And by basing my tiles on subjects and configurations which had not been used before, I could create new patterns and images distinct from that of others.

World Wide Web · When artists create Escheresque images, they usually have one dominant figure in a tile that is completely filled. There are greater possibilities beyond this, such as having multiple figures of people in the tile which allows for the visualization of other interesting patterns once the tiles are assembled, especially regions of density and void. Also, when trying to completely fill the tile, the figures usually interlock rather than overlap, unlike my images where the people's limbs intertwine. This is enhanced by having negative space which contrasts the bodies to the background. With the use of overlapping figures, I also created connections of the people beyond their connection across tile boundaries, i.e. connections within connections.



Penrose II
25 in X 22 in
watercolors, digital
2006



Rhombi
26 in X 22 in
watercolors, digital
2004

Penrose II · M.C. Escher passed away before he had a chance to apply Penrose tilings to his work with tessellations. Using the principles I developed in my own experiments, I came up with this piece.

Rhombi · The tiles comprising this piece were my first attempts at having both periodicity and randomness. There are 3 interchangeable tiles which can be assembled so that they may form a random pattern even as they follow the traditional periodic rhombus tiling.

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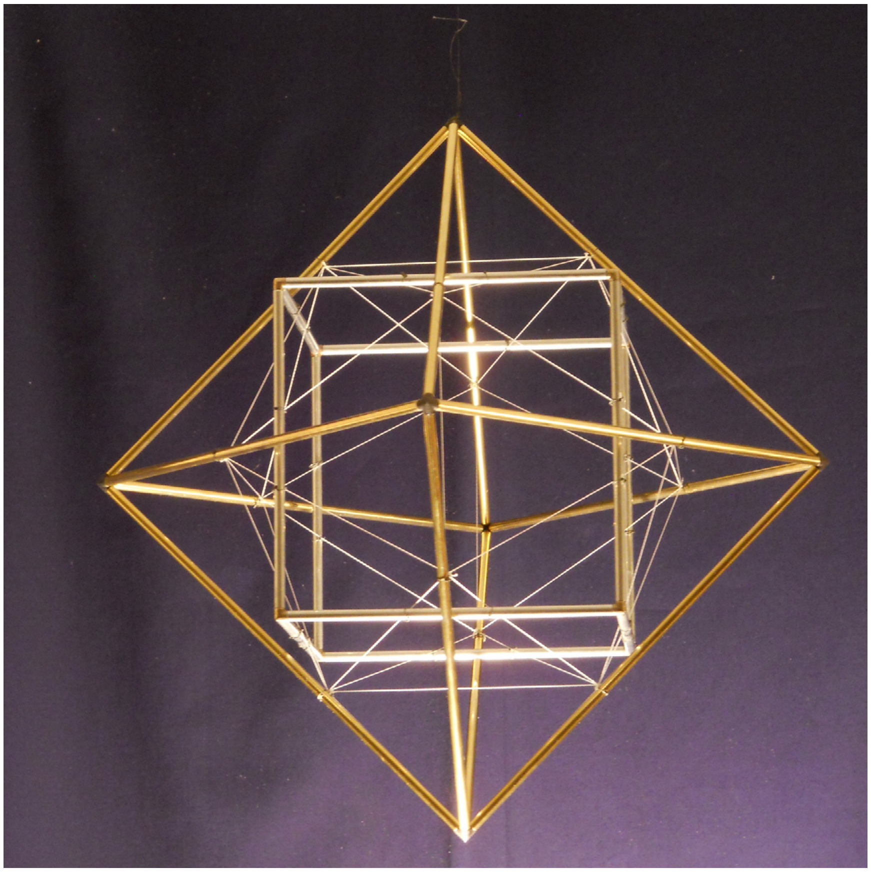


Relations Between Some Platonic Solids - A Series of Five Models
48" x 48" x 18"
Brass, aluminum, steel, nylon, carbon fiber, styrene, and beading thread
2012

I received a Ph.D. in mathematics from Johns Hopkins. For most of my career I taught high school mathematics in Waldorf schools, where the pedagogy encourages the bridging of mathematics and art. I'm now retired.

The Platonic solids are, in a way, quite simple geometric forms, and yet, as one contemplates them and builds up and holds the forms in one's imagination, they become quite captivating. One can view a cube, for instance, as a bounded solid, but it is more than that. The center point of the figure has a dual (in the sense of projective geometry), which is the plane at infinity. Opposite vertices have a common line that lies on the center point, while opposite faces have a common line that lies on the plane at infinity. One can imagine the form carved out by planes and lines coming in from the infinitely distant periphery. The models shown here are designed to suggest shapes that are not solid blocks, but rather created by lines and planes coming from the periphery.

Relations Between Some Platonic Solids - A Series of Five Models • For any two Platonic Solids, by lining up axes of order 3, and adjusting relative sizes, one finds many interesting relationships, a few of which are shown here.

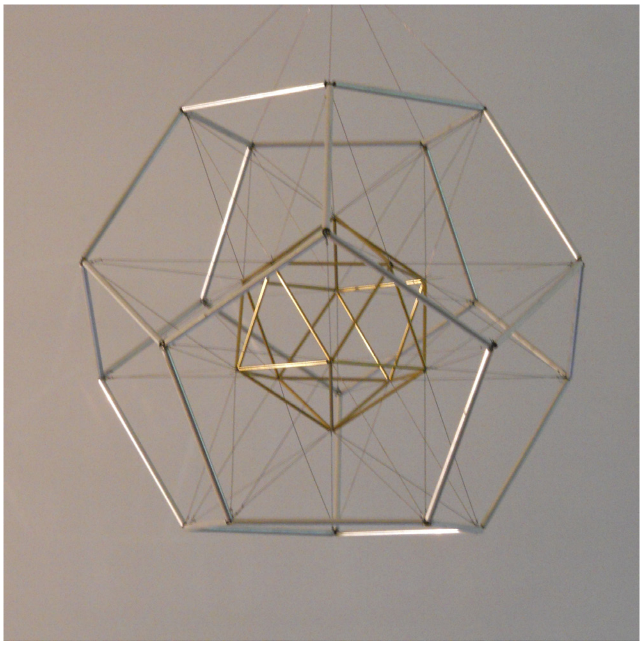
A. Octahedron, Cube, and Dodecahedron: This could be called a tensegrity figure, since the cube and octahedron are suspended from one another by strings in tension. I have not seen this model anywhere else.

B. Dodecahedron: This highlights the dodecahedron shown in black string in model A.

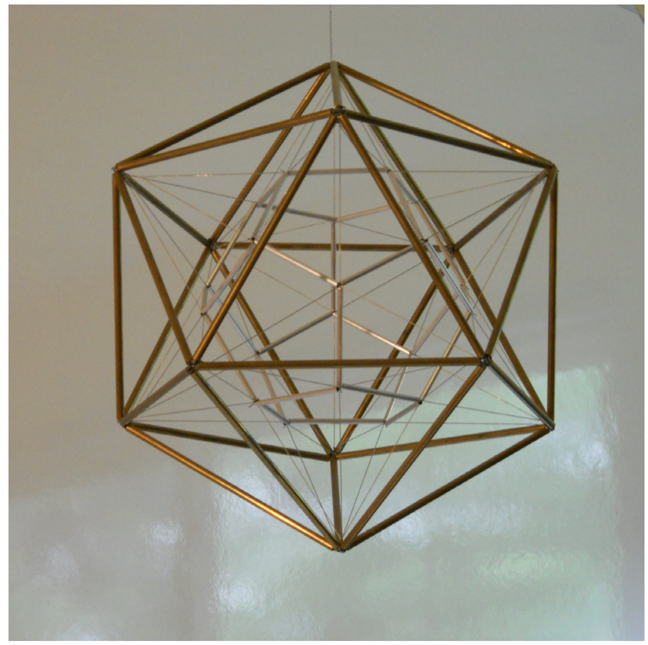
C. Dodecahedron and Icosahedron: Superposition of models B and D.

D. Icosahedron This highlights the icosahedron shown in white string in model E.

E. Octahedron, Cube, and Icosahedron: This is the dual of model A. The cube becomes the octahedron and vice versa in the dual, but the black string dodecahedron becomes the white string icosahedron in passing to the dual. Mental exercise: while looking at model E, picture in your mind the black strings of model A added to it.



Dodecahedron with Icosahedron Suspended Inside
13" x 13" x 13"
brass and aluminum tubing and steel wire
2008



Icosahedron with Dodecahedron Suspended Inside
10.5" x 10.5" x 10.5"
brass and aluminum tubing and steel wire
2001

Dodecahedron with Icosahedron Suspended Inside • There is a polarity of space that pairs the vertices of the icosahedron with the faces of the dodecahedron and vice versa; it leaves invariant a sphere that lies between them. The ratio of the mid-radius (i.e. to the midpoint of an edge) of the dodecahedron to the mid-radius of the icosahedron is the golden mean squared.

Many Worlds • The ratio of the mid-radius of the icosahedron to the mid-radius of the dodecahedron is the golden mean.

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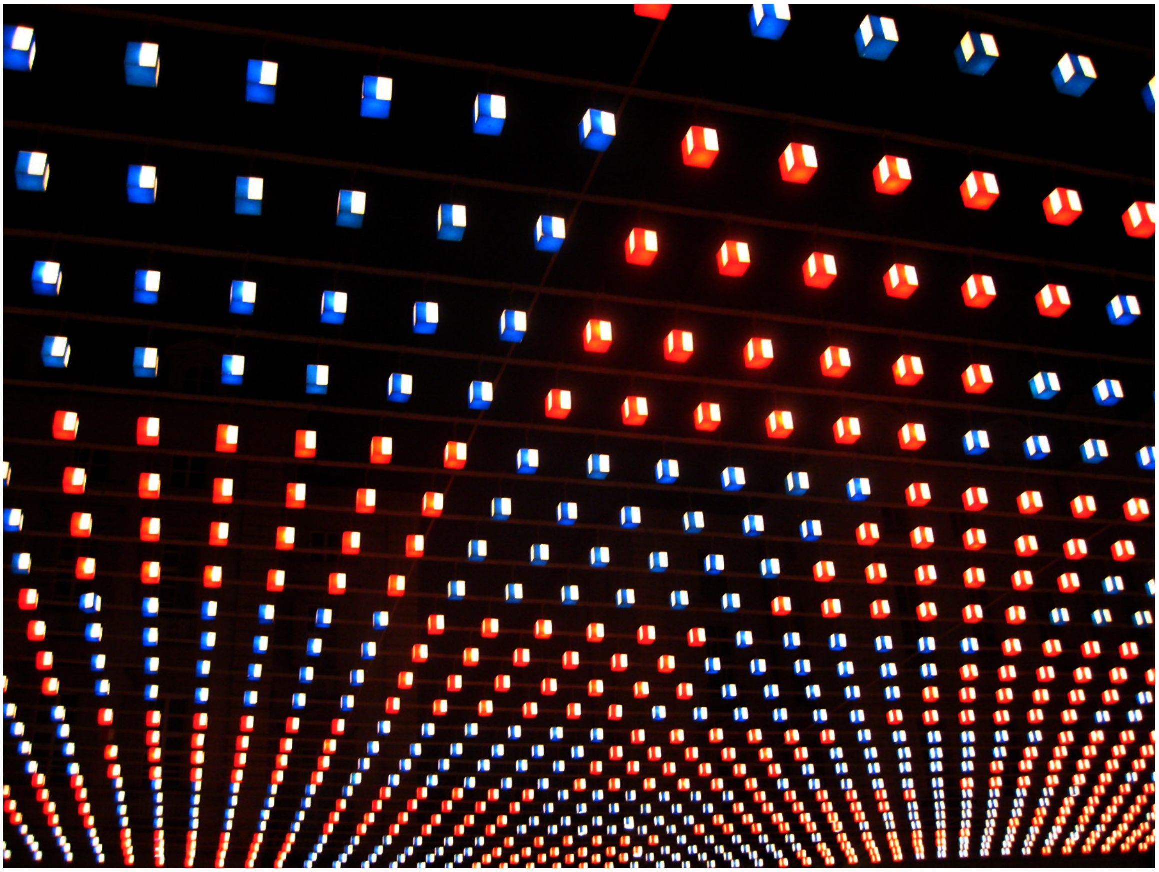

Luci d'artista - Torino matematica
47x63 cm
Digital photography
2008

The word "Photography" comes from two Greek words, Photos (light) and Graphos (writing, painting), so "drawing with the light". Taking pictures needs some devices and a particular process in Space and Time. According to Einstein the basic structure of our world is SpaceTime and things exist in a spacetime continuum, a world of four dimensions: height, width, depth and time. A generative process is usually referred to as "setting in motion". Motion is the essence of Life. To be alive is to move. Selecting particular initial conditions, adding a fourth dimension and photographing motion by means of randomised generative processes can give rise to very expressionistic results. "Painting with light".

The three images represent an ideal sequence, from Platonic solids to curved surfaces (wormholes) in three-dimensional space, from past to future.

Luci d'artista - Torino matematica • Torino (Turin), Italy, is the city of Lagrange and Peano and many other famous mathematicians. At Christmas time the city celebrates with a contemporary art exhibion named "Luci d'artista" (Artists' lights). Among them, "Tappeto volante" (Magic Carpet) Installation in Piazza del Municipio by Daniel Buren. A digital picture of the public installation, taken isolating only the lights, is almost an hypnotic illusion, with mesmerizing perspective effects. In the three images sequence it represents the past, Platonic solids.

Waves. More than light
47x63 cm
Experimental digital photography
2007

Dancing Wormholes
47x63 cm
Experimental digital photography
2012

Waves. More than light • Multicolored Sinusoids created using a panning experimental technique on a symmetrical background. Symmetrical rays in the background explode linearly upwards, while lightwaves with all the colors of the spectrum dance on the foreground. Energy is more than visible light! In the three images sequence it represents the present, curves in two dimensions.

Dancing Wormholes • This is a real photo, made using experimental techniques. Reality hides future dimensions. Through wormholes one can travel in time, exploring the colors of invisible Universes and tunnelling by a quantum jump into the Future. In the three images sequence it represents the future, curved surfaces (wormholes) in three-dimensional space.

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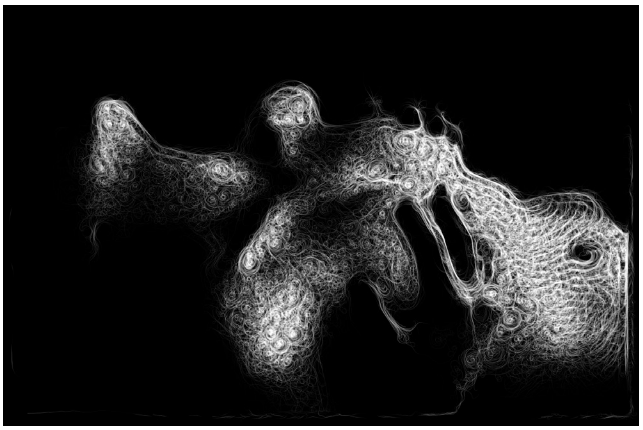
Nude #7
50x50cm
Inkjet print on Photo Rag Bright White paper
2011

Our work is inspired on ant colony approaches: the trails of artificial ants are used to produce an artistic rendering of the original image. An interactive Genetic Algorithm is used to evolve the parameters that govern the behavior of the species of ants, allowing the user to guide the algorithm to areas of the search space that she/he finds promising.

The novel characteristics of our approach derive, directly and indirectly, from the adoption of scalable vector graphics, which contrasts with the pixel based approaches used in most ant colony painting algorithms. This enables the creation of resolution independent images and, as such, large-format artworks. The rendering algorithm represents the trail of each ant through a continuous line of variable with, which contributes to the expressiveness of the artworks.

Nude #7 • The artwork is a non-photorealistic rendering of a photograph taken by Mick Waghorne. The painting algorithm produces a stylized rendering of the original photograph by deploying artificial ants on a virtual canvas and reproducing their trails. The parameters that govern the behavior of the ants are evolved through and interactive genetic algorithm. In this particular case the user chose to value behaviors that contribute to the creation of thin, organic and intertwined trails, which create ornamentation.



Nude #13
75x50cm
Inkjet print on Photo Rag Bright White paper
2011

Breakfast
50x75cm
Inkjet print on Photo Rag Bright White paper
2011

Nude #13 • The artwork is a non-photorealistic rendering of photograph (taken by an unknown author) produced by artificial ants. The ants live on the 2D world provided by the input image and they paint on an artificial canvas. They perceive luminance as food. To gain energy they must locate, using their sensory organs, light areas of the original photograph. The ants' movement is determined by their reaction to the sensory information. If the energy of an ant is bellow a given energy threshold it dies, if it is above a given threshold it generates offspring. The species of ants evolved to create "Nude #7" was applied to a different photograph, in order to illustrate how the ants behave in environments that are different from the one where they evolved.

Breakfast • The artwork, produced by artificial ants, is a non-photorealistic rendering of photograph (taken by Miguel Goncalves). In this case the user favored thick organic lines of varying width to produce an abstract rendering of the original image.

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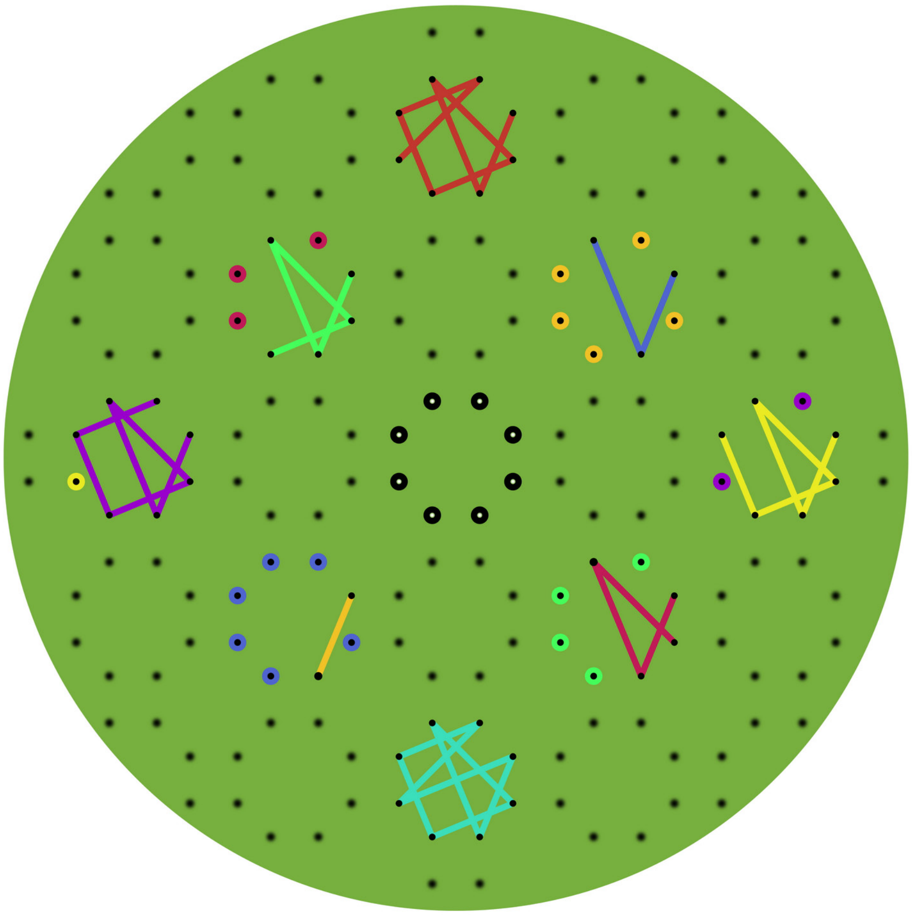
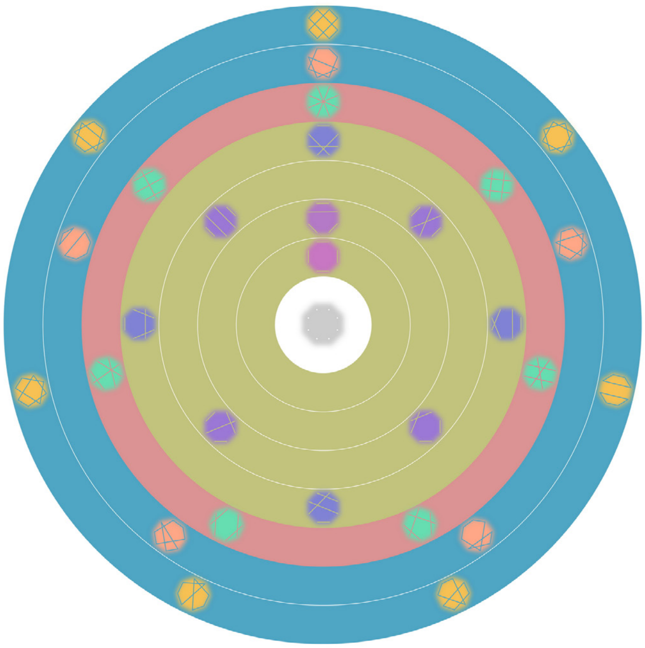


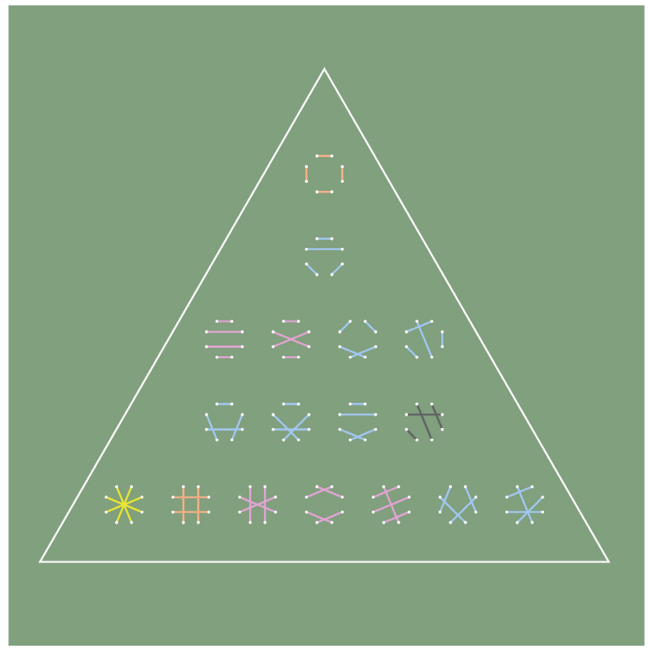
"Culture" (Octets - Yellow-Green)
24 x 24"
archival digital print
2011

Mathematics and visual art converge in their mutual preoccupation with pattern and structure. In mathematics, patterns and structures are usually understood cognitively and symbolically; in visual art, they are experienced perceptually and palpably. The former is largely quantitative in nature, the latter largely qualitative. My work results from both of these approaches. Current work includes exhaustive permutations of forms derived from octagonal point-arrays. These generate complete form-sets, from which I choose subsets for compositions. Compositions and coloration are guided by the inherent characteristics of the forms of a given subset, and those forms are often grouped by common features or arranged in gradients of increasing/decreasing features. Final composition and color decisions are sometimes intended to allude to such figurative subjects as the macroscopic universe of stars and galaxies and the microscopic world of atoms, molecules, and cells.

"Culture" (Octets - Yellow-Green) • This is one octet-form from a much larger set of forms, each of which is a closed, circuitous line that visits each vertex of an octagon only once. By varying the order in which the line visits the vertexes of the octagon, over 200 unique octet-forms result (this, after elimination of any forms that are symmetrically "redundant" by rotation or reflection). This composition includes each step of the line-segment construction of this single octet-form, completed as circuitous form in blue at the bottom of the composition.



"Orbital Shells" (Octets - Yellow, Red, Blue)
24 x 24"
archival digital print
2011



"Peak" (Octets - Green Ground)
24 x 24"
archival digital print
2012

"Orbital Shells" (Octets - Yellow, Red, Blue) • These 29 forms include 2 complete form-sets: 17 octet-forms that are built from 4 straight line segments connecting pairs of points (yellow and red shells) and 12 octet-forms built from 2 closed shapes connecting 3, 4, or 5 points (blue shells). Starting from the inner shell and proceeding outward, the yellow shells hold forms that gradually lose their external edge-lines (lines that join adjacent vertexes of the octagon). The red shell holds linear forms with no outer edge-lines (no adjacent vertex lines). The inner blue shell holds forms made with triangles and pentagons; the outer blue shell has forms made with pairs of quadrangles. This composition employs the complete sets of octet-forms made from line + line combinations and shape + shape combinations.

"Peak" (Octets - Green Ground) • This composition employs the complete set of 17 octet-forms made from 4 straight line segments connecting pairs of points in an octagonal array. The octet-forms are arranged in horizontal rows in descending order from more to fewer outer edges (lines connecting adjacent points of the octagon); the top form possesses all 4 outer edges, while forms in the bottom row possess no outer edges. The forms are further ordered by color coding for degrees of reflective symmetry; the chromatic order, yellow - orange - red - blue, indicates a decreasing number of internal axes of reflective symmetry (yellow = 8 axes, descending to blue = 1 axis), while the single asymmetrical form is colored neutral.

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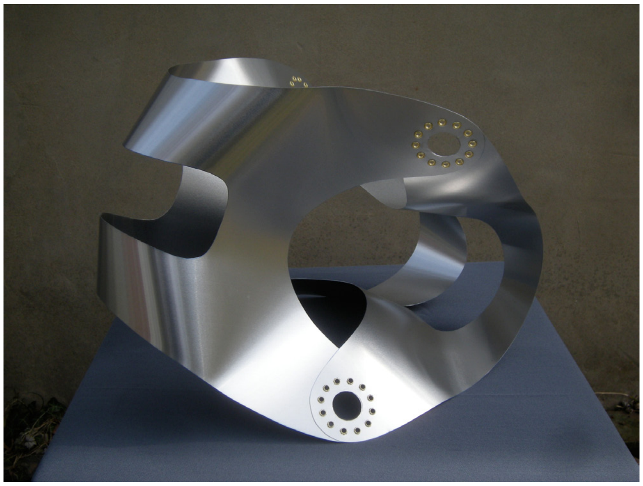
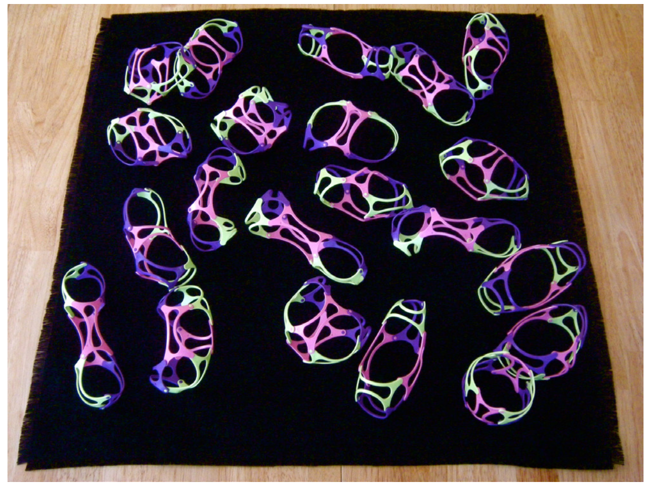


Torus
13" x 19" x 13"
aluminum and brass eyelets
2012



Deformations
2" x 24" x 24"
Flexeez construction toy and cloth
2012

I am interested in weaving both as a practical means of making surfaces and for its connotations of collaboration and conflict. The topic of maps (the embedding of graphs in surfaces) is a mathematical common ground for all the fabric arts. These works express my interest in the smallest maps and the shapes they make.

Torus • The simplest graph that embeds in the torus is the "bouquet of two circles." Charmed with what the Flexeez construction toy makes of the this simple graph embedding, I have sculpted a variation in aluminum. The game is to imagine the presence of the missing topological disks that would complete the surface of the torus.

Deformations • The tetrahedron has a close relative that also has four trivalent vertices and six edges, but is not a polyhedron: it is the digonal prism, a prism with two-sided faces (digons) at each end. The Flexeez construction toy can easily make a digonal prism. In fact, in making a digonal prism, each Flexeez can be played in one of two ways: long or short. This creates, from one simple map on the sphere, a large number of what chemists call deformation isomers, compounds that differ only in bond length. This work includes the 21 binary deformation isomers of the digonal prism. It is interesting to me how biology-like they are in both the building process and the resulting shapes.

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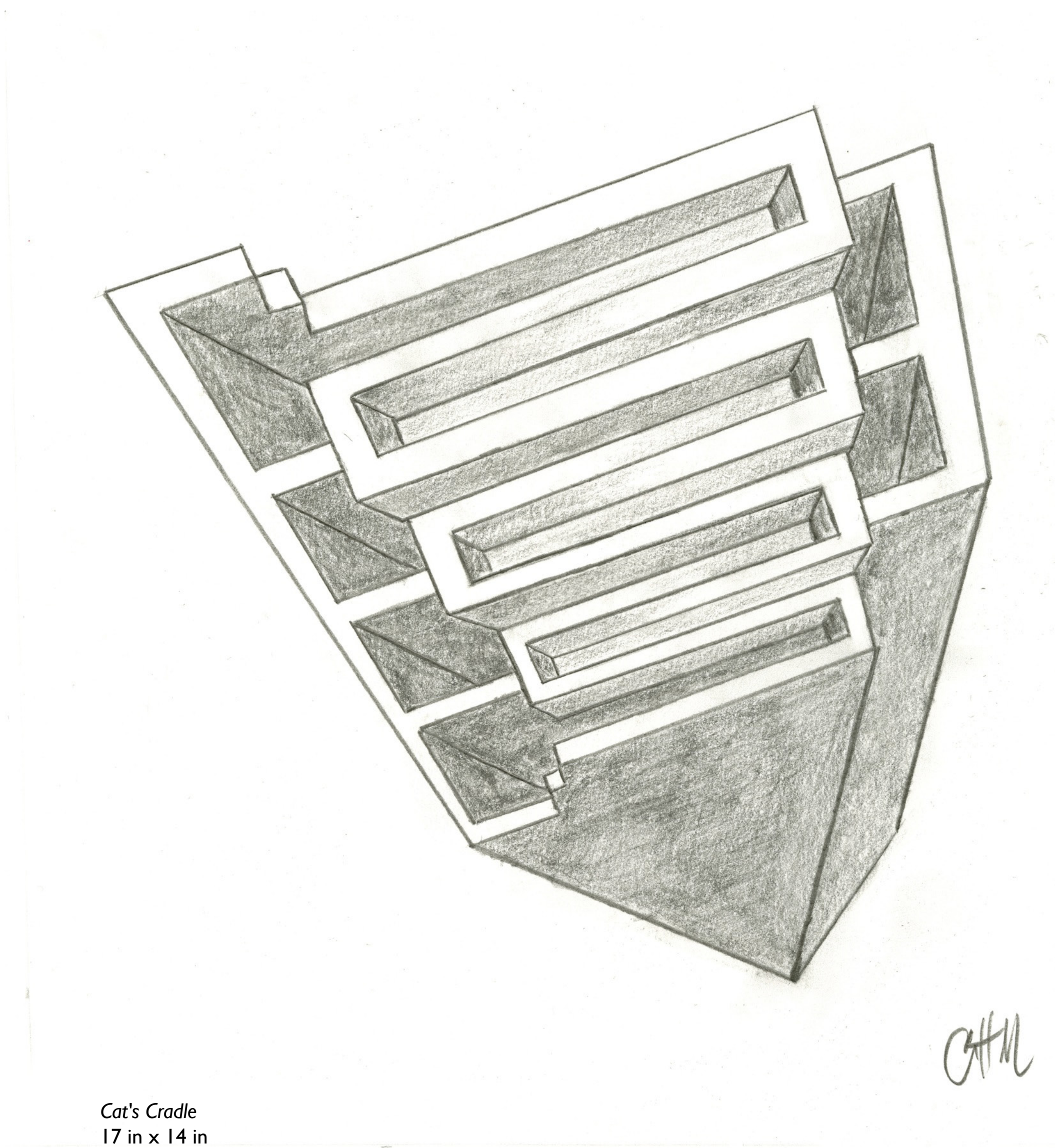

Cat's Cradle
17 in x 14 in
Pencil
2012

This past summer I did a 1000-piece puzzle of an M.C. Escher sketch without knowing what the sketch looked like. I spent months trying to put together pieces that looked like perfect fits and being unable to understand why the pieces that did fit together formed impossible shapes. When the puzzle was finally complete I was amazed with the drawing itself. It was so difficult to put the puzzle together, even more difficult to comprehend the drawing itself, but I realized the amazing thing was M.C. Escher was able to create an impossible image that seemingly mirrored reality. It took me three months to put that puzzle together, but the challenge immediately presented itself: I wanted to create impossible images that mirror some sort of reality. I do not consider myself an artist but I have spent countless hours creating impossible figures and if any of these figures can make you think for just a little bit, that would be really great.

Cat's Cradle • This is an overhead view of a tall structure with a spiraling and weaving walkway at the very top. The walkway is formed by 7 connecting blivets. Can you follow the path? Can you find the structures tallest point? Can you tell which paths are higher than which other paths?

KAZ MASLANKA

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The Monastic Path
24" x 34"
Digital Light-jet Print in a lightbox
2012

"As an artist, my interest in correlating experience through language spawned my desire to study mathematics and physics. I am currently pursuing my interest in using mathematics as a language for art. I serve the concept of polyaesthetics and mathematical poetry by viewing mathematical equations and the variables within the equations as capable of providing the structure for metaphors. Furthermore it pushes the boundary for the use of mathematical equations from the traditional role of denotation into a new role of connotation. Mixing poetics in the structure of mathematic equations enables me to blend the aesthetics of poetry, science and mathematics. With phrases embedded in the mathematic equations, one can construct relationships between the phrases that can bring a linguistic richness to subjects that normally not use mathematics as a language, e.g. cultural, spiritual, etc."

The Monastic Path • The artwork titled, "The Monastic Path" is a series of five images plus a sixth being a mathematical poem. The original photos in this series were taken in a special "Zen Room" at the Tongdosa Buddhist Monastery in South Korea. The room is reserved for a special event called a Kyol Che. For this occasion the monks meditate between eight and twelve hours a day for a hundred days. The mathematical poem speaks to the experience I had while conversing with the monk in the images. He possessed the rare quality of having extreme confidence with no ego. The mathematical poem is in the form of what I call an orthogonal space poem which is always in the form of a = bc or its syntactical equivalent. One may notice that confidence is not as important when the ego approaches zero.

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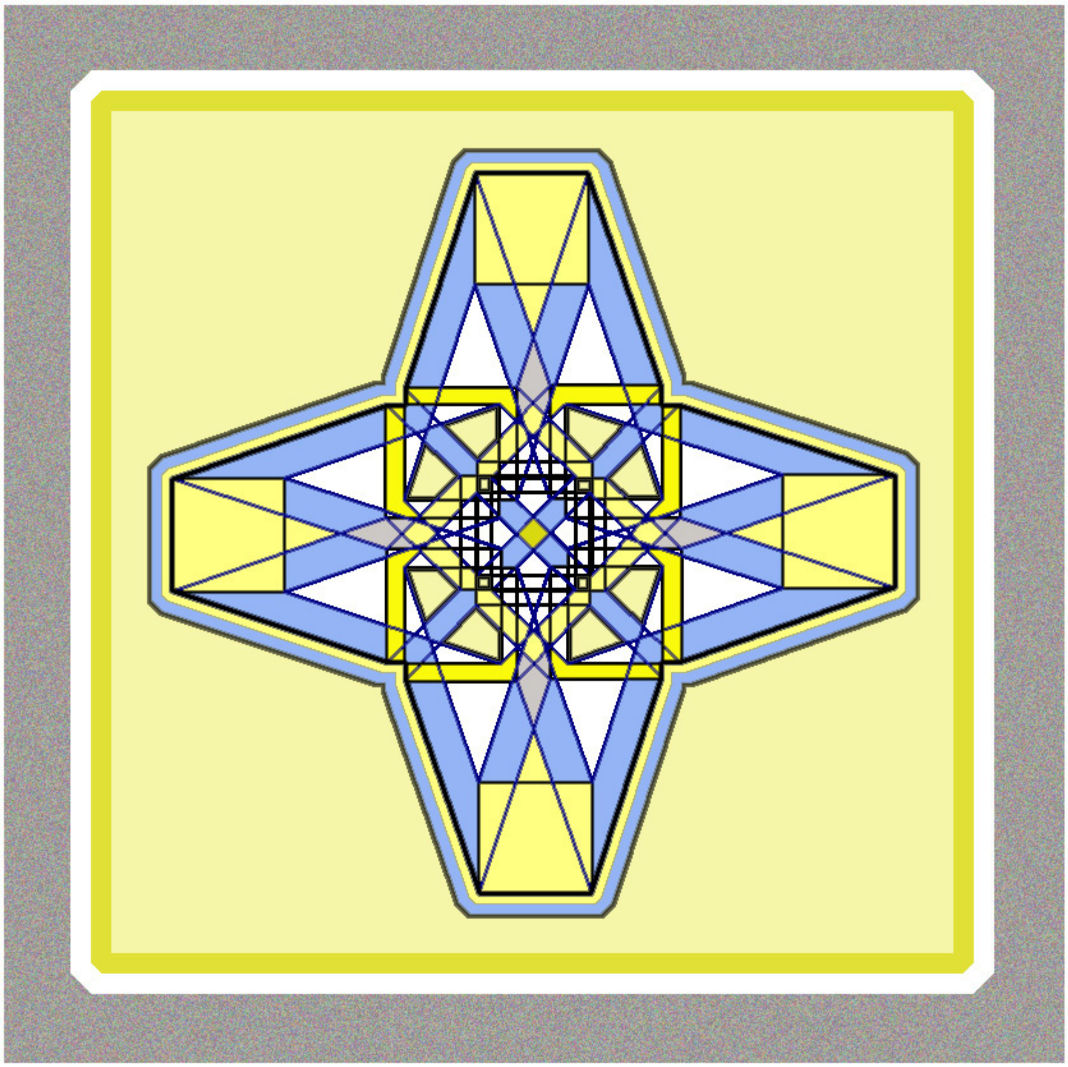

Blue, Skewed Hypercube
17"x17"
Digital computer art
2012

The computer serves as an invaluable tool for graphic designers and can add new dimensions of precision, repeatability and experimentation to the artists' toolkit. Coming from a math and computer science background, I am especially interested in how the computer can be used to create new designs. I am also fascinated by the beauty and complexity revealed when simple building blocks and algorithms combine to produce complex and elegant artwork.

Blue, Skewed Hypercube • This artwork is a two-dimensional drawing of a four-dimensional hypercube that has been manipulated to produce a design. A three-dimensional cube can be drawn on the plane in a form that is easily recognized. Our minds automatically adjust for the missing dimension and there is little ambiguity. However, because we have less experience with four dimensions, interpreting a planar picture of a 4-D object requires more imagination. Dynamic graphic drawing systems now allow the artist and mathematician alike to experiment with new forms and methods of expression. This enhanced artwork is the result of one of many possible outcomes of such an exploration.

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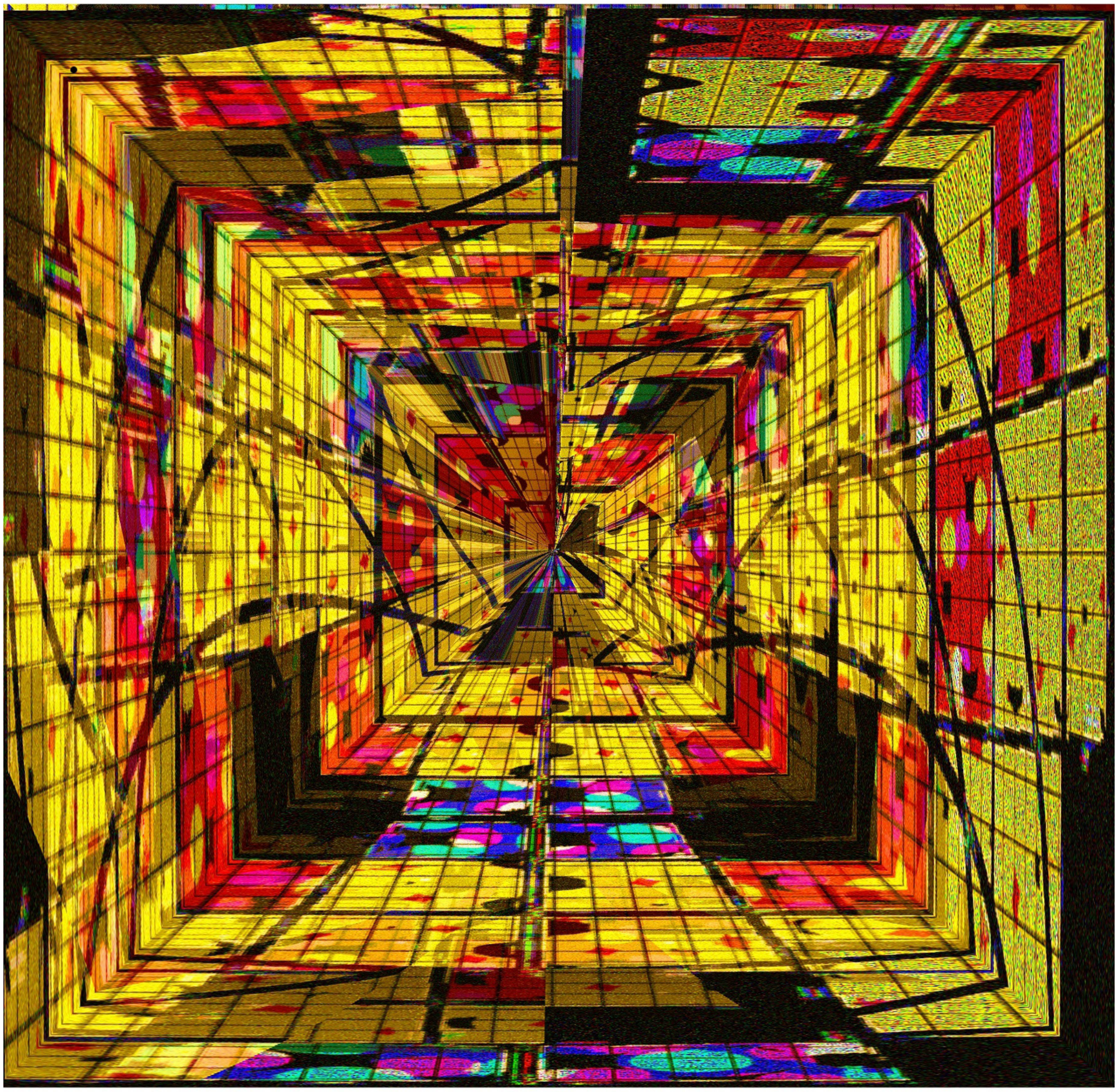
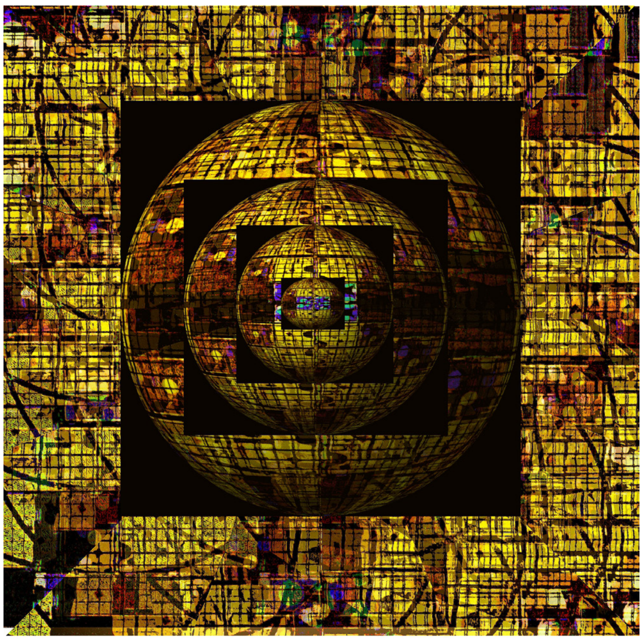


Fibonacci Mod 4
18.75X18.625 inches
Computer Generated graphic design
2012

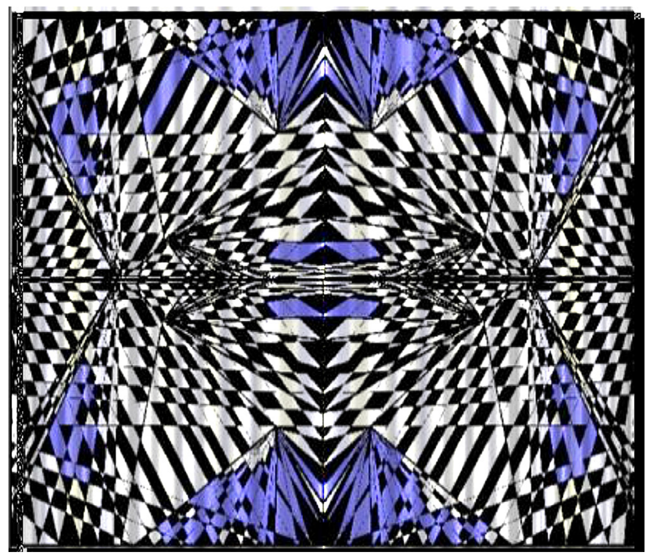
After graduating with a major in mathematics and a minor in art, I wanted to share my knowledge of mathematics. However, very few of my acquaintances understood or appreciated math but most appreciated some type of art. The art spurred conversations. It was at this time that I began exploring the connection between mathematical patterns, symmetry properties and graphic designs.

The language of mathematics is an obscure language for most. In an attempt to drawn people into discussions on the beauty of mathematics, my artwork utilizes number patterns, such as the Fibonacci sequence, magic squares, function patterns or matrices along with symmetry properties and a little imagination.

Fibonacci Mod 4 • Fibonacci Mod 4 design was created using the Fibonacci sequence converted to mod 4, symmetry properties and the concept of infinity.



Sphere Within
18.75X18.625
Graph Design
2012



Butterfly Function
12.323x10.537 inches
Graphic Design
2009

Sphere Within • This image uses Fibonacci sequence mod 4, symmetry properties and a globe within a globe depicting higher dimensions.

Butterfly Function • This design was created usinging functions and symmetry properties.

MIKE MCKEE

CONTACT

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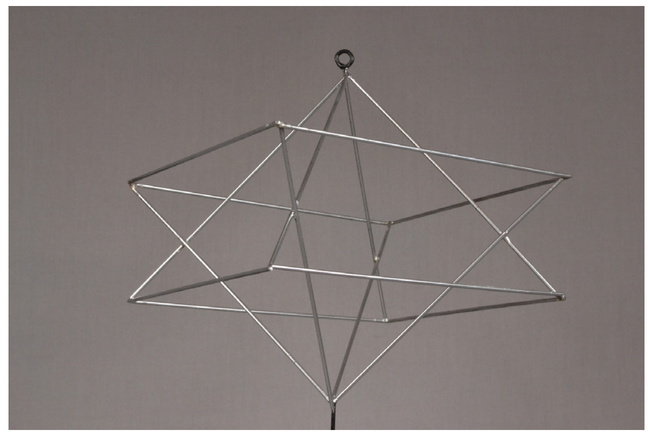
Bicorn Frequency
21" x 18"
acrylic on panel
2010

My art work is inspired by the unknown, the subconscious and the metaphysical. As an artist I am always searching beyond the borders of what was defined by the art made yesterday. In recent years I have found that mathematical formulae provide certain laws that act as guide lines for which my vision can be projected upon. The field of mathematics is so vast and certain that it captures the simplicty and grace as well as the enormity of nature. The grid is a perfect example of mathematical simplicity and yet it provides the matrix for very complex representations. Aesthetics are the manifestation of mathematics in nature where by balance and harmony become an observable equation that is pleasing to our senses. So the art that I make finds inspiration in the unknown elements of our universe exemplified through math and manifest in the final aesthetic product.

Bicorn Frequency • I am fascinated how one shape can be reflected within another. In this painting the Bicorn Crescent nests on the Frequency Curve as they mimic one another. This reveals the knitted fabric of our universe. I have included the formula for each of the shapes in the painting so as to ackowledge the periphery, which is where the hidden aspects of the universe seem to exist.

Mathematical Sanctuary
12" x 17"
acrylic on panel
2010



Octahedron Merkaba
8" x 8"
Painted Steel Rod
2011

Mathematical Sanctuary · In our frenetic fast paced world I have aspired to depict a serene location where the laws of mathematics provide refuge. The structures and shapes of geometry call to my mind a sacred quaulty that is perfect in every way.

Octahedron Merkaba · This octahedron is outfitted with a ring that allows it to spin. When the object spins it takes on a new identity that reminds me of how an Oak tree is bound within the acorn. There are so many mysteries waiting to be unbound in the same manner.

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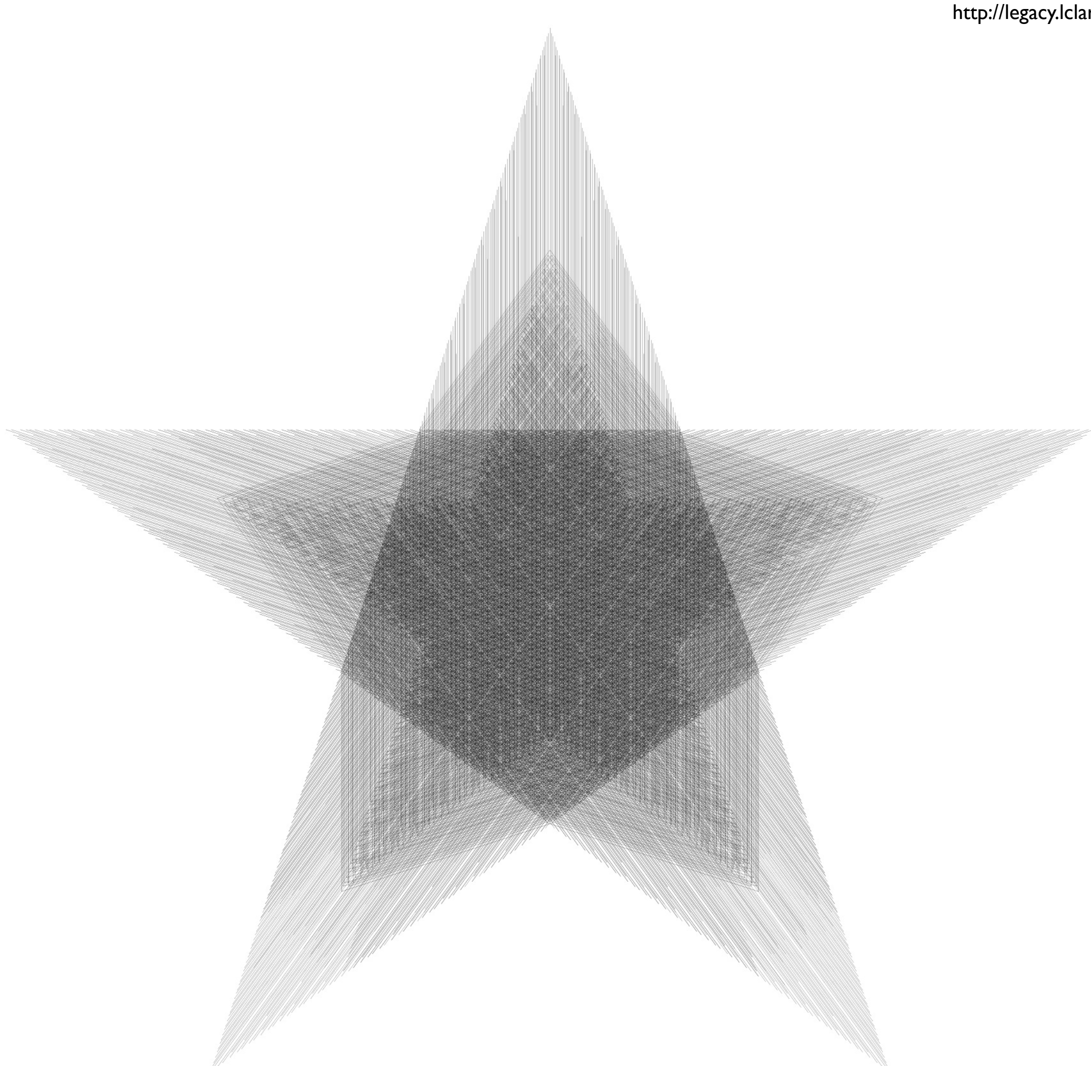

Ternary Tree Star, Version 1.618
24" x 24"
digital print
2012

I've had a decades-long fascination with geometric trees. When the iPad came out, I resolved to employ its multi-touch technology in a tree-drawing app, which I named "Geom-e-Tree". The app enabled me to re-explore the tree form, going into areas I had never ventured. I saw trees snap into grids and shape themselves into polygons and pinwheels. I was shocked to see a three-branched tree form a five-pointed star. I was disoriented because I didn't understand where all these special trees were located in the parameter space, but gradually, patterns emerged. To share this new knowledge, I released a poster of 150 Geom-e-Trees at the Gathering for Gardner last March, and gave a short talk, "What Shape is a Tree?". With this gallery entry, I invite others to explore this wild and beautiful treescape, mathematically and esthetically.

Ternary Tree Star, Version 1.618 • This is a three-branched tree with two 144° obtuse angles between branches at each node throughout the tree. The branches grow in length by the Golden Ratio (phi) on each level away from the trunk in the center. Ternary Tree Star, Version 1.618 is one of an infinity of 5-pointed stars with common ratios ranging from phi (1.618...) up to two (2.0). I found that the Golden Ratio organizes the lines crossing through the interior of the star more highly than other common ratios do, so that a geometric pattern is formed by the white space as well. Ternary Tree Star is also a member of a larger family of polygon-, grid-, and star-shaped patterns formed by geometric trees (Geom-e-Trees) at special angles. [Technical note: The 1800x1800 art catalog image uses 88,574 lines. The web gallery image is downsized to 600x600. The 24 inch digital print has 265,721 lines.]

KERRY MITCHELL

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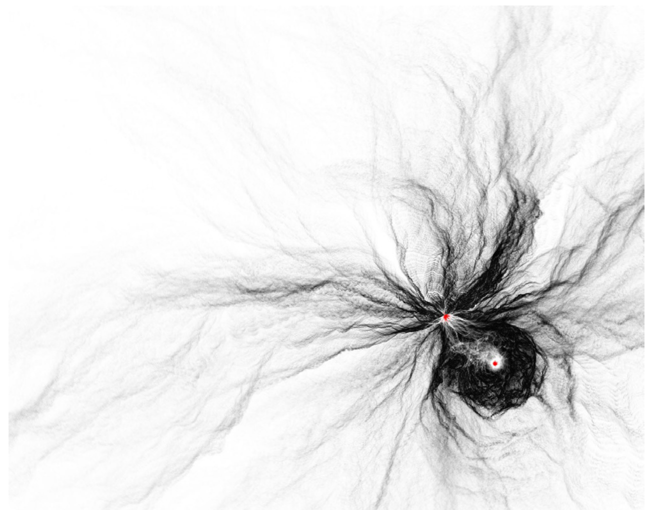
Simple as the Number Nine
16" high x 20" wide
digital photographic print
2009



Black Widower
16" high x 20" wide
digital photographic print
2009

My work is composed primarily of computer generated, mathematically-inspired, abstract images. I draw from the areas of geometry, fractals and numerical analysis, and combine them with image processing technology. The resulting images powerfully reflect the beauty of mathematics that is often obscured by dry formulae and analyses.

An overriding theme that encompasses all of my work is the wondrous beauty and complexity that flows from a few, relatively simple, rules. Inherent in this process are feedback and connectivity; these are the elements that generate the patterns. They also demonstrate to me that mathematics is, in many cases, a metaphor for the beauty and complexity in life. This is what I try to capture.

Simple as the Number Nine • This image presents a linear combination of four chaotic orbits of boundary points of the Mandelbrot set. The individual orbits were weighted so as to approximate the first derivative of the orbit. Logarithmic scaling was used to convert the frequency of pixel visitation to a color. The title of the image was taken from a line in the song, "Burning Bush," by Earth, Wind, and Fire.

Black Widower • This image presents a linear combination of five chaotic orbits of boundary points of the Mandelbrot set. The individual orbits were weighted so as to approximate the natural exponential of the fourth derivative of the orbit. Logarithmic scaling was used to convert the frequency of pixel visitation to a color.

JEANNIE MOBERLY

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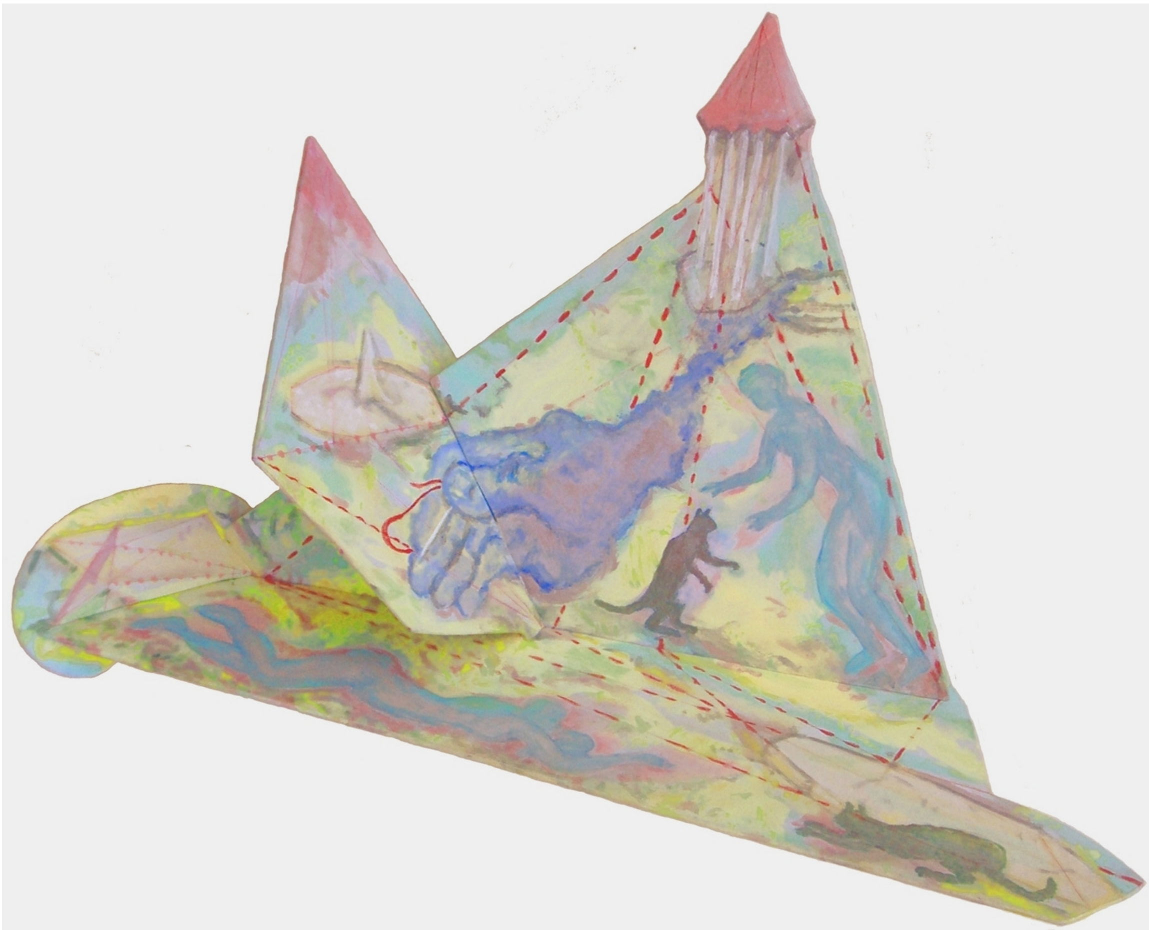
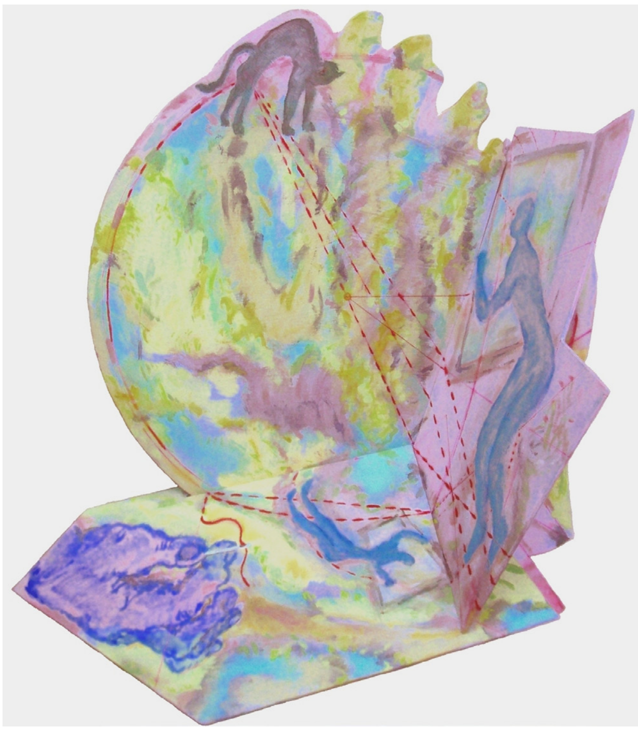


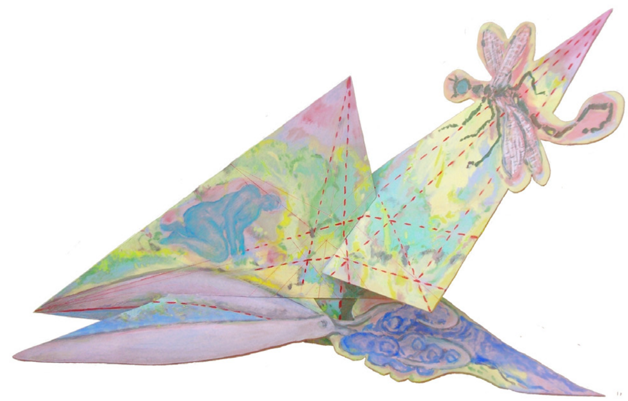
Here Kitty
21"x18"x7"
oil on board
2012

Harmonic Perspective
In projective geometry basic incidence relations and duality are primary. Perspective is an elementary relation between points or lines linked to perspective drawing. Harmonics are geometric invariants featuring a fundamental fourness divided into two pairs. Using different definitions of harmonics, from basic incidence constructions to non-projective ones with circles, angles and distance ratios I've made three artworks that explore harmonics, perspective and their interrelationships. They are composed on hardboard painted with acrylic and oil. My pieces create 3D spaces with intersecting planes and based on CJ's diagrams made with Geogebra are an attempt to understand projective space without the influences of Renaissance and photographic perspective.

Here Kitty • In Here Kitty harmonics are set up using a complete quadrangle and its diagonal points to find the conjugates. Various quadrangles in various planes share a harmonic line. Quadrangles can switch diagonal and conjugate points.



Inside Out
18"x21"x9"
oil on board
2012



Intentional Cut
24"x21"x9"
oil on board
2012

Inside Out · Inside Out features an an Appollonian circle construction of a harmonic line and an inversion through separate conics so the observer observes the observer iteratively.

Intentional Cut · In Intentional Cut harmonic pencils derived from 2 lines intersect in a quadrangle whose points will act in the involution of conjugate points along the harmonic line on the left which has one distant invariant point.

CHARLENE MORROW

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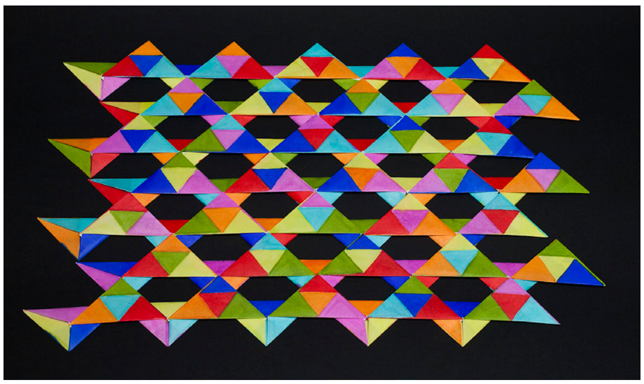
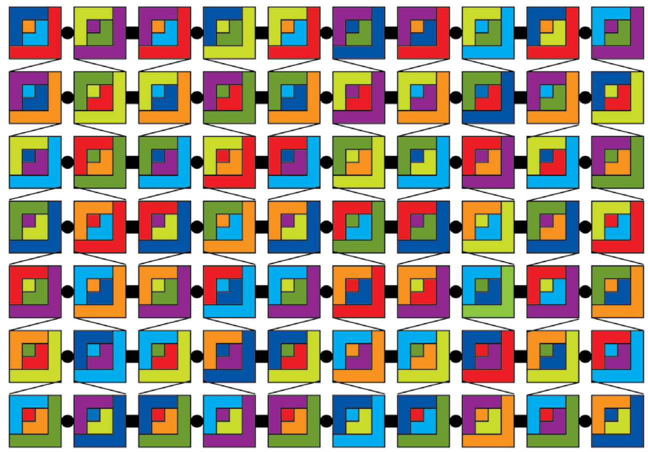


Pascal's Palette (front view)
16 x 24 inches framed
Origami kami paper, hand colored
2012



Inspired by 70
16 x 20 inches framed
Laser color print on Bristol paper
2012

I work mainly in the medium of modular origami. I am motivated to understand mathematical ideas by attempting to express these ideas in visual ways. I am deeply impressed by the ways that visually pleasing art often emerges through the process of trying to gain a deeper understanding of the mathematical ideas I set out to explore. I also find that new questions emerge as I look for ways to express my original questions. The dialectical process of mathematical question – visual expression – mathematical question engages my imagination and allows me to experience both the beauty and the power of mathematics.

Pascal's Palette (front view) • This piece is a unit origami "quilt" made from 70 isosceles right triangles, hand colored and interlocked with tab and pocket construction. 35 triangles are each colored with a unique set of 4 colors, chosen from a set of 7 colors, thus representing all of the 4 color combinations that can be made. The remaining 35 triangles are each colored with a unique set of 3 colors chosen from the same 7 colors as above, thus representing all of the 3 color combinations that can be made. The quilt has this same property on both sides, although the colors appear in different areas of the origami units. The thumbnail image prominently displays the 3-colored side of the quilt while the image above features the 4-colored side. Pascal's triangle, which is a comprehensive catalog of combinatorial information, was the inspiration for this work.

Inspired by 70 • The idea for this print was inspired by a friend's upcoming 70th birthday. My search for interesting mathematical connections with 70 led to the idea of combinations of a set of colors, which led to Pascal's triangle. This print represents the set of 4-color combinations and 3-color combinations chosen from 7 colors as described for the origami work above. Black dots encode the pairs of squares that represent non-overlapping 4-color and 3-color sets. Black squares and slanted lines encode separations between pairs that are not related in this way. Note that the number of combinations of 8 colors taken 4 at a time is also 70, which will lead to yet another print.

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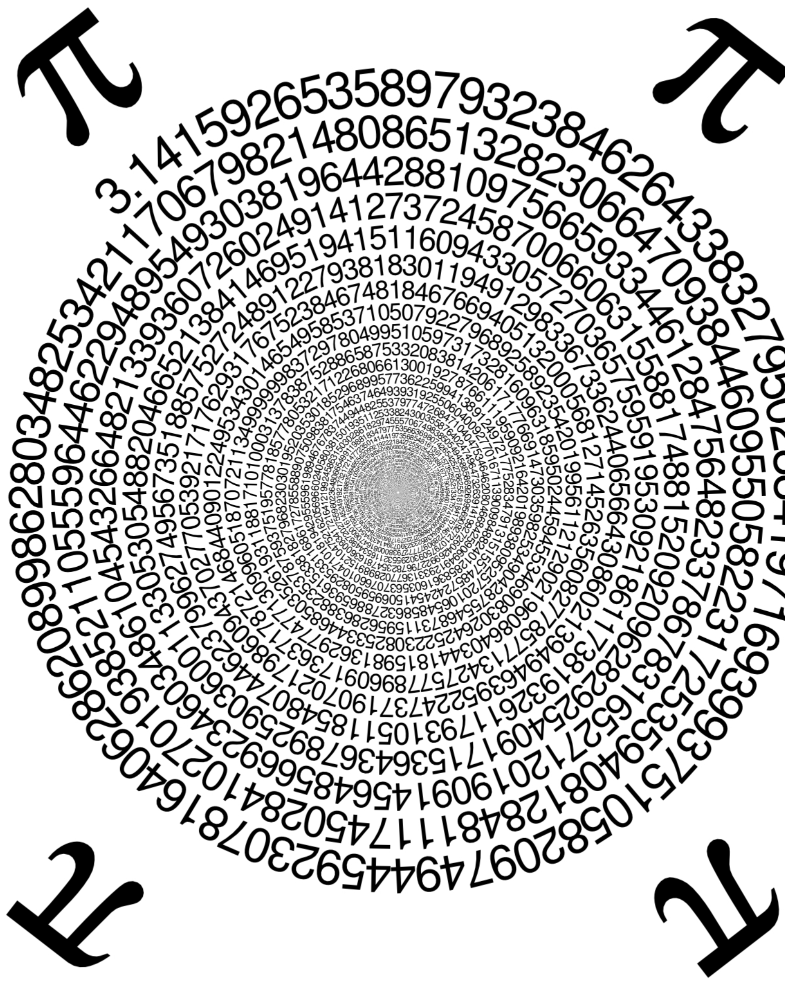

Pi
17 x 22 (inches)
digital print
2003

I am interested in mathematical patterns that convey a message at multiple levels or scales. I enjoy creating art that uses text to form geometric patterns and geometric patterns that form text. I am also very interested in using tessellations as the basis of interesting patterns.

Pi • Pi is a fundamental constant found in many areas of mathematics. I created this artwork to give a visual connection between pi, the circle, and pi's nonterminating decimal expansion.

MOSELY, ESTERLE, & BOX

CONTACT

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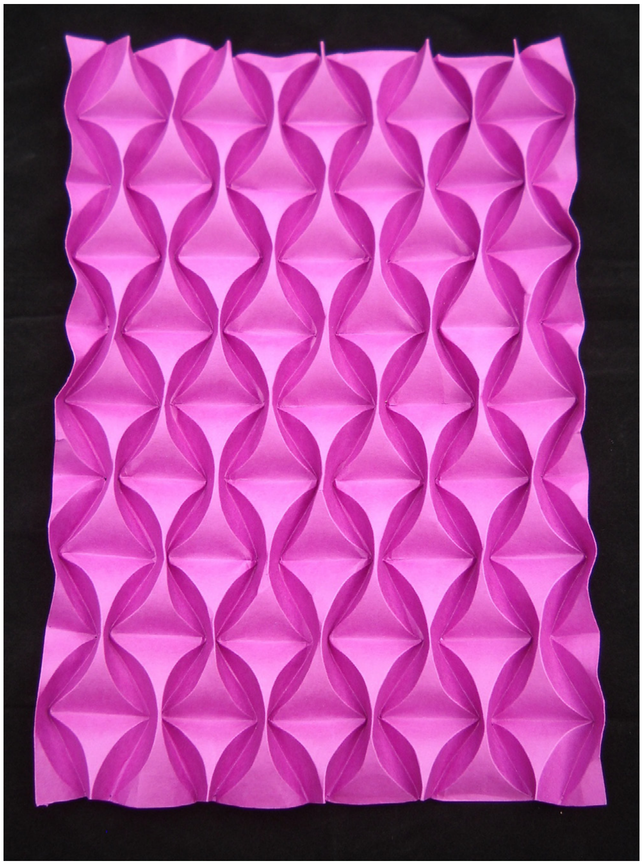
Waxing Gibbous
15" x 15" x 15"
Bronze, Gold, Egg Cartons
2012

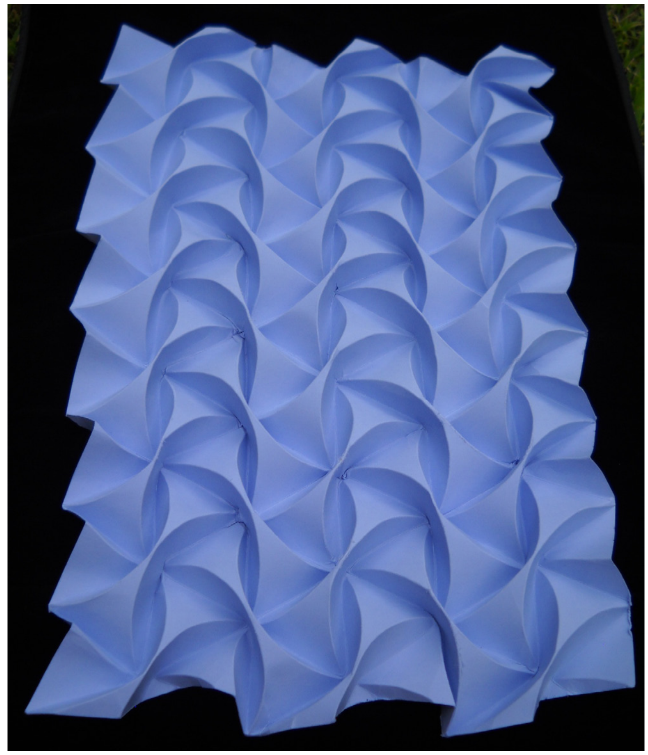
I am an mathematician and origami artist. I am interested in abstract geometric designs with repeated motifs. Recently I have been exploring the connection between traditional smocking designs and paper tessellations. Most artists working in cloth tessellations either treat the cloth as a developable surface - like paper - producing a flat surface by pressing, or they allow the cloth to deform into three dimensional bulges with fluid shapes. I wanted to reproduce these rounded shapes in paper, so I used differential geometry to develop a theory that could compute the shape and position of the straight and curved creases needed to describe some of the forms that cloth takes when smocked.

I also occasionally work in other media, such as egg cartons.

Waxing Gibbous • In 2008 I invented "or-egg-ami", the art of weaving geometric sculptures from strips of egg cartons. Sculptor Kevin Box with assistance from Dick Esterle bronzed and gilded one of these models. The result is "Waxing Gibbous", whose external white patina and golden interior are reminiscent of a broken egg, or a moon that has cracked open to reveal a molten interior. The mathematical form is based on the rhombicuboctahedron.



Smocking Tessellation
10" x 15"
Paper
2011



Herringbone Tesellation
10" x 15"
Paper
2011

Smocking Tessellation • I was inspired by classic smocking patterns to create this paper tessellation. In smocking, tiny stitches on the back side of the fabric create gathers that cause the cloth on the front side to form orderly pillows. Recreating these pillows in paper presents a special challenge because the surfaces must be developable. I derived equations to determine the shape and position of the curved and straight creases required for this design. The resulting integral lacks a closed form solution and was solved numerically using Mathematica. I printed the principal domain onto card stock, cut it out and used it to trace multiple repetitions of the design onto a larger sheet of paper. These were "scored" with an embossing tool and then folded.

Herringbone Tesellation • I was inspired by classic smocking patterns to create this paper tessellation. In smocking, tiny stitches on the back side of the fabric create gathers that cause the cloth on the front side to form orderly pillows. Recreating these pillows in paper presents a special challenge because the surfaces must be developable. I derived equations to determine the shape and position of the curved and straight creases required for this design. The resulting integral lacks a closed form solution and was solved numerically using Mathematica. I printed the principal domain onto card stock, cut it out and used it to trace multiple repetitions of the design onto a larger sheet of paper. These were "scored" with an embossing tool and then folded.

MIKE NAYLOR

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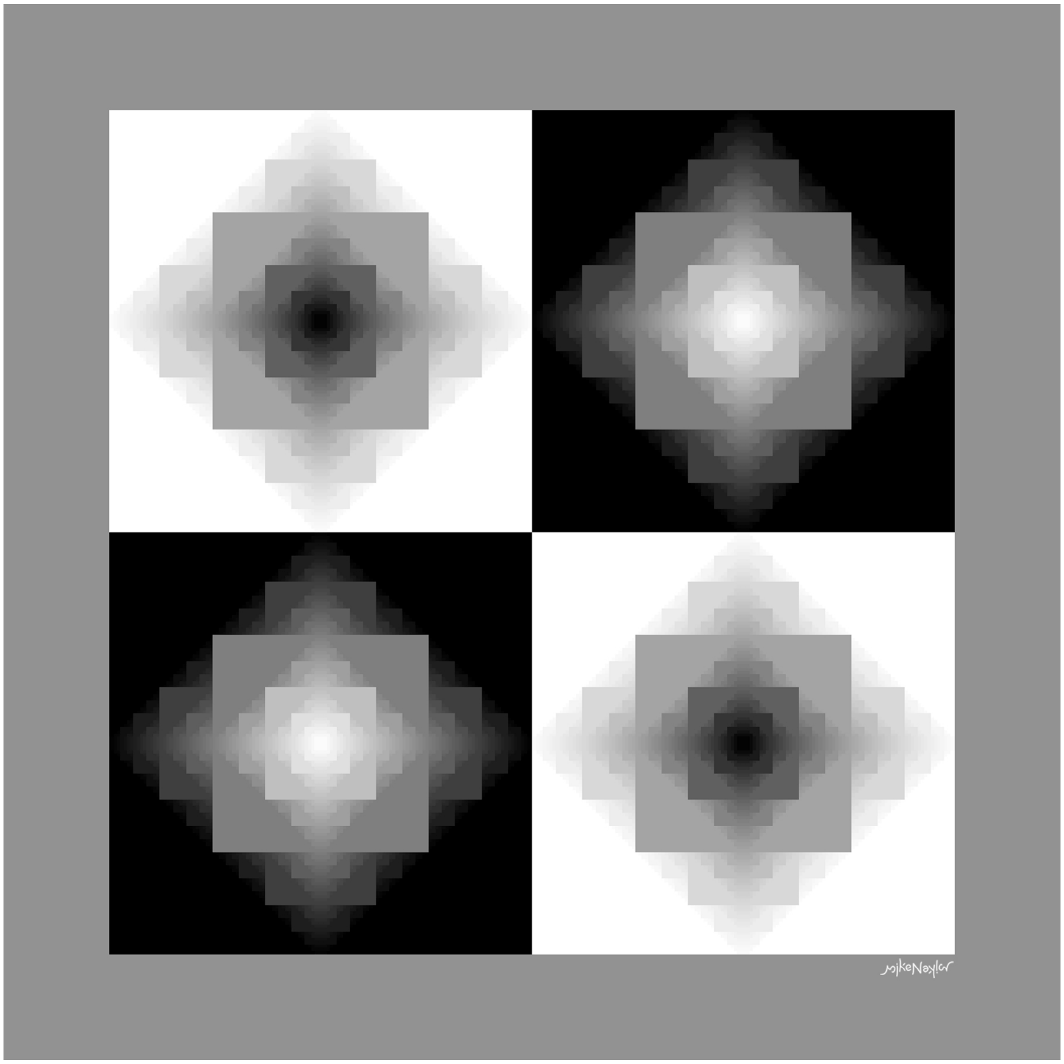
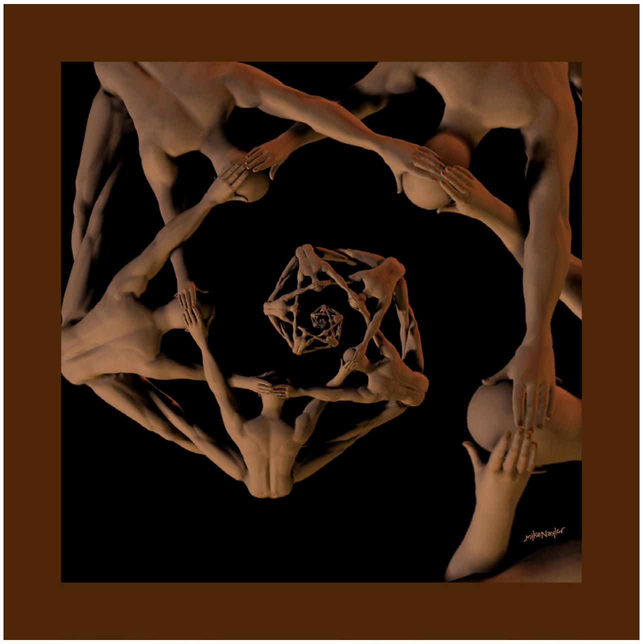


Binar
32 cm x 32 cm
Digital print on acrylic
2011

I enjoy creating mathematical artwork with multiple interpretations and hidden ideas that can be revealed by thoughtful inspection. Much of my artwork focuses on the use of the human body to represent geometric concepts, but I also enjoy creating abstract works that capture mathematical ideas in ways that are pleasing, surprising and invite further reflection.

Binar • This image contains 4 fractal elements each of which contains a representation of the binary numbers from 0 to 127 (0 to 1111111). Each quarter of each of the 4 main images was created by starting with a 50% gray square on a white or black background. Two half-size squares are placed adjacent to this square and one half-size square within. The squares are given a shade of gray which averages the two shades around them. This rule is carried out 7 times. The resulting abacaba fractal contains 128 binary numbers in the sequence from 0 to 127. You are encouraged and challenged to find these binary numbers within the artwork; it is an interesting challenge with many solutions!



Pentaman Spiral
32 cm x 32 cm
Framed digital print
2011

The Human Cube
10 cm x 10 cm x 10 cm
Painted SLS nylon sculpture
2012

Pentaman Spiral • This spiral of human figures link their arms and legs together to form an infinite spiral based on design elements of a inscribed pentagram. An inscribed pentagram is 5-pointed star inside of a pentagon and is one of the sacred symbols of the ancient Pythagoreans. Whereas in the traditional form the edges of the pentagon are equal length, in this representation each successive edge is scaled in proportion to the golden mean, thus creating a spiral instead of a closed figure. The arm and leg linkages create both of the forms of the golden triangles with angles of 36°, 72° and 108°. This work was inspired by a previous work, Pentamen, shown at Bridges 2011.

The Human Cube • In this sculpture four human figures join together to create a cube. This work also joins together mathematics and the human experience, reminding us that we are as much a part of mathematics as mathematics is a part of us. The four figures are separate and identical except for coloration. They snap together to make a free-standing form. Each figure is hand-painted with acrylic.

ELIZABETH PALEY

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Klein Bottles
12 x 3.5 x 6 inches (left), 6 x 9 x 5 inches (right)
Wood-fired white stoneware
2010

A recovering academic with degrees in physics, astronomy, piano performance, and music theory, I took a beginning pottery class in 2002 and have been hooked ever since. My art typically begins with wheel-thrown pieces that I subsequently alter, cut, and assemble. While much of my work is traditionally functional, I have recently become interested in math-influenced forms and the design challenges they present.

Klein Bottles • This pair of Klein bottle models illustrates two different construction possibilities: bottle + torus + cone (left), and torus + torus (right). All components were thrown on a potter's wheel, then trimmed, cut, and nudged together. Feeling jealous of the transparency of Cliff Stoll's glass Klein bottles, I covered both forms with holes. After bisque firing, the bottles were fired in a wood-fueled kiln to cone 9-10 (~2330F), with soda ash added late in the process to give the bottles a glassy finish.

Nested Spheroids
Spheroids range from ~2 x 2.5 x 2.5 inches to ~3.5 x 4 x 4 inches
White stoneware
2011-2012

Interlocking Sliced Tori
1.5 x 6.5 x 6.5 inches each (when closed)
White stoneware
2011

Nested Spheroids · With the exception of the two hand-built Borromean-rings stands, all components in this collection of nested spheroids were wheel thrown. The inner balls were thrown, trimmed, carved, and brushed with terra sigillata (a suspension of very fine clay particles) and bisque fired. I then threw the outer spheroids, pausing roughly halfway to insert and enclose the inner balls, so that the spheroids were embedded within one another without slicing any of them in half. The outer balls were then trimmed, carved, brushed with terra sig, and fired to cone 06 (~1828F) in an electric kiln.

Interlocking Sliced Tori · After coming across George Hart's instructions for slicing bagels into linked halves, I tried a similar cut with wheel-thrown clay tori. After slicing, the exterior of each half was stamped with either a flat- or Phillips-head screw to suggest positive and negative charges. After bisque firing, the exterior surfaces were stained with patinas and the interior surfaces lined with glaze. The boxes were then fired to cone 6 (~2264F) in an electric kiln.

CURTIS PALMER

CONTACT

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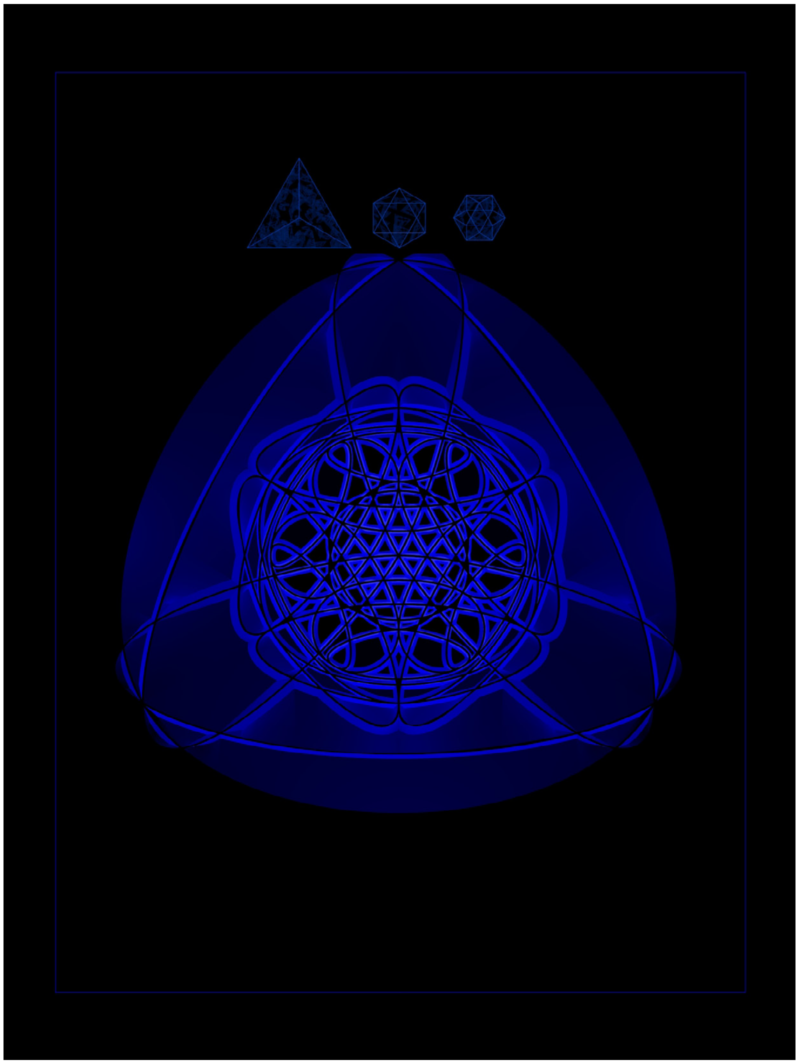

Triptych Left
Framed 20" x 17"
Photo paper and archival inks
2011

Triptych Left, Triptych Centre and Triptych Right are renderings of Rhinoceros models of edge illuminated, engraved glass architectural panels. Each panel of the triptych is a cyclon, a record of an algorithmic transformation (cf. Bridges - Spelunking 2005, 2009) of three of R. B. Fuller's "Synergetic Hierarchy": the tetrahedron, octahedron and cuboctahedron arranged concentrically. Planar projections of these three polyhedra are lightly placed in an exploded view near the top of each print showing their alignment within the construction, before they were 'spelunked'. Three views are presented because as Fuller says, "the universe is non-unitarily conceptual". The inherent symmetries of the isotropic vector matrix are revealed in these views.

Patterns that seem mutually exclusive are derived from the same source.

I have rendered these in primary colours leaving it to the mind of the perceiver to integrate them into the white light of understanding.

Generated Prints.

Triptych Left • In blue. Trilateral symmetries of the isotropic vector matrix.

Triptych Centre
Framed 20" x17"
Photo paper and archival inks
2011

Triptych Right
Framed 20" x 17"
Photo paper and archival inks
2011

Triptych Centre • In Red. Bilateral symmetries of the isotropic vector matrix.

Triptych Right • In Green. Quadrilateral symmetries of the isotropic vector matrix.

BERNHARD RIETZL

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Prime divisor cube towers on Ulam spiral
27cm (h) x 54cm (w) x 54cm (d)
Colored wood cubes
2012

I am interested in the combination of art and mathematics especially number theory. Prime numbers can be seen as the elements of the whole numbers, compound numbers literally are the products of these basic elements. It is like in chemistry where the chemical elements are the basis for all compound molecules.

Prime divisor cube towers on Ulam spiral • This kinetic art object displays the numbers from 1 till 144. The numbers are arranged in the form of a so called Ulam spiral with 1 in the center and consecutive numbers spiraling around the center on a rectangular grid. The numbers are represented by stacks of cubes, each cube standing for a prime divisor of that number. So prime numbers are represented by a single cube, compound numbers by stacks of two or more cubes. The prime divisors 2,3,5,7,11 and 13 are color coded (2=green,3=red;5=yellow;7=blue;11=orange;13=purple), higher prime divisors are coded by a black and white binary pattern on the cube. People are invited to go round the sculpture to explore the mathematical aspects and also to experience the changing impression of colors depending on the point of view. The artwork can be extended by placing further boards round the starting one.

IRENE ROUSSEAU

CONTACT

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Curved Space: fragments towards infinite smallness
48" x48"x 2 1/2"
oil on canvas
2009-2011

My interest is in exploring mathematical and scientific concepts and creating works from and artistic and aesthetic point of view.

BOB ROLLINGS

CONTACT

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The Platonic Solids

My interest in geometry stems from a lifetime spent in the cabinet making industry. Initially I worked as a hands on craftsman and later in a supervisory position which comprised of interpreting designer/architectural concepts and turning them into practical and beautiful pieces. After my retirement, I turned my interest in geometry into a hobby using wood as a medium. My investigation and interpretation of the platonic solids has been influenced by Johannes Kepler, Luca Pacioli, Leonardo Da Vinci, M.C. Escher and later by Buckminster Fuller and Donald Coxeter. After exhibiting some of my work at the Fields Institute, I was invited to share space in Donald Coxeter's showcase in the Department of Mathematics at the University of Toronto. Using a lathe as my primary tool gives me a more individualistic approach to the study and presentation of various geometric forms.

The Platonic Solids • This group of five platonic solids shown here are of different sizes but their vertices lie on the surfaces of spheres that are approximately four to six inches in diameter. They are made from various species of wood which have been laminated together to create the individual designs achieving the edge matching required.

Rotating Sculpture

Trefoil Number 3

Rotating Sculpture • My wood sculpture has been inspired by the work of Charles Perry and C.H. Séquin. It is five by five by eleven inches high. The wood is babinga and it is lathe turned by hand and is based on a streptohedron.

Trefoil Number 3 • The wood used in this sculpture is burled maple. It is made from three rings, three quarter inch in section and five inch diameter. These rings were divided, rotated and then reassembled to make this a three dimensional continuous ribbon.

REZA SARHANGI

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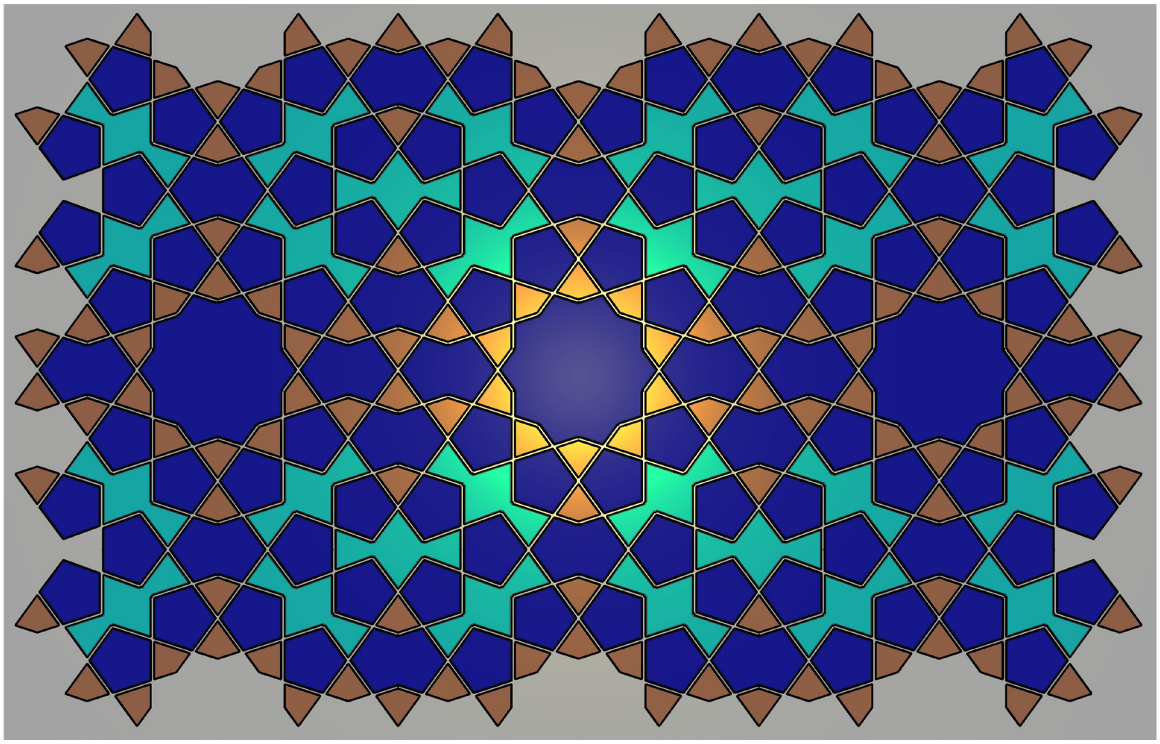

DahPar I
16" X 20"
Digital Print
2011

I am interested in Persian geometric art and its historical methods of construction, which I explore using the computer software Geometer's Sketchpad. I then create digital artworks from these geometric constructions primarily using the computer software PaintShopPro.

DahPar I • DahPar I (September 2011) is an artwork based on a design in the class of Decagram Interlocking Star Polygons. The common element for the course of study in this class is a special ten pointed star polygon. This special concave polygon, which is called a decagram for convenience, is the dominant geometric shape of a series of polyhedral tessellations that all consist of the same common motifs. The decagram can be created through the rotation of two concentric congruent regular pentagons with a radial distance of 36° from each others' central angles. However, to create a decagram-based interlocking pattern, a craftsman-mathematician needs to take careful steps to locate a fundamental region. The rectangular-shaped fundamental regions, which are constructed using radial grids, have different proportions for their dimensions.

HORST SCHAEFER

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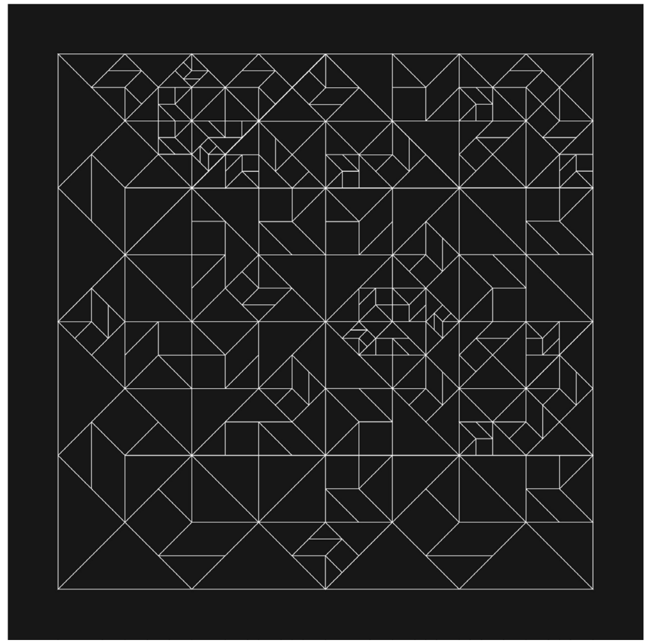
Recursive Colored Tangram (3 Levels)
40 cm x 40 cm
Digital Print
2012



Recursive Tangram (3 Levels)
40 cm x 40 cm
Digital Print
2012

I am trying to apply formal concepts from mathematics, logic or science in my work. One of my goals is to reach a balance between the formal aspects, artistic freedom and the resulting aesthetic appearance. For me it is important, that the viewer can be aware of these aspects. In short, I am exploring how formal concepts generate a visual form. The name 'Rule and Form' of my cycle describes this relationship.

My previous submissions to Bridges consisted of classical copperplate prints. I used a unique set of 7 copper plates which were cut from one square plate of copper. The plates represented the tangram puzzle.

A Tangram consists of a square, a parallelogram and 5 rectangular, isosceles triangles. All of these figures can be constructed with the tangram pieces. Applying a recursive process one gets a recursive tangram.

Recursive Colored Tangram (3 Levels) • Each piece of the tangram (the square, the parallelogram and 5 rectangular, isosceles triangles) gets a unique color. Each of these figures can be constructed again with the tangram pieces (recursion level 2) and gets again a unique color. The process is is repeated again (recursion level 3). All three levels a laid over each other and the colors are blended together. As a result, each piece receives a distinct color.

Recursive Tangram (3 Levels) • A Tangram consists of a square, a parallelogram and 5 rectangular, isosceles triangles. Each figure can be constructed with the tangram pieces. So one gets a square (the original square), a parallelogram and a rectangular, and 5 isosceles triangles. This process is repeated two times, giving a recursive tangram with 3 levels.

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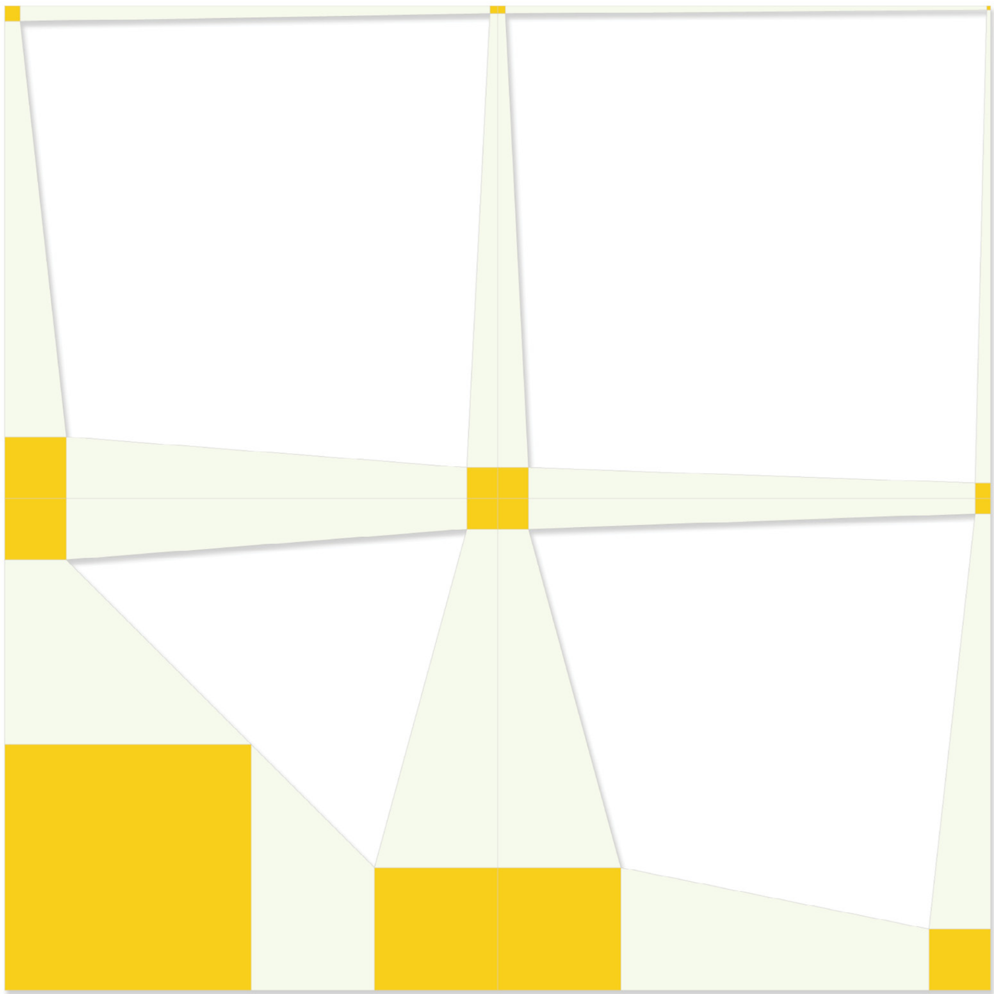
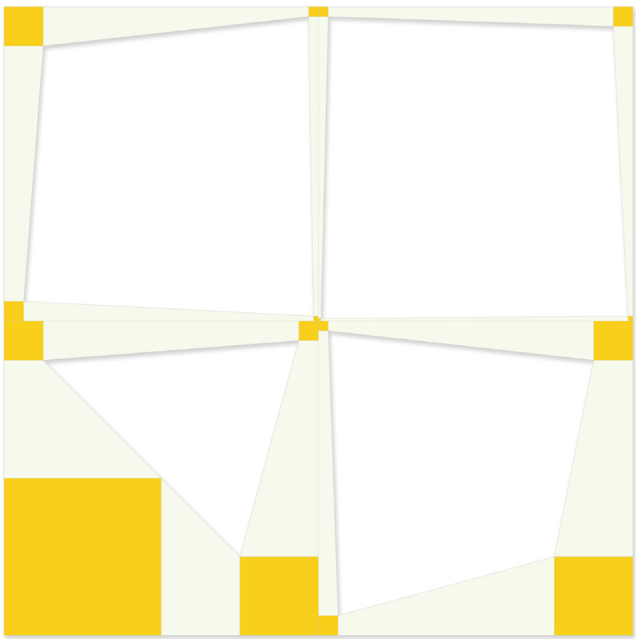


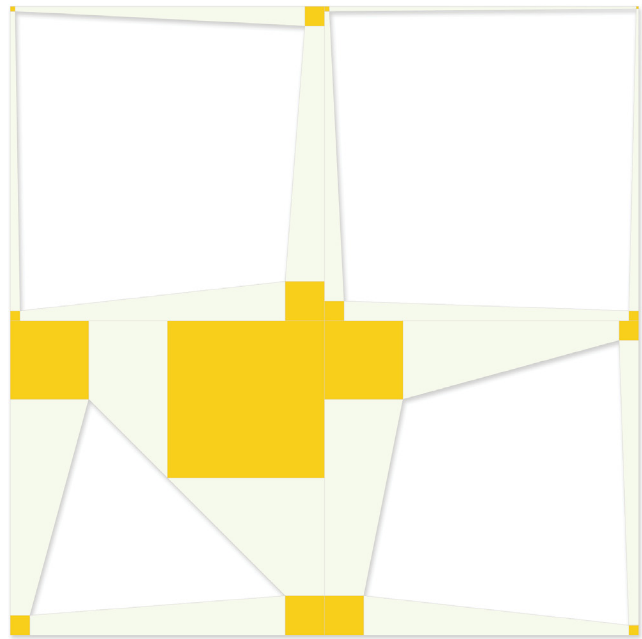
Galaxy I
20 x 20 in
Print of an original oil on wood
2004

The idea of immaterialisation I could only model in painting by using such elements as even in themselves represent the supremacy of pure sensation. Thus two basic suprematist elements, the square and the cross through which the square is divided into four parts, have served as points of departure. In this case, the square bears a yellow colour symbolising existence, whereas its opposite, the cross is characterised by a white tone that creates an impression of emptiness. During the construction of the picture, i.e. the deconstruction of the yellow square, I came to set up a polydimensional net. The net that connects micro- and macro-worlds, stretched in infinite dimension structures as a hyper-filter, incessantly attempts to jettison the imperfect objects (yellow squares) of existence from its 'body'.

Galaxy I • From a mathematical perspective, we can say about a point that it is the smallest unit, an axiom. On the other hand, these infinitesimal points which do not even have an extension constitute lines, planes, space, our physical world, and our infinitely large Universe as well. This is the real dimension paradox. We could represent this with a hierarchical model of the world, in which the lower-level systems combine to form higher-level systems. From this point on, it is merely a question of agreement between universes whether we can consider the atomic particle a point compared to the globe, the globe in turn compared to the Milky Way, the Milky Way compared to the immeasurable worlds built up of sets of Galaxies, or, to take a more tangible example, the (inseminated) ovum compared to a human being. Should this agreement be reached, we could define the point as a multidimensional phenomenon, as the condensation of all dimensions and dimension structures.



Galaxy II
20 x 20 in
Print of an original oil on wood
2004



Galaxy III
20 x 20 in
Print of an original oil on wood
2004

Galaxy II • All of us have probably observed already that the trunk of a tree branches in two or three directions, the thicker branches in turn divide into boughs of smaller circumference, down to the thinnest twigs at the end of which we can find the leaves. If we continue our observation, we may see that the capillary vessels within the leaves reflect the image of a small tree. Taking our contemplation even further, we might conclude that the divisions of our own body resemble those of the tree—the limbs (boughs) extending from the trunk end in fingers (twigs). Of course, the divisibility of trees does not stop at the level of their capillary vessels; it carries on in the flow of molecular and atomic particles: the vital energy itself is radiated to the leaves straight from the star called Sun in the form of light. This is how the smallest and the largest we are capable of perceiving are connected: the worlds of atoms and stars in relation to a tree—and, evidently, in relation to us, too.

Galaxy III • If we place geometrical elements of varying size or proportion, but of similar form, on a sheet of paper, our eyes will perceive the connections between large, small and even smaller elements in perspective. If, however, we connect and combine the same forms, perspective ceases to be effective, and we arrive at new structures constituted by the different forms attached to one another. The "poly-dimensional fields" thus emerging are able to model the abundance of nature (trees, blood and water systems, crystals, cell division, etc.) and the infrastructural growth of human civilisation (networks of roads, pipe systems, networks of communication, etc.). On the other hand, they can represent the dimension structures of atomic and stellar systems, which have a similar structure, but are realised on extreme scales. As a matter of fact, this excessively visual attitude in art can be considered at least as "nature-based" as Flemish landscape painting.

RADMILA SAZDANOVIC

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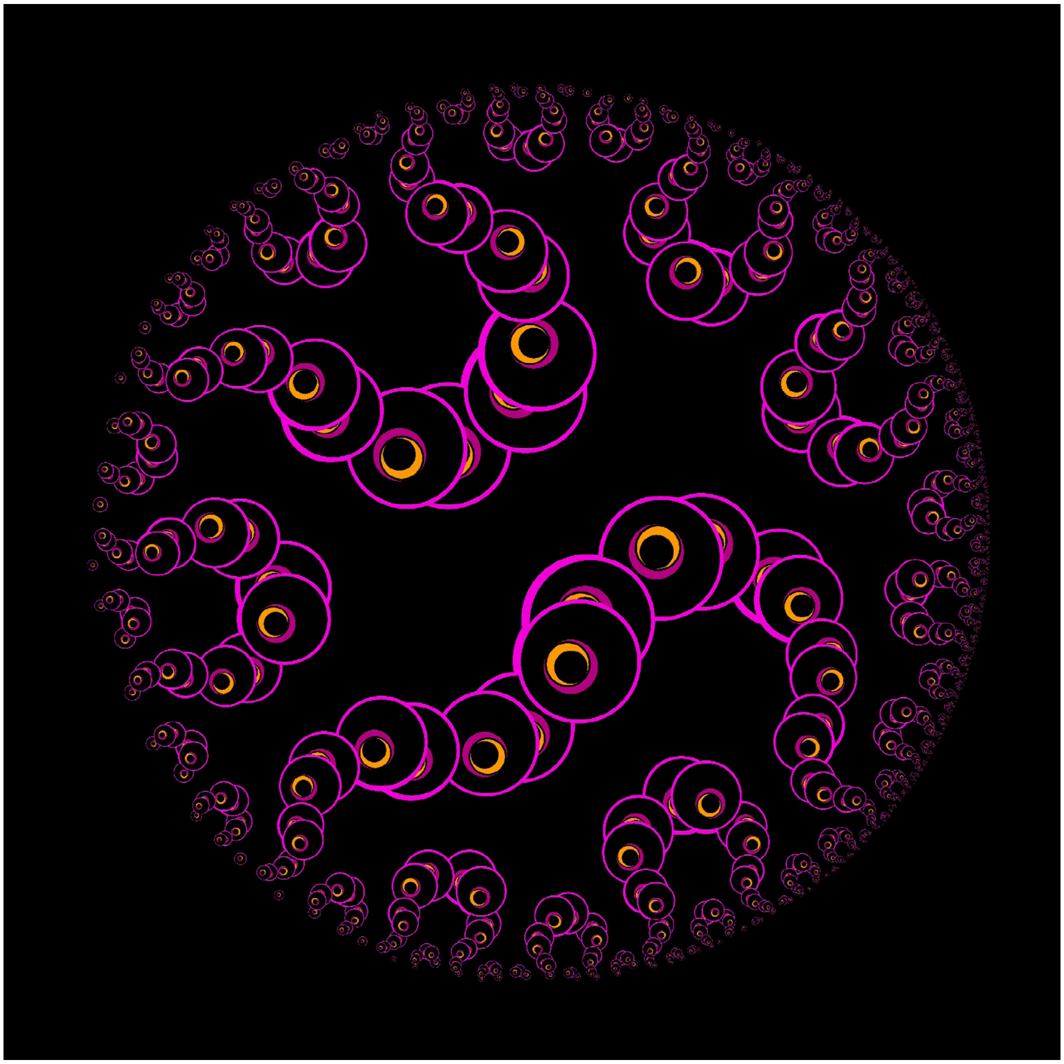
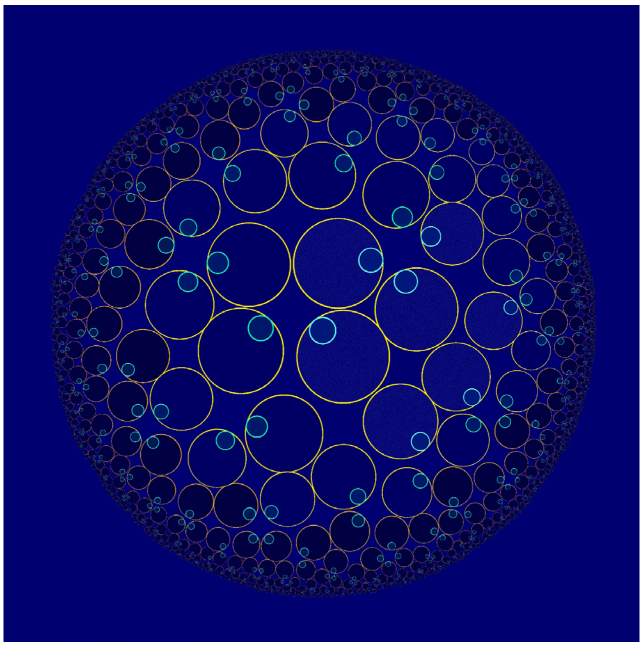


Eridanus
15x15in
Digital Print
2012

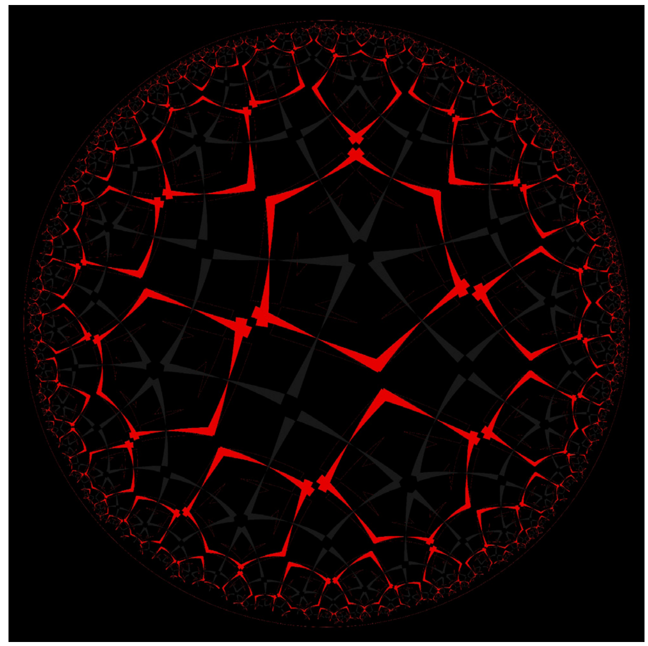
Radmila Sazdanovic is a Postdoctoral fellow at the University of Pennsylvania whose art is inspired by her research. Rich geometric structures found in tessellations of the hyperbolic plane, knots, and diagrammatic representations of algebraic structures that appear in categorifications, together with the ideas and methods used in mathematics, are in the core of Radmila's mathematical art. She has published many articles unveiling the beauty of mathematics, symmetry of knots and tessellations, and placing mathematical models in the broader context of cultural heritage.

Her photography received a special recognition from the Upstream People Gallery, and her mathematical art appeared at the Joint Mathematics Meetings Exhibitions from 2008-2012, as well as Knotting Mathematics and Art exhibition in the Museum of Science and Industry, Tampa, Florida 2007, and Mathematics and Art Exhibit, Institut Henri Poincare, Paris, 2010.

Eridanus • Eridanus is a hyperbolic constellation reminiscent of the river Po, governed by the symmetries of the tessellation (3,4,8,4). Overlapping is a result of asymmetrically placed motif that is larger than the fundamental domain.



Disoriented
15.15in
Digital Print
2012



Lava
15x15in
Digital Print
2011

Disoriented • Disoriented is a tessellation (3,4,3,4,4) in the Poincare disk model. Fundamental domain contains a yellow circle with another smaller circle inside it, inspired by Slavik Jablan's work "Square on square".

Lava • Lava is is an emanation of one of the two realizations of the (4,4,4,6) tessellation of the Poincare disk model. It was used as a starting point for several computer graphics, including Worlds and Starts, Ladders, and Crossroads.

HENRY SEGERMAN

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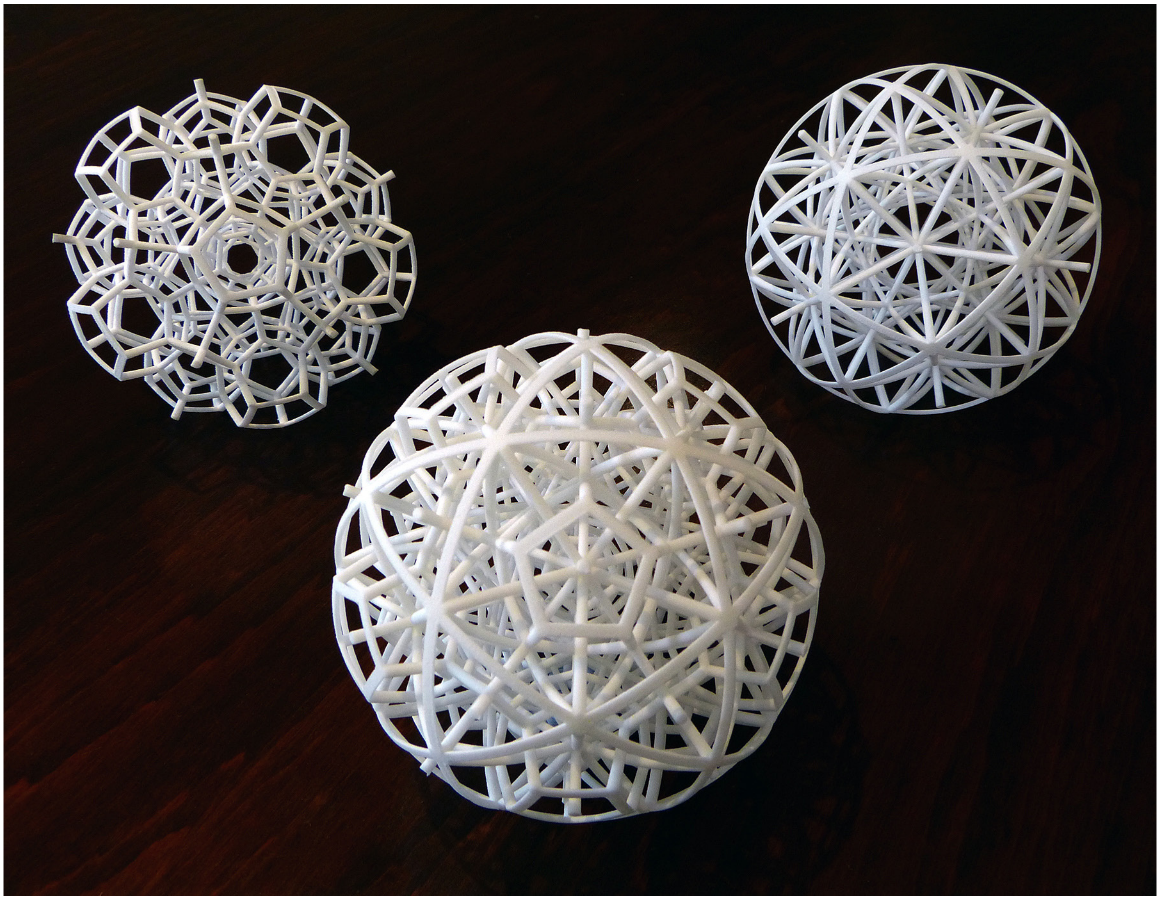

Dual Half 120- and 600-Cells
3 objects, each 10.5cm x 10.5cm x 10.5cm
PA 2200 Plastic, Selective-Laser-Sintered
2011

I am a postdoctoral mathematician. My mathematical research is in 3-dimensional geometry and topology, and concepts from those areas often appear in my work. Other artistic interests involve procedural generation, self reference, ambigrams and puzzles. These sculptures were designed with the assistance of Saul Schleimer.

Dual Half 120- and 600-Cells • These three (actually four) objects are representations of regular 4-dimensional polytopes, the analogues of the 3-dimensional regular polyhedra. The edges of the polytopes are first radially projected onto the unit sphere in 4-dimensional Euclidean space, then stereographically projected into our 3-dimensional Euclidean space so they can be 3D printed. Only the parts of the polytope within the hemihypersphere furthest from the projection point are printed, but one can imagine reflecting across the equatorial 2-sphere to recover the whole of the polytope. The 120-cell and 600-cell are shown, which have 120 dodecahedral facets and 600 tetrahedral facets respectively. These two polytopes are dual to each other, which means that the vertices of one correspond to the 3-dimensional facets of the other, and vice versa. This is illustrated in the third object, which is simply copies of the two other objects occupying the same space, interlinking with each other.

NATHAN SELIKOFF

CONTACT

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Untiled Faces
13 1/2 x 15 3/4 x 20 inches
Interactive sculpture (computer, LCD display, joysticks, electronics, wood enclosure)
2011

I love to experiment in the fuzzy overlap between art, mathematics, and programming. The computer is my canvas, and this is algorithmic artwork—a partnership mediated not by the brush or pencil but by the shared language of software. Seeking to extract and visualize the beauty that I glimpse beneath the surface of equations and systems, I create custom interactive programs and use them to explore algorithms, and ultimately to generate artwork.

In the world of chaotic dynamical systems, minute changes in initial conditions produce radically different results. The interface of my software gives me hooks into the algorithms and allows me to exert a measure of control.

Art and mathematics, the right brain and the left, are inextricably linked in this work. My art depends on mathematics, yet simultaneously illuminates and unravels its beauty. I am the explorer who uncovers something extraordinary, bringing into view that which was always there to be discovered.

Untiled Faces • Untiled Faces is an interactive sculpture that mixes a chaotic dynamical system with its "meta" representation, allowing the viewer to explore the four-dimensional parameter space by moving a series of levers. The left pane of Untiled Faces shows a 32x32 grid of images. As the left lever is moved, a red square over one of the small images moves, updating two variables that affect the center and right panes. The right pane shows the selected image from the left pane at a larger size. The right lever moves a small red target within this image, updating another two variables that affect the center pane. The center pane shows a chaotic attractor, whose four coefficients are taken from the positions of the left and right levers. The center lever adjusts the virtual camera viewing this strange attractor. Thus, all three images are linked, and in a somewhat mysterious way, show the relationship between a strange attractor and its Lyapunov exponent. More info at http://bit.ly/eu2gzc

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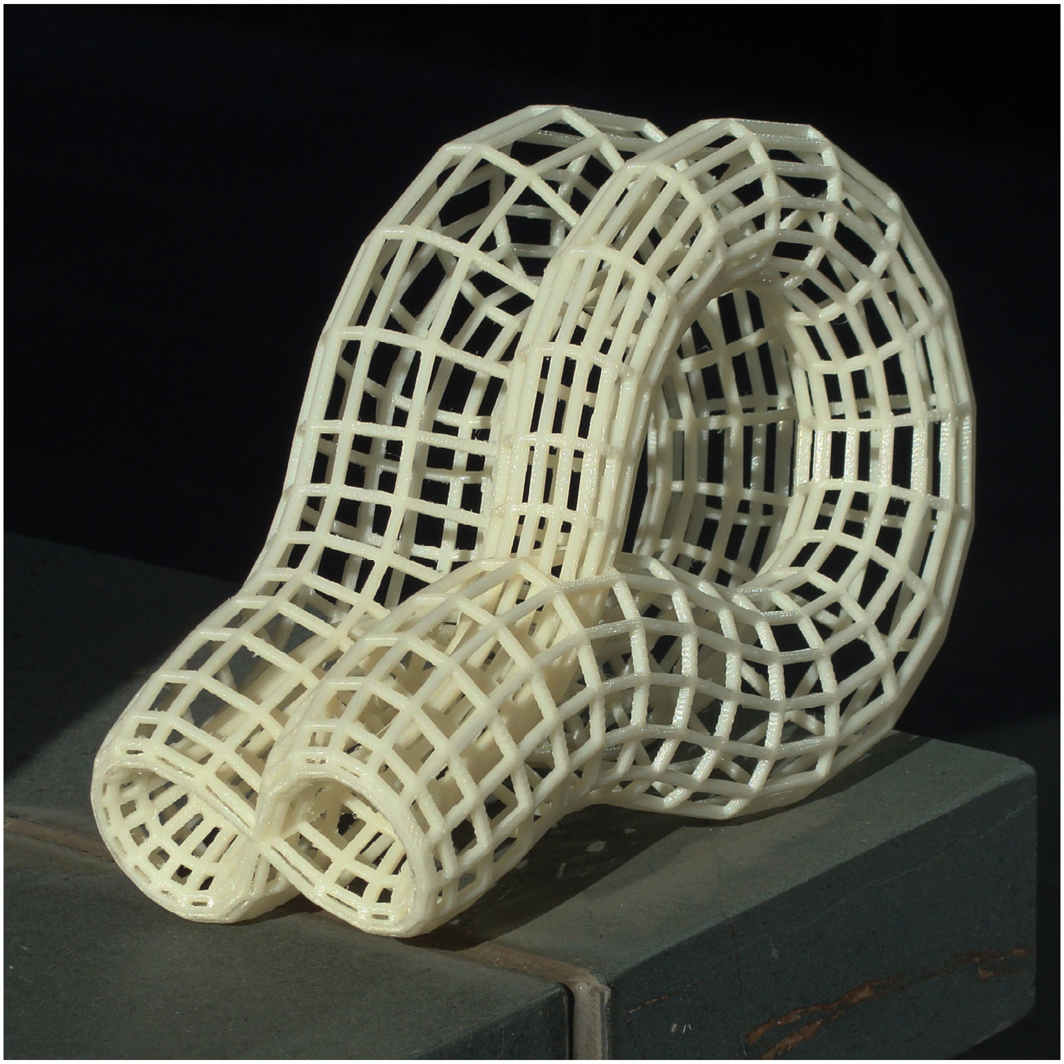
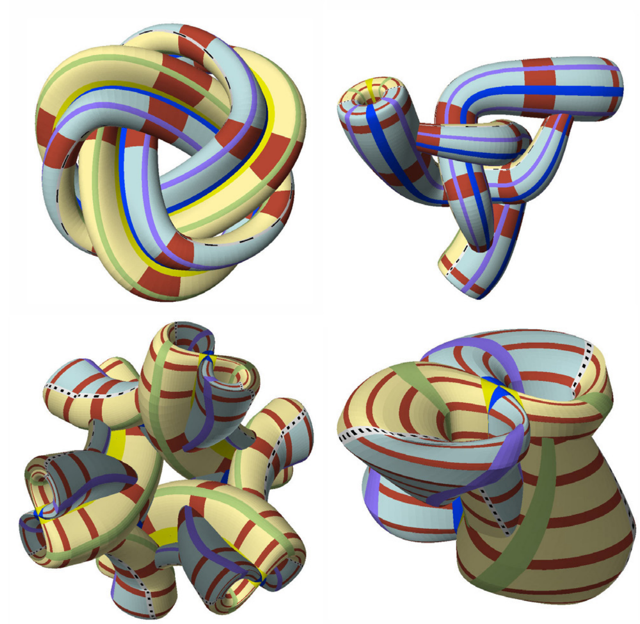


Klein Bottle of Type K8L-JJ
5" x 8" x 3"
3D Model made on an FDM machine, ABS plastic
2012

I work on the boundary between Art and Mathematics. Sometimes I create artwork by using mathematical procedures; at other times I enhance a mathematical visualization model to the point where it becomes a piece of art. For the art exhibit at Bridges 2012 my submissions support my oral presentation: "From Moebius Bands to Klein Knottles." My presentation elaborates on the classification of all types of Klein bottles into four regular homotopy classes, where the members in one class cannot be smoothly transformed into members of another class. My art submissions depict some intriguing structures that topologically are all Klein bottles, some as computer renderings and some as 3D rapid-prototyping models.

Klein Bottle of Type K8L-JJ • There are four different regular homotopy classes for Klein bottles decorated with a grid of parameter lines. This unusual model is inspired by the classical "inverted sock" Klein bottle, but uses a figure-8 cross-section. It turns out that it is composed of two left-twisting Moebius bands; it is thus in the same regular homotopy class as the left-twisting figure-8 Klein bottle.

Trefoil Klein-Knottle
8" x 8" x 3"
3D Model made on an FDM machine, ABS plastic
2012



The Kracy Kosmos of Klein Knottles
24" x 24"
2D composite of computer images
2012

Trefoil Klein-Knottle • A Klein bottle of type K8L-O. A tube with a figure-8 cross section is tangled up into a trefoil knot in which it experiences a right-handed twist of 540 degrees; this is equivalent to a left-handed twist of 180 degrees. This model is thus in the same regular homotopy class as the K8L-JJ Klein bottle depicted above.

The Kracy Kosmos of Klein Knottles • Four panels of four differently contorted or knotted Klein bottles: Panel A: A Klein bottle with a figure-8 cross-section forming a trefoil knot. Panel B: Three classical "inverted sock" Klein bottle segments forming a trefoil knot. Panel C: A cycle of six "inverted sock" Klein bottle segments with a figure-8 cross section. Panel D: A figure-8 cross section making a 4-bounce zig-zag pass with 90 degrees of twist in each to form a Klein bottle. The challenge now is to figure out for each of these Klein bottles into which regular homotopy class that they belong.

LAURA SHEA

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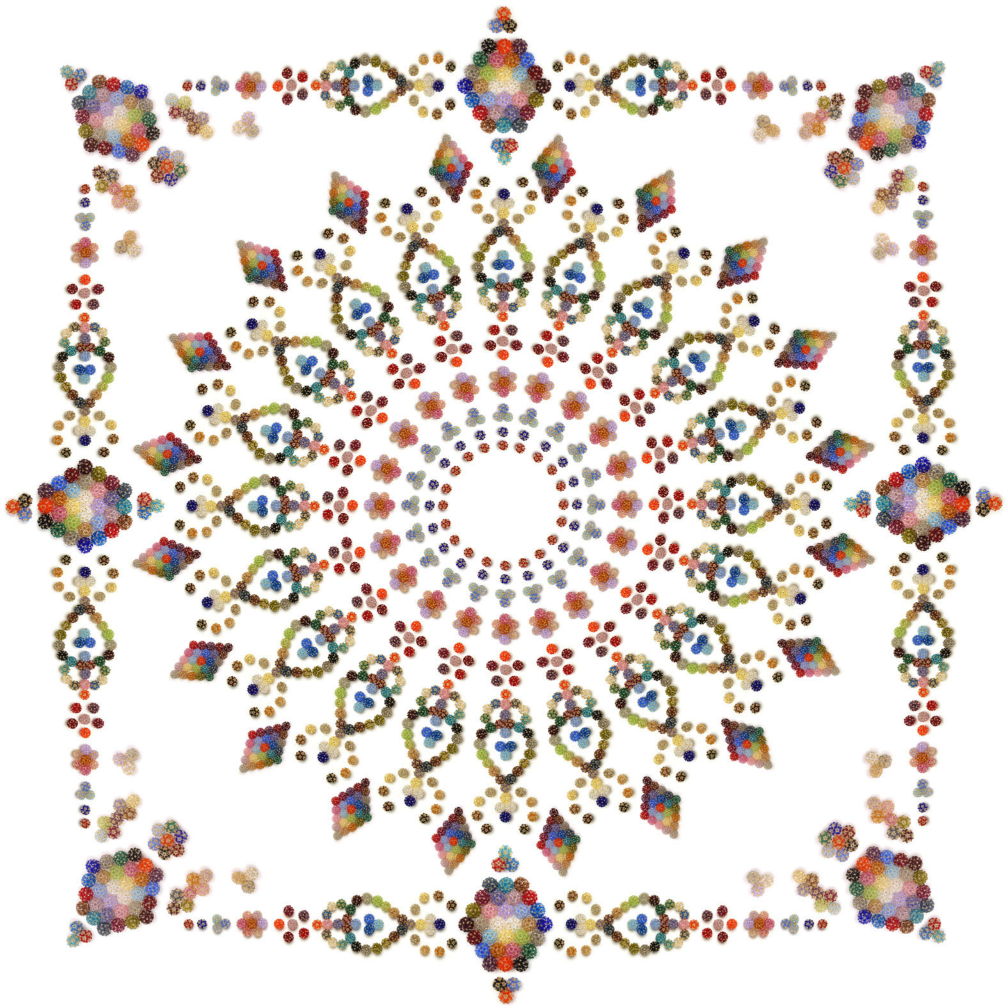

Bead Reverie
30" X 30"
Digital Image
2008

I create complex polyhedral and polygonal structures with beads and thread. My work explores the vast array of possible ways to connect component shapes at contiguous polygonal faces to construct chains and polyhedral sculptures. I label the beading operation of my work "Angle-stitching" which encompasses the geometric patterns and variety of angles in regular tilings (right-angle stitch, triangle stitch, hexagonal stitch), tessellations, open framework polyhedra and other forms. The open networks of tilings and frame polyhedra provide a magical space for light to play with glass. The architectural characteristics of polyhedra enable heavier beads to be stitched together with much lighter thread in a give and take of tension and pressure. The malleability of thread allows the inter-connected bead polygons and polyhedra to move fluidly and bend in improbable ways creating both abstract and natural seeming forms.

Bead Reverie • Digital image of computer manipulation of two transformations of beaded truncated icosahedra exploring the patterns of medieval rose windows. Beadwork and concept--Laura Shea, photographer and computer manipulation--Dick Kaplan. I studied medieval history and art in college and have visited many of the great European cathedrals. I have always loved the inspiration gained in gazing at these beautiful mandalas. Dick (who is Jewish and not familiar with cathedrals) studied photos and books that I provided. He created the wonderful image here from a series of his photographs of my beads made over several years as a color study. The truncated icosahedra have two sizes of beads in a 30/60 pattern which reverses large to small, crystal and seed beads.

Planet Bead
5 inches diameter
Swarovski crystal beads, monofilament
2012

Triple Eureka Bead
5 inches overall
Angle-stitching, Swarovski 3 mm crystal beads, monofilament
2011

Planet Bead · Great rhombicosdodecahedron sprouting cube columns with ten great rhombicuboctahedra. An abstract sculpture of Earth with ocean, planets and trees.

Triple Eureka Bead · Truncated icosahedron sprouting 12 stacks each of three connected dodecahedra. Multi-colored.

BOB SIDENBERG

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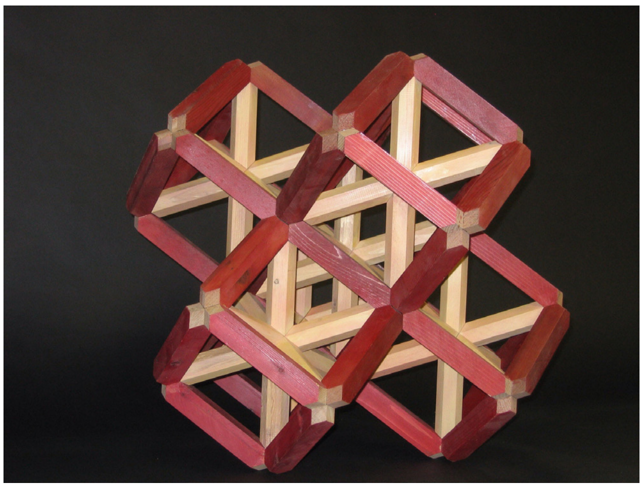
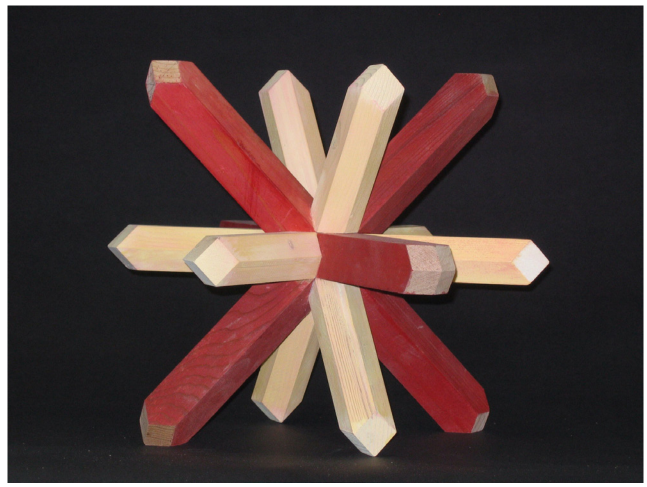


Flake
27" x 27" x 27"
Pine, cedar
2012



Crux
12" x 12" x 12"
Pine, cedar
2012

As always I've been exploring the rhombic dodecahedron and the complex relationships of its structural elements. It contains, or is contained within, a wide variety of related geometric shapes -- triangle, tetrahedron, square, cube, rhombus, hexagon, et al. It is part of larger matrices that seem to flow through its square and hexagonal axes and grow through space. It even shares some structural similarity with the pentagonal dodecahedron, in addition to twelve sided-ness.

I try to work from a center point, but have found that the center is always shifting, never constant, temporary, momentary -- in fact, never really a center at all, but part of a larger construct, somewhere in the matrix. Center is simply a useful and arbitrary concept for the study of geometry.

Flake • The mighty rhombic dodecahedron, momentarily ensnared by the cubic matrix, whose exposed joints show that it shares kinship with its captive. Another generation will reverse the advantage.

Crux • This shows the path from the fourteen vertices of the rhombic dodecahedron to its center -- six square legs and eight hexagonal, originating at the square and hexagonal axes, or in the inner ether. Alas this center exists only if the legs continue in space. If they turn back to form a matrix, all center is lost. Que sera sera.

BENTE SIMONSEN

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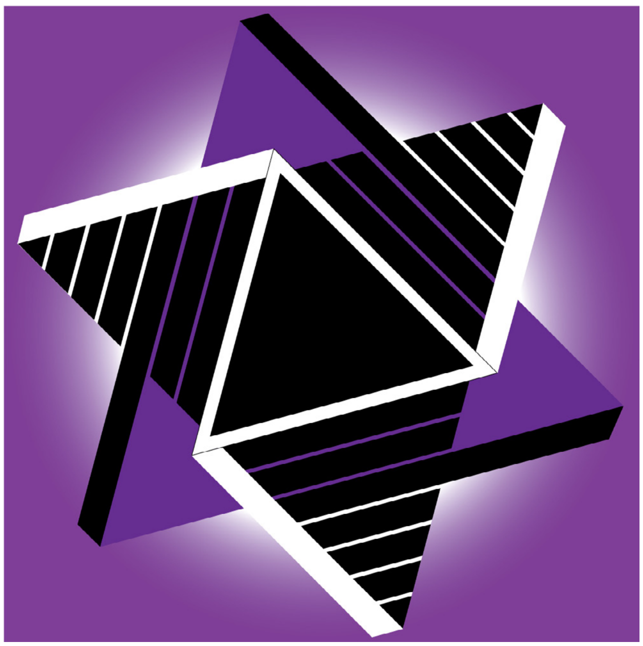
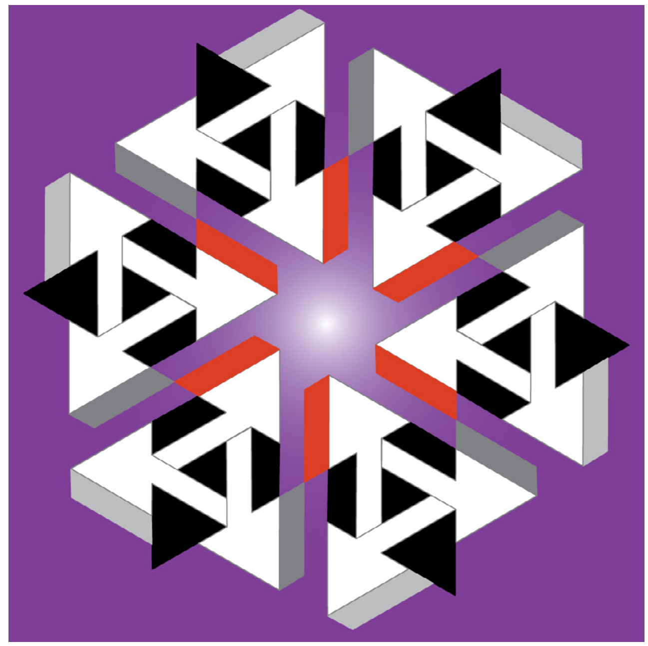


Con I
50cm x60 cm
Digital print
2012



Con I
50cm x60 cm
Digital print
2012

Impossible deceiving constructions. Digital prints made in Adobe Illustrator.

I work with geometric, mind teasing (meditative) objects, with sculptures of different materials like metal, paper, clay etc. I do digital works, but also work with traditional artist techniques.

ALAN SINGER

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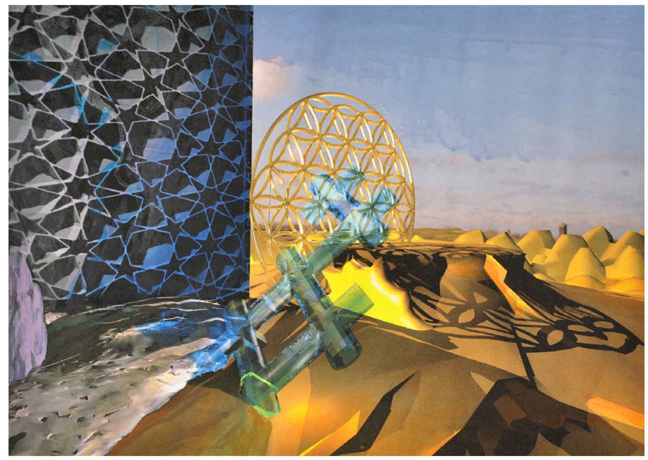
Red Rock Story
15" x 18.75" x 2"
watercolor and digital transfer monoprint on Fabriano paper
2009

Over the past ten years I have studied the use of mathematical forms in visual art, and employ many of those forms in my own art. I found software that is free on the Web, such as 3D-Xplormath, K3D-Surf, and Cinderella and others to be very useful in the creation of forms which I compose with and create "scenes". The use of mathematical visualization is a new area that artists can discover and use to great effect. My favorite area of exploration is one function of the software that allows me, the user to define the terms to create implicit surfaces from algebraic equations. The average viewer may not know it but almost everything in my compositions come from this ability to use math to describe form and compose with it, this is very powerful and new territory for the artist to consider.

Red Rock Story • Each one of the elements in this artwork was created by me as a visualization of an algebraic formula. I compose the elements in Photoshop once they are rendered by my software, to this I add a layer of watercolor to enhance the color relationships and to strengthen the 3D effect. I output this onto a flexible film, and transfer the image onto moist watercolor paper under the pressure of an etching press. My inspiration comes from my travels in the western U.S. and also from my knowledge of art history.

The Auslander
15" x 20 " x 2"
watercolor and digital transfer monoprint on Fabriano paper
2008



A Wonder Wheel
14" x 18.75" x 2
watercolor and digital transfer monoprint
2010

The Auslander • I employed a software called Knotplot to help me render a chrome knot on top of which I placed a grid pattern or checkerboard. The setting is made of individual elements rendered with the use of 3D-Xplormath, a program that allows me to define the parameters for implicit surfaces. All of the elements are created separately, and then composed using Photoshop, and a program called Strata. The inspiration for this work comes from my travels in western U.S. and through my dreams and knowledge of art history.

A Wonder Wheel • Patterns are fascinating and I like to play this off of a landscape bathed in light. I am also playing with cylinders and transforming every form into something expressive and seemingly solid (even solid glass). Mathematics and measurement are the basis for most patterns and this one is full of stars and light. All of my artworks are one-of-a-kind, each one is a unique hand pulled monoprint made using the latest technology that I can afford.

JEREMY SMITH

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Three-bander four-bander six-bander and ten-bander
Four spheres of diameter 1 2 3 and 7 inches
metal strips from windshield wipers
2012

Art is in the family - my parents met in art school, dad was a cartoon animator, and my brother is an artist - but so is science - brother 2 teaches mathematics, my cousin runs a wheat physiology lab, and brother in law is actually in the Physics department at Arizona State.

I'm a long-time programmer, and keen on complexity because it's on the cutting edge of science. But lately I've been making 'toys' - various printable kits that you construct to make polyhedra, puzzles, and games. I have workshops at science and arts related festivals, and teachers are often ecstatic to discover these (free) resources.

Although some stuff is educational, I am driven by the fun factor and the wow factor, which I love to share. In my own explorations I am continually blown away by some new discovery that is inherent in the numbers, in the mathematics. I tell folks when I hit a rich vein, and wonder where everyone else is. That's why I'm coming to this conference - I'm sure they're all here.

Three-bander four-bander six-bander and ten-bander • This family of four 'banders' come from the platonic solids. Draw a line on a tetrahedron from the midpoint of an edge to the midpoint of an adjacent edge and keep going. The line soon finds itself to form a loop, as do two other lines if you exhaust all possibilities. If you expand these three bands onto the surface of the mid-sphere you arrive at the three-bander. Because the Platonic solids are symmetrical, so are the bands, being geodesic circles. A similar exercise will form the four-bander from the octahedron and the six-bander from the icosahedron. The cube will form the three- and four-bander, as a geodesic path can be found by chasing the opposite edge or the adjacent edge (but not both). Triangles provide only one bander model since triangles only have one possible track, but like the square the pentagon also has two tracks - adjacent mid-points and opposite, and these (on the dodecahedron) produce the six-bander and the beautiful ten-bander.

Cube of Chess
4 x 4 x 4 inch cube
wood
2011

Socolar-Taylor Tiles
24 inch sphere
color laser printouts on matt board and shish kabob sticks
2012

Cube of Chess • Cube of Chess A 4x4x4 cube of wood is dissected into 32 pieces, sixteen identical pieces of size 1.5 cubes and sixteen of size 2.5 cubes. The latter is five kinds differing only in the half-cube on top which has been bisected mostly using common symmetrical cuts. The thirty two pieces are of course a chess set. By giving the pieces a waist turning the half-cube on the base cube, the set looks like a chess set (rather than a cubist sculpture, though don't sell short your Staunton stock). I saw the Graham Lanier chess set 1966 in the NY MoMA, which fit impressively into a 2x4x6 box. At some point I thought 'but why not a cube'. I just had to do it. The box, by the way, turns into the board.

Socolar-Taylor Tiles • These hexagonal pieces are a rendition of Socolar-Taylor aperiodic tiles. I made them to explore aperiodic tiling in general, and these in particular. I've explored rule one but not yet all of rule two, or mirror image possibilities. In the meantime I've created a number of designs for friends and family. I rendered them spherically here just for fun. (Aperiodic tiling on the surface of a sphere?) The tile is hexagonal and a path crosses each edge on the left or right hand side. These paths must match up (this is rule #1. There is a second rule, using the little pennant flags.). There are six ways to internally arrange the paths in each hexagon but otherwise all the tiles are functionally identical. Socolar and Taylor discovered this tile in March 2010. It is the first single aperiodic tile. Penrose found a 2-tile aperiodic set in 1974 and prior to 1966 they were unknown. Is this an 'einstien' (one stone)? - a single tile that can aperiodically tile an infinite plane?

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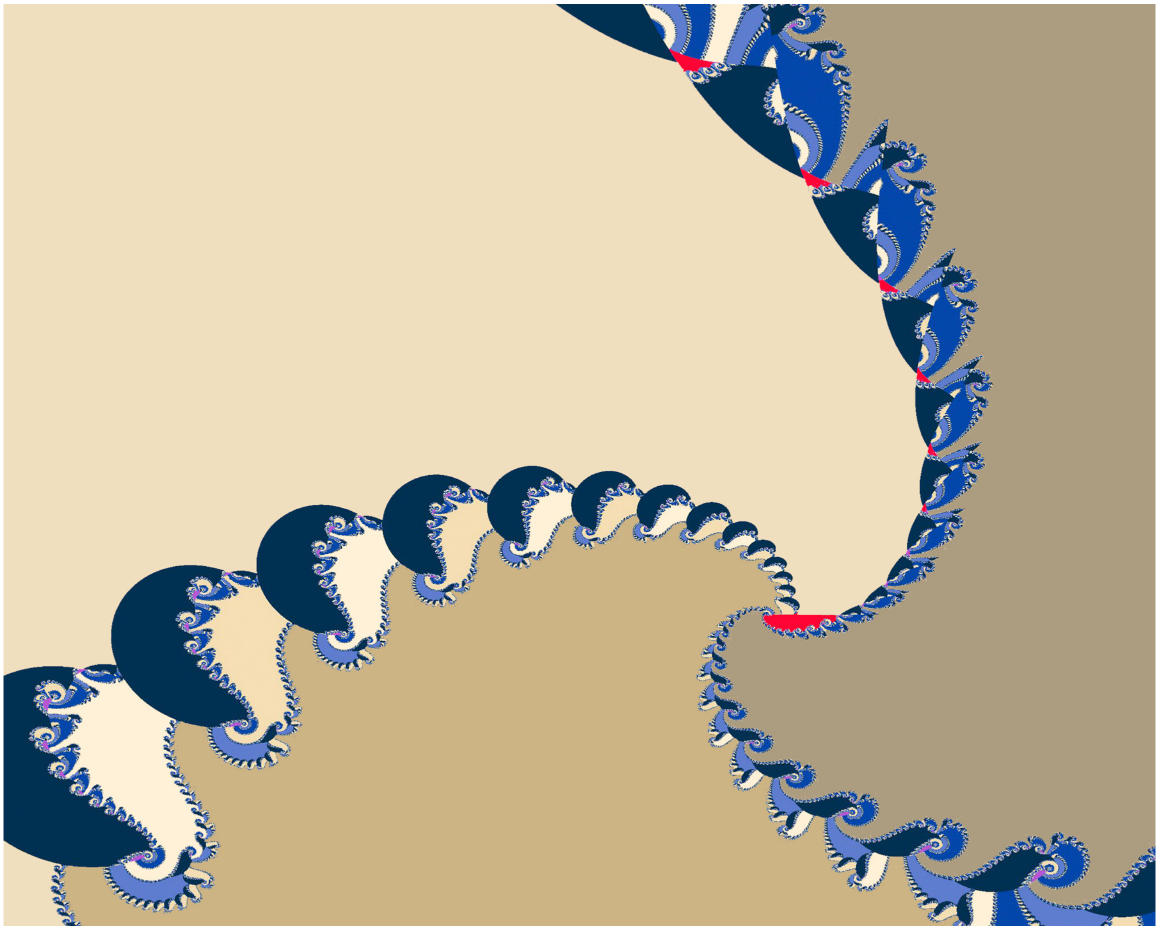
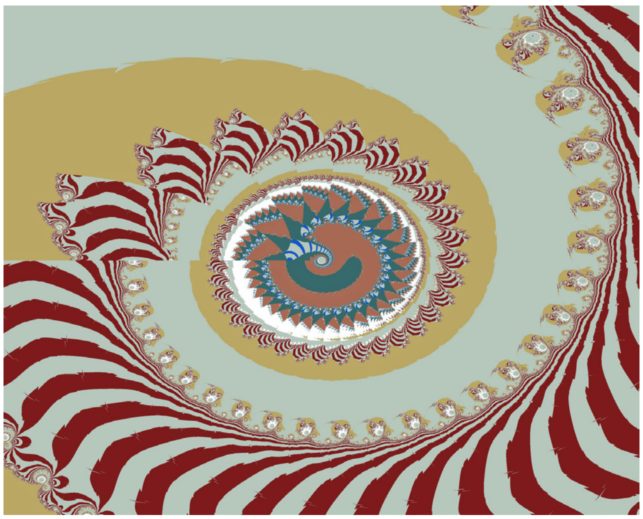


Wave
8" x 10"
Digital Print
2010

I have always been fascinated with the behavior of dynamical systems -- be they mathematical, physical, or financial. Where do different points end up and how do they get there? Do they reach an equilibrium or do they continue moving randomly forever? Computer graphics allows one to see both the numerical and aesthetic properties of these systems. Recently I became interested in the properties of complex polynomials with complex, rather than integer, exponents. The images I have produced are the basins of attraction for the roots of complex polynomials with complex exponents under Newton's method.

Wave • This image is obtained by applying Newton's method to the function z^(3+2i) - i =0, where i is the square root of -1. Each point in the complex plane is assigned a color based on which root that point converges to under iteration by Newton's method for finding the roots of an equation.



Vortex
10" x 8"
Digital Print
2010

Dragon Slayer
8" x 10"
Digital Print
2010

Vortex • This image is obtained by applying Newton's method to the function z^(6i) - 1.045z(^4i) + .045z^(2i) -8.23x10^(-5) =0, where i is the square root of -1. Each point in the complex plane is assigned a color based on which root that point converges to under iteration by Newton's method for finding the roots of an equation.

Dragon Slayer • This image is obtained by applying Newton's method to the function z^(3i) - 1.251z(^2i) + .261z^i - .009 =0, where i is the square root of -1. Each point in the complex plane is assigned a color based on which root that point converges to under iteration by Newton's method for finding the roots of an equation.

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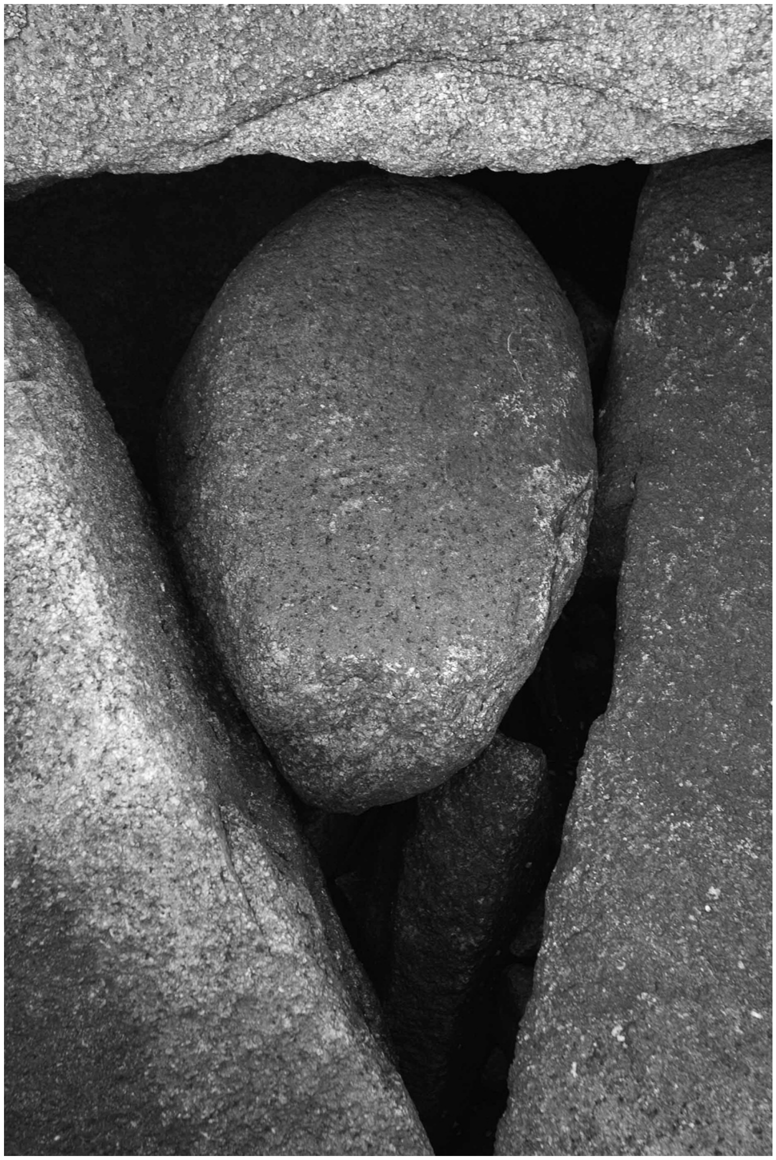
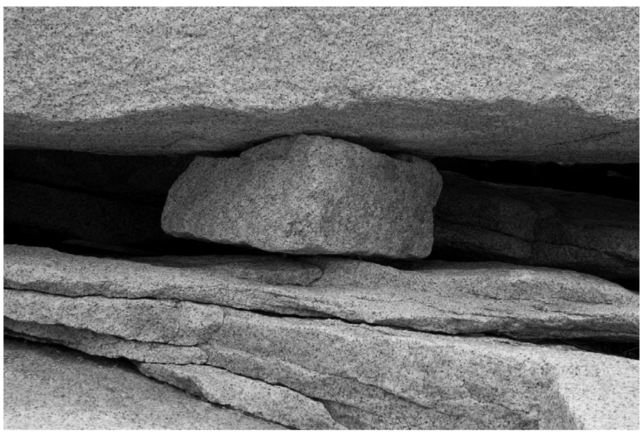


Inscribed
32 x 26
Photograph
2009

This series of stone photographs attempts to bridge two worlds. In a personally meaningful way, this body of work reflects the unification of two areas of deep interest, math and photography. It also shows my style of photographing which looks further and deeper into everyday surroundings to discover what singular perspectives may exist both in the object and in the space around the object.

Inscribed • The oblate stone embedded in the center is positioned to barely touch the exterior triangle in three locations. This egg shape is therefore inscribed within the triangle.



Singularity
26 x 32
Photograph
2009

Fractal Flatland
26 x 32
Photograph
2009

Singularity • The single stone in the center of the image largely reminds me of a single plotted point.

Fractal Flatland • The image Fractal Flatland was captured with the notion of fractals in mind. The image almost looks like an aerial shot from above, but is really on the same scale as the other images.

M. STOCK AND M. BAILEY

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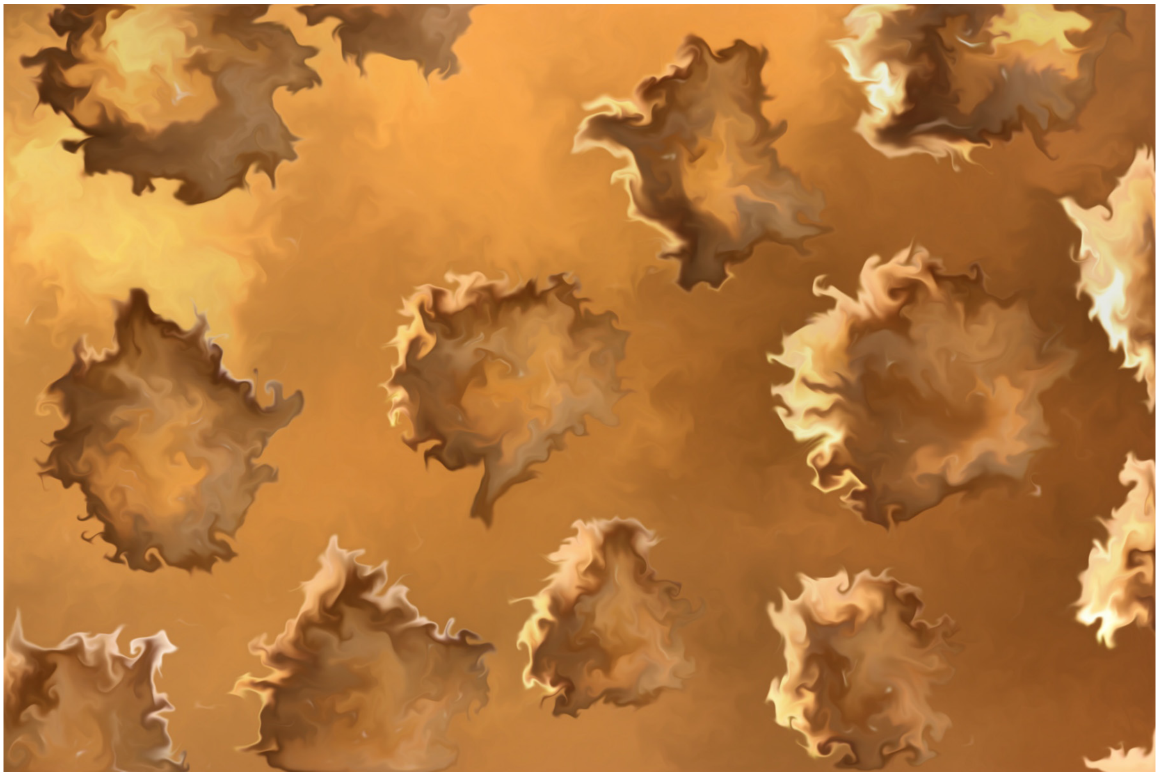

Synthesis 5
19"x25"
Digital archival print
2012

Mark J. Stock is a scientist, programmer, and artist who creates still and moving images combining elements of nature, physics, chaos, computation, and algorithm. He focuses on works that can be created only with scientifically-accurate research software and methods---never commercial CG software---so he must either write the code himself or borrow it from researchers in their respective fields. Often, these codes have never been re-tasked for artistic purposes. His works explore the tension between the natural world and its simulated counterpart---the one created on supercomputers by scientists and engineers hoping to understand nature's mysteries.

Marlene Bailey is a color artist and photographer who constantly experiments with objects, colors, sounds, and ideas; arranging them into new configurations and finding connections in unexpected places. She seeks to inspire herself and others to see beyond the ordinary and everyday.

Synthesis 5, 6, 8 • "Synthesis" is a collaboration between a photographic artist and a computational artist. Each aims to capture essential, but often hidden, patterns in the world---the former the constructed world and the latter the natural world. This work contains the synthesis of these patterns: the colors, textures, and forms are overlapping and intertwined as much here as they are in life. Yet the resulting images leave few clues as to their origins. The photographs depict fractal-like and geometric forms, observed with a keen eye to composition. The algorithmic processing involved transferring properties from the source image into fluid dynamic simulation parameters, and evolving the differential equations of viscous flow forward in time until the boundary between the two processes vanished.

Synthesis 6
19"x25"
Digital archival print
2012

Synthesis 8
19"x25"
Digital archival print
2012

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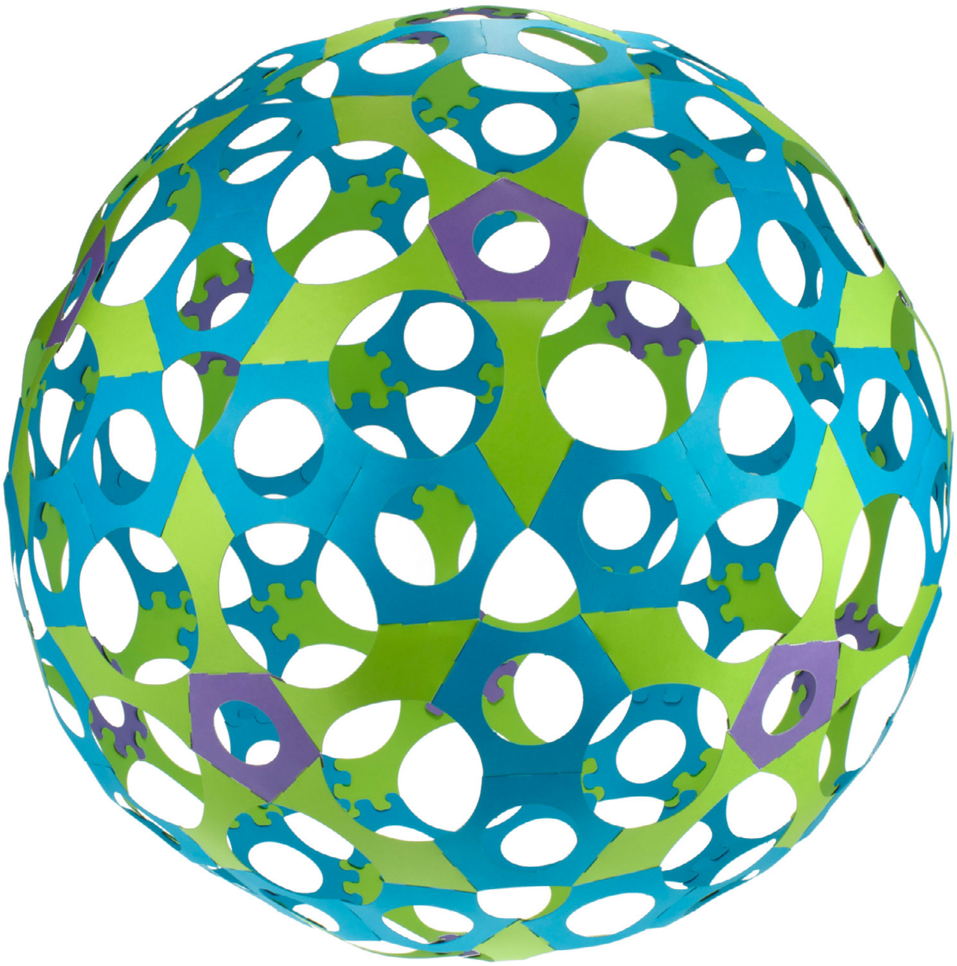
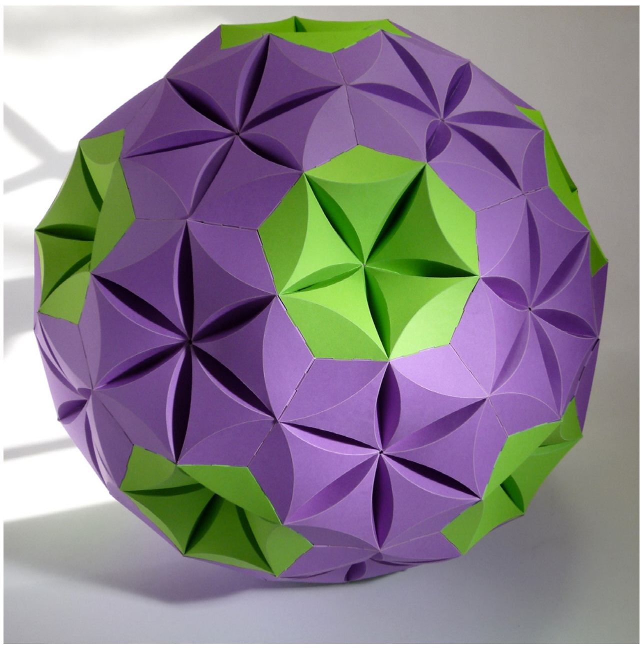


Blue-Green Super Sphere
19 inches x 19 inches x 19 inches
Laser-cut paper
2012

I created these three pieces using a geometric construction system called PolyPuzzle, which uses a programmed laser to precision-cut myriad shapes in high-quality colored paper. The system was invented by my friend and colleague James Ziegler. The seeds of this new method of working were planted a few years ago, when James and I were looking at my geometric paper constructions, some of which were exhibited at the 2005 Banff Bridges Conference. The availability of a stock of pre-cut pieces allows me freedom to experiment in a spirit of open-minded play with different combinations of shapes. While the PolyPuzzle system relies solely on locking-tabs, I have taken the liberty of moving beyond this system, creating new works, or modifying existing ones and augmenting with glued joints. Although these constructions come out of a knowledge of the basic geometric solids, PolyPuzzle has led me to surprisingly different structures – ones I may not have otherwise discovered.

Blue-Green Super Sphere • The Super Sphere came out of experimentation with PolyPuzzle pieces. I discovered a module made of three hexagons (three edges curved) and three small triangles, and realized they could be connected in the manner of an icosidodecahedron. To fill the left-over, five-sided openings, I made the longer "bow-tie" pieces which connect the pentagons in the centre. The design evolved so that the bow-tie and isosceles triangle were combined into a single piece. This piece was sized to create a curved form with the set of hexagons. Aesthetically, the bow-tie pieces emphasize the pentagonal faces. I love spherical forms and the feeling of accomplishment I get when the last pieces are installed. Although this has a basic icosidodecahedral form, it is in fact quite unique. Does it fit any known geometric solid?



180 Folded Hexagons
16 inches x 16 inches x 16 inches
Laser-cut paper
2012

Sphere with Imbedded Crystal
7.5 inches x 7.5 inches x 7.5 inches
Laser-cut paper
2012

180 Folded Hexagons • This piece of folded hexagons goes back to a discovery I made in 1969 about the possibilities of curved scoring in combination with regular and semi-regular geometric solids. It is made up of 180 hexagonal PolyPuzzle pieces with curved scoring in a triangular pattern. Because the inherent tension in the form tends to pull the joints apart, the internal joints are glued. The spherical form is a derivative of a truncated icosahedron and its intrinsic beauty is emphasized by the "flower of life" pattern in both the pentagons and hexagons.

Sphere with Imbedded Crystal • This spherical form is derived from a small rhombicuboctahedron and is constructed of 18 octagonal PolyPuzzle pieces with curved scoring in a square pattern. The colored inserts are each made of three rhombi to form a three-pointed star shape. As with the piece titled '180 Folded Hexagons', this form required a high degree of skill and craftsmanship. The contrast between curved and straight-edged forms, and the interplay of overlapping circles, creates a compellingly aesthetic piece that invites the eye to trace the patterns and symmetry.

TETTEH TAWIAH

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Cleopatra's Wings
12inches/ 16inches/ 21inches
resin (precision-cut wooden piece was used to make mold)
2012

Vegetative Star
11 inches /11 inches/ 5 inches
resin (precision-cut wooden piece was used to make silicon mold)
2012

To me the process of making art, exploring and developing innate abilities, is a vehicle of self-discovery that evolves into one of self-expression. A paint brush, a camera or a mitre saw are not just tools but the means to escape the outer world to reconcile the one within; finding a balance between the use of logic and imagination, integrating the use of left and right brain functions. The concept of whole brain thinking is one set of lenses I use to view the world .This lense provides a child like fascination with the mundane and fuels my art.

The constant pursuit of precision using miter saws (no computer numerical control machinery, laser cutters or 3D printers), painting with both hands simultaneously, and sculpting three dimensional fractals are things that make my work unique.

Cleopatra's Wings • Thirty triangular toroids connected via trapezoid facets to form structure. Two rings (each comprising of 15 toroids) is a pentagon ring that fans out into a pentagram ie the top side of the ring is a pentagon and the bottom is a pentagram.

Vegetative Star • Fifteen pentagonal toroids are connected via trapezoid facets to form star-like structure. The pentagram shape on two ends are not aligned (like an anti prism). This structure is a segment of a fractal star, and fractal sphere I designed.

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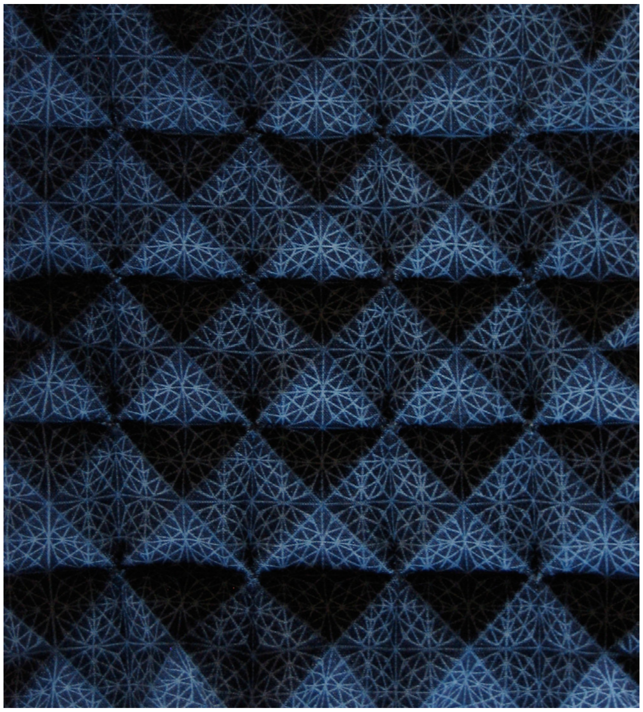
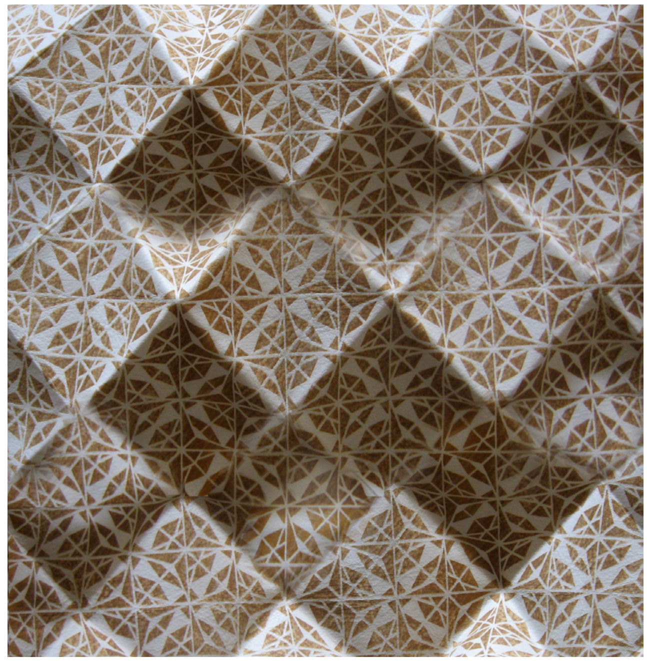


Fold #1
40 x 40 cm
Laser-etched denim
2012



Fold #2
40 x 40 cm
Laser-etched leather
2012

As a designer I am fascinated by the fundamental concept of symmetry and its varied interdisciplinary applications. My recent work explores the possibilities of extending repeating patterns beyond the two dimensional plane.

Fold #1 • This work explores the relationship of line, pattern, form and structure. The fabric is etched with a p4m geometric design before being folded with crease lines, which correspond with certain pattern symmetries, to create form. In Fold #1, the crease pattern motif corresponds to four unit cells of the underlying p4m etched pattern. The mountain folds correspond with glide reflection axes in the etched pattern and the valley folds with axes of reflection. Centres of four-fold rotation are located at the centre, corners and midpoints of each edge in the crease pattern motif, which translates to create the overall structure.

Fold #2 • In Fold #2, the crease pattern motif corresponds to four unit cells of the underlying p4g etched pattern. The mountain folds correspond with glide reflection axes in the etched pattern running through the four-fold axes at the centres and corners of the crease pattern motif. Valley folds correspond with the edges of the crease pattern motif connecting centres of four-fold rotation.

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Multicultural Conference Poster
24" X 18"
Computer generated / Digital print
2008

As a graphic artist and an educator I am always looking for solutions that are not only the answers to clients' need but also to bring a new educational aspect to the artwork. Although in graphic design solutions are subjective; relevant to time of an era; aiming to create a design that is timeless is my goal. I like my design to connect to nature with harmony and balance, and I believe simplicity is always the key for better communication.

Multicultural Conference Poster • The natural division of the golden section and its application in nature inspired me to apply this beautiful grid in designing my poster in order to display the diversity in every aspect of our life.

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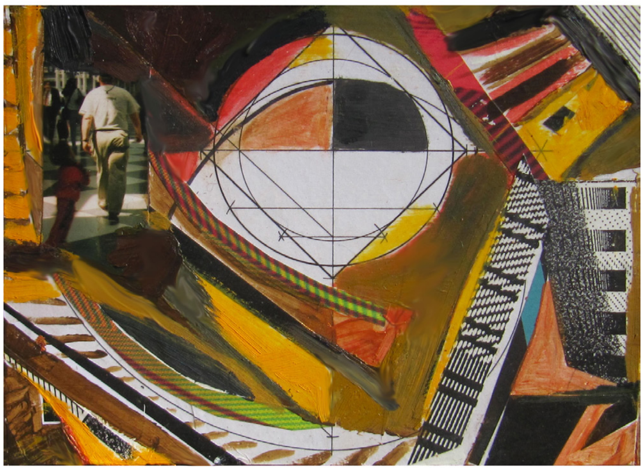

Alternative Explanation
8" x 10"
archival print
2011

An Eclipse
12"x14"12"
wooden sculpture
2012

Typically, my creation process runs through several stages. First I draw abstract geometric designs for executing my computer programs. I use the computer on different levels. Some of my computer programs produce two dimensional images; others are three — depending on my composition's final dictates. Then I add photographic content using scanners and digital cameras. The programs that produce two-dimensional artwork serve as a point of departure for photolithographs and photo silkscreened prints on canvas and paper. They are included both into my two-dimensional and three-dimensional works. All of these approaches are combined for image creation.

For three-dimensional works, computer programs make representations of masses in a vector mode that shape my wooden and mixed media sculptures. Later, the 3D wireframe designs guide construction of wooden sculptures. I often incorporate the factor of time into the sculpture, giving the viewer the illusion of movement.

Alternative Explanation • Often discrepancy between attempted action and possible ways of solving the problem is unavoidable. My inspiration came from exploring tension between the regularity of sets of lines, where any stripe that lies between two other lines in this set is also included in the set, and the special cases of the curvatures, the precise meaning of these depending on context. Our individual actions often result from the sets of prearranged plans that have been warped by the contextual events. Unique results of solving an equation depending on variables, and specific circumstances in competing an intended project make any artwork unique.

An Eclipse • An Eclipse Astronomical events are being described by mathematical calculations. Observations, sometimes hindered by the obscuring of the light by the passage of a celestial body, can support a theory or stimulate a series of proofs. This work results from exploration about the relations between curvatures, such as ovals or semicircles versus angular shapes, rendered with the aid of a wireframe for rotational ellipsoid that determines this sculpture's overall structure.

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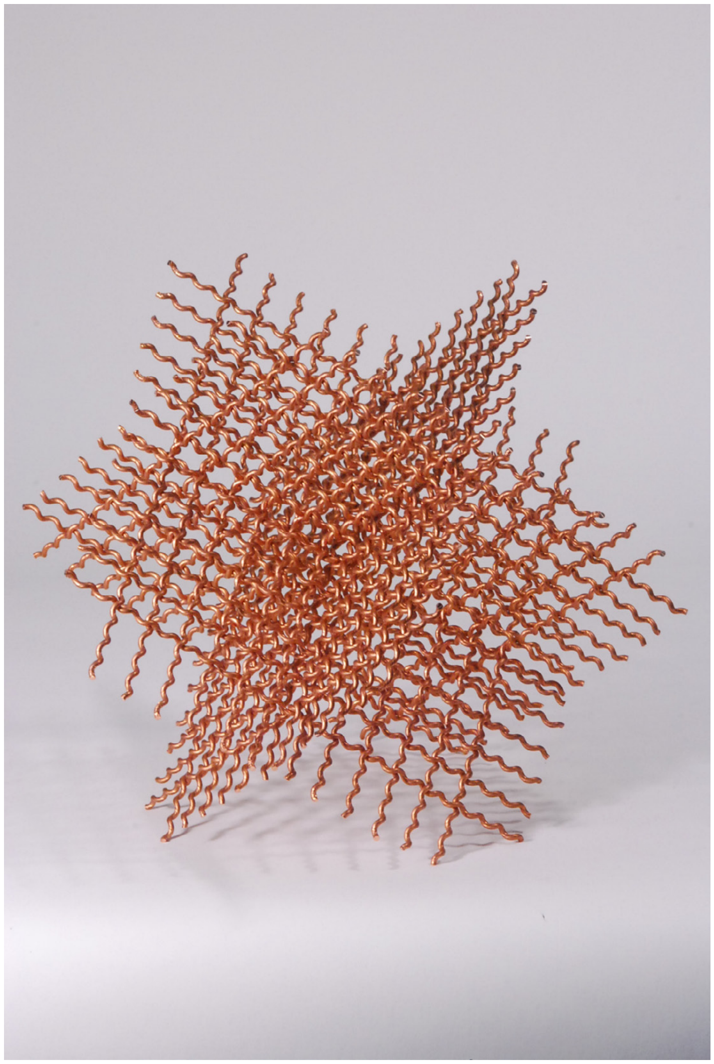
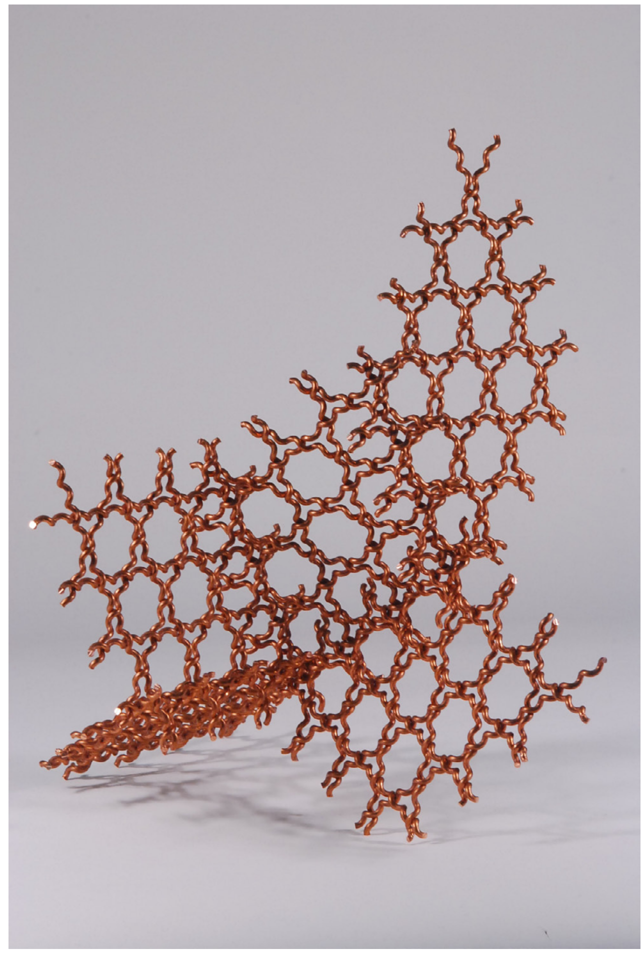


The Genesis of a Woven Dice
9 x 9 x 9in.
copper wire
2011

It was a combination between the chain mail of medieval armor, “the wire curtains” of some buildings in New York City and the minutely detailed wire jewelry of Mary Lee Hu that gave me the starting points to create my own technique of wire weaving. In early spring of 2011 I met Paul Tucker, a mathematician and a scholar, who introduced me to “Bridges” organization. Geometry being the language of my visual expression I realized that art and mathematics coexist in a perfect harmony. The helix wire is the commanding element in my work and has two functions, a unit and a connector at the same time. This system has a wide range of practical applications in architecture, sculpture, industrial and interior design, textile, jewelry etc.

The Genesis of a Woven Dice • The structure is made of three wire screens intersected at 90° angle. Each screen is made by weaving together horizontal and vertical helix wires, wound right hand and left hand. The weaving process consists in twisting the helix elements that slides over and under each other creating a stable structure.

Structure 1
9 x 6 x 6in.
copper wire
2011



5 Rhombic Screens
11 x 11 x 11in.
copper wire
2011

Structure 1 • This object is made by intersecting two sets of four parallel rhombic screens at 60° angle. Each screen has (9) nine equal hexagons formed by weaving together (8) wire helix elements. The weaving process consists in twisting the helix elements that slides over and under each other creating a stable structure.

5 Rhombic Screens • Each screen is made of twelve helix wire elements that form nine equal hexagons. The screens are connected by weaving together their edges allowing a movement that change their orientation. The weaving process consists in twisting the helix elements that slides over and under each other creating a stable structure.

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Labyrinthic St.Omerization from an Apple-like Dried Florida Grapefruit to a New York Bagel
A diameter 85 x height 58 mm dried grapefruit and a diameter 112 x height 40 mm bagel
Dyptic work consisting of two originally edible objects decorated with permanent black ink
2011-2012 and 2012

Besides expressionistic painting and sculpting of the figure and portrait, I am recurrently drawn to geometric projects, probably by previous life experiences in engineering.

This year, still deeply amazed by labyrinths since some ten years, I couldn't help producing a fourth paper on this subject as an unexpected gift of serendipity brought me to an even further morphing of these emblematic patterns, and its showing in the US looks particularly fitting.

Labyrinthic St.Omerization from an Apple-like Dried Florida Grapefruit to a New York Bagel • The work 'St.Omerization of a Grapefruit', shown at the Bridges Exhibit Coimbra 2011 and which was inspired by Carlo Séquin as explained in my paper 'Amazing Labyrinths - further Developments II', dried slowly under my care back home, changing into an apple-like shape with north and south pole dimples. I imagined the poles coming further closer together to a point where an inner hole would appear, transforming the fruit and its labyrinthic decoration into a donut or bagel shape, suggesting that Chartres-like labyrinths could morphe all the way from circular annuli to cylinders to spheres and to tori, which now seems evident indeed. When realizing also that Carlo amazed all of us at the Coimbra conference with an involved and beautiful talk on tori, I considered that this story had to become an inherent part of this dyptic work, illustrating the rich cross-pollination Bridges brings yearly to our minds. In the US here, where fittingly a Florida fruit combines with a New York pastry!

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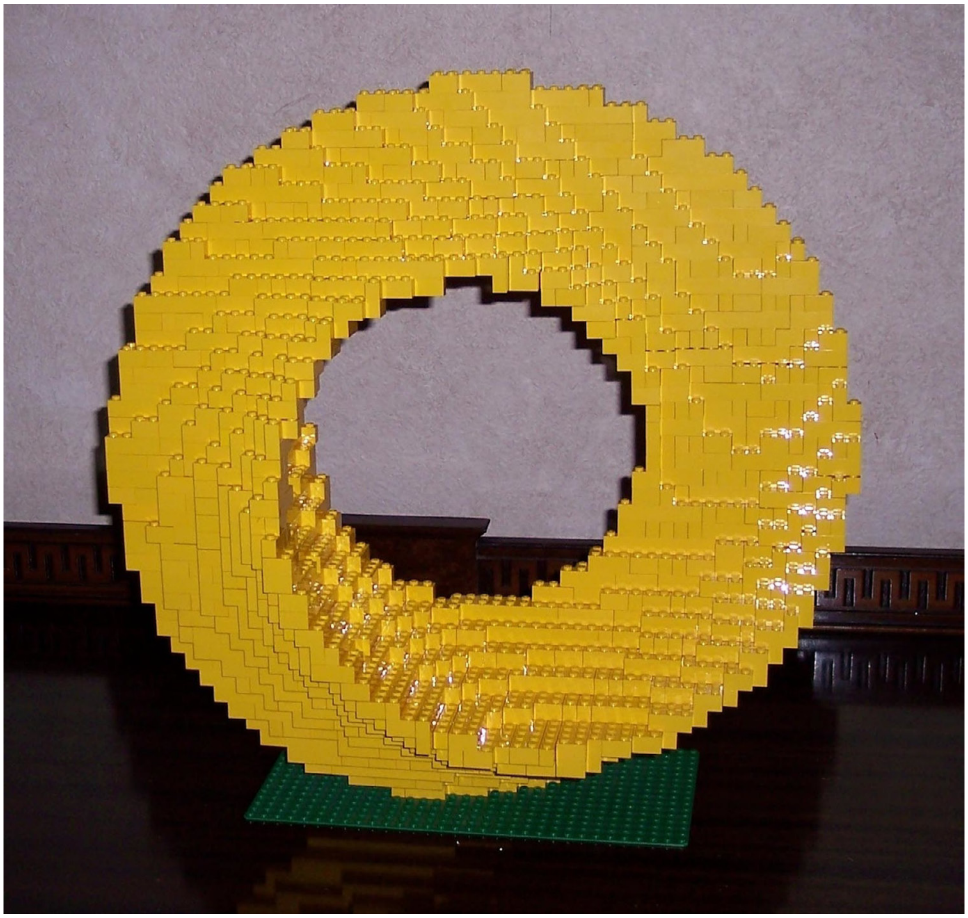

Umbilic Torus
17" x 17" x 10"
LEGO bricks
2005

My work is inspired by pixel representations of objects. I sought to extend this practice to the third dimension, using voxels to illustrate sharp angles and flowing surfaces. The use of LEGO bricks emphasizes the discrete nature of the voxels.

Umbilic Torus • An homage to Helaman Ferguson's Umbilic Torus, a torus with deltoid cross sections and a single surface and edge. The smooth surface illustrates the details of the voxelization as it continuously rotates relative to the underlying grid. Contours for all three dimensions are made visually apparent by the discretized construction.

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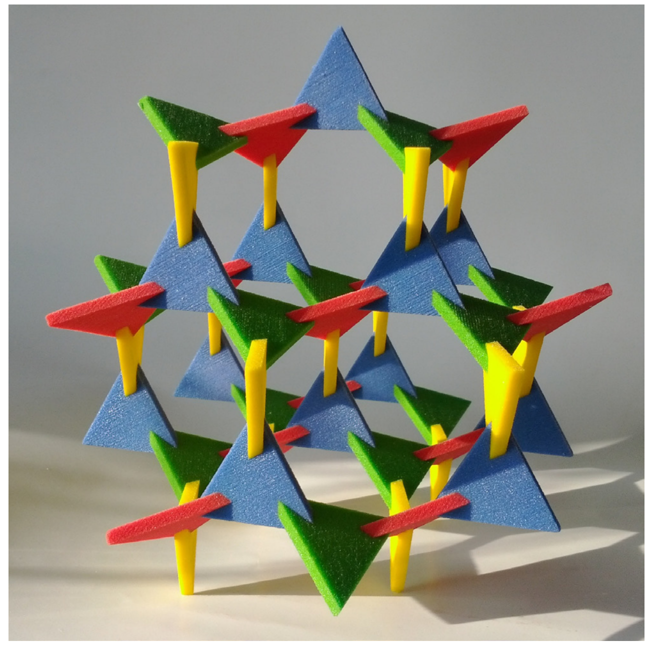
Mitered Fractal Tree I ("The Tree")
100 cm x 120 cm x 40 cm
Bronze
2010

The main artist is Koos Verhoeff, retired Full Professor of Computer Science at the Erasumus University Rotterdam, The Netherlands. Koos has designed and constructed mathematical art since the early 1980s. He mainly designs 3D sculptures, constructed in wood, bronze, aluminum, stainless steel, and plastics, often involving mitered beams. He has described himself as more of an explorer and a discoverer than a designer. He wonders and wanders about the abstract world of mathematical structures, looking for forms with intriguing mathematical properties as well as aesthetic appeal.

Anton Bakker has rendered various designs by Koos, especially on a larger scale.

Mitered Fractal Tree I ("The Tree") • Mitered fractal tree (designed late 1980s, first executed in wood), constructed from a beam with a rectangular cross section in the ratio 1:sqrt(2). When this beam is cut at 45 degrees, the result is a square cut face. When this beam is cut twice at 45 degrees, where the cuts are perpendicular, the result is a "roof" consisting of two smaller square panels. On this roof, two smaller copies of the entire tree are grown. No two branches point in the same direction. The result is an awe inspiring organic structure that is both highly structured and chaotic. Details can be found in the article by Tom Verhoeff and Koos Verhoeff submitted to Bridges 2012. This bronze cast was constructed under the direction of Anton Bakker.

Mitered Fractal Tree II
35 cm x 25 cm x 12.5 cm
Bronze
Early 2000



Trism Lattice
15 cm x 15 cm x 15 cm
3D print in Full-Color Sandstone
2012

Mitered Fractal Tree II • Mitered fractal tree (designed late 1980s, first executed in wood), constructed from a beam with a square cross section. When this beam is cut at 45 degrees, the result is a rectangular cut face in the ratio 1:sqrt(2). When this beam is cut twice at 45 degrees, where the cuts are perpendicular, the result is a "roof" consisting of two smaller 1:sqrt(2) rectangular panels. On this roof, two smaller copies of the entire tree are grown. However, because the beam's cross section is a square, the roof can (and is) rotated over 90 degrees (compared to Mitered Fractal Tree I). The branches point in six directions only. The result is highly regular structure. Details can be found in the article by Tom Verhoeff and Koos Verhoeff submitted to Bridges 2012. This bronze cast was constructed under the direction of Anton Bakker.

Trism Lattice • This sculpture consists of 51 triangular prisms (contracted to "trism"), arranged in one of the eleven chiral (i.e. non-mirror-symmetric) lattices among the 230 space groups. Each trism is connected to three neigbors at an angle of 70.5 degrees. The trisms appear in four orientations (cf. the main diagonals of the cube and the faces of a tetrahedron), represented by the four colors. The shortest cycle consists of 10 trisms.
The design arose out of explorations by Koos Verhoeff and Tom Verhoeff of interlocked trefoil knots constructed from mitered triangular beams. To our surprise this interlocking could be extended to a rare lattice. No picture does justice to its 3D beauty ("A sculpture says more than a thousand pictures"). Recently, we discovered that this structure is also known as (10,3)a; its history is presented by George Hart at georgehart.com/rp/10-3.html

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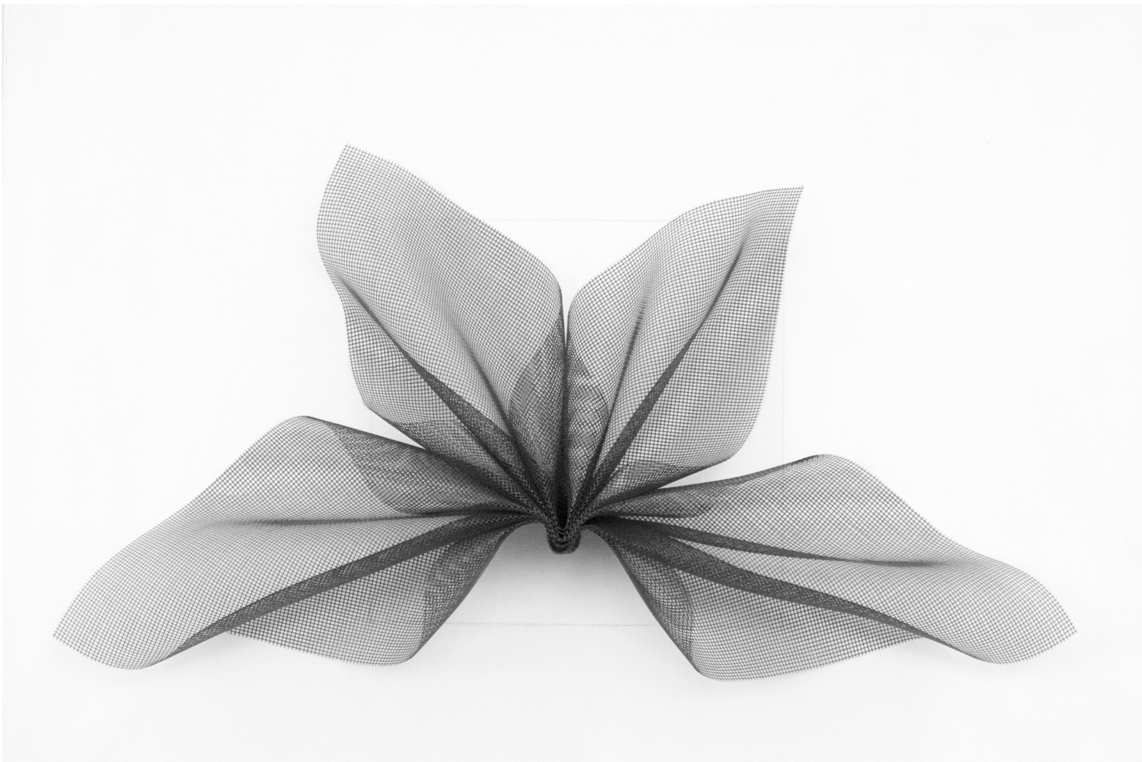


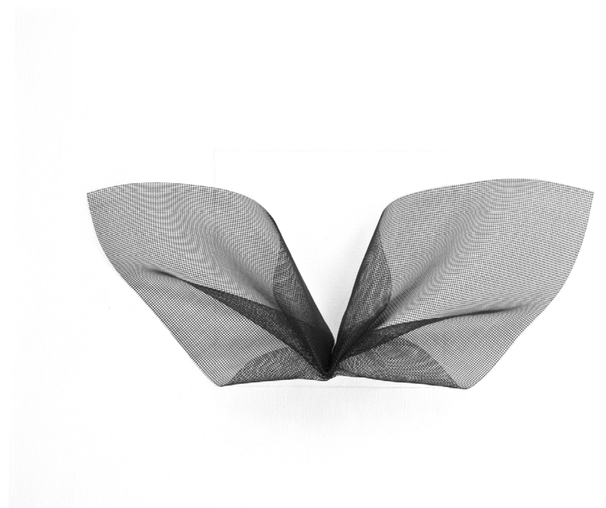
Curved Squares 1
16" x 20" x 5"
Fiberglas, Acrylic Paint, Canvas
2011

As a fine artist, I treat squares, and their triangular subdivisions, as creative shapes to be explored and transformed into sculptures that represent my personal expression and have a unique presence.

I use fiberglas screening as my material. The flexible planar surface responds to warping, wrapping, curving, and torquing. The finished sculpture is changeable in response to light conditions. Gravity and tension affect it; volumes alternate with transparency. Moire patterns appear. On close inspection, the many squares of the grid slow the viewer's eye down and encourage an appreciation of curved space.

Curved Squares 1 • I began with two squares of fiberglas screening and manually folded them along an identical, simple pattern. The process is somewhat like non-computational origami without creating sharp creases. I joined the two forms. The geometric energy is concentrated in the center. The resulting black sculpture projects from a white canvas. I drew a square with a pencil line on the canvas to refer viewers back to the original geometric shape of the form.

Curved Squares 2
20" x 16" x5"
Fiberglas, Acrylic Paint, Canvas
2011



Curved Squares 3
16" x 20" x 5"
Fiberglas, Acrylic Paint, Canvas
2011

Curved Squares 2 · To fabricate this sculpture, I diagonally subdivided a square piece of screening into two equilateral triangles and manually folded them along identical, simple patterns. The process is somewhat like non-computational origami without creating sharp creases. I joined the two forms. The geometric energy is concentrated in the center. The resulting black sculpture projects from a white canvas. I drew a square with a pencil line on the canvas to refer viewers back to the original geometric shape of the form.

Many Worlds · I began with one square of fiberglas screening and manually folded it along a simple pattern. The process is somewhat like non-computational origami without creating sharp creases. The resulting black sculpture projects from a white canvas. The geometric energy is concentrated in the center. The resulting black sculpture projects from a white canvas. I drew a square with a pencil line on the canvas to refer viewers back to the original geometric shape of the form.

CAROLYN YACKEL

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Spherical Symmetries in Temari
18.5 in x 9.5 in x 3.25 in
styrofoam, thread, pearl cotton, embroidery
2008

Truncated Temari
10 in x 6 in x 3.25 in
styrofoam, thread, pearl cotton, embroidery
2011

Carolyn Yackel is deeply moved by mathematics, particularly abstract algebra. However, she is unable to communicate that sense of excitement and well-being to the general public. Through the medium of fiber arts, Carolyn attempts to express the beauty that she observes within mathematics. Conversely, sometimes her fiber art work helps her to better understand mathematics.

Spherical Symmetries in Temari • TThe fourteen finite spherical symmetry types are analogous to the seventeen wallpaper patterns or crystallographic groups. (A nice treatment of both is contained in The Symmetry of Things, by Conway, Burgiel, and Goodman-Strauss.) In Making Mathematics with Needlework (eds. belcastro and Yackel), Mary Shepherd proved that only twelve of the seventeen of the wallpaper patterns can be represented in cross-stitch on a rectangular grid. This set of temari balls was created as a constructive proof that all fourteen of the finite spherical symmetries can be realized in temari. The fourteen types incorporate seven Frieze patterns wrapped around a ball, three dual pairs of Platonic solids projected to the ball surface and embroidered with dihedral symmetry, three dual pairs of Platonic solids projected to the ball surface and embroidered with cyclic symmetry, and the bonus ball, which is a projected octahedron with cyclicly embroidered faces having mirrors across projected edges.

Truncated Temari • Consider cutting all the corners off of a cube in such a way that the resulting faces are regular octagons. The former eight vertices have become eight equilateral triangles. The final solid is called a truncated cube. Alternatively, deeper cuts could have been made at each corner so that the cuts connected midpoints of adjacent edges. In that case, the resulting faces would have been smaller (rotated) squares. The eight removed vertices would still have revealed eight equilateral triangles. The resulting solid this time is a cuboctahedron. This piece shows five truncated Platonic solids projected onto the sphere: the truncated cube, the cuboctahedron, the truncated tetrahedron, the truncated octahedron, and the icosadodecahedron. Two more of the Archimedean solids can be obtained by truncation from Platonic solids.

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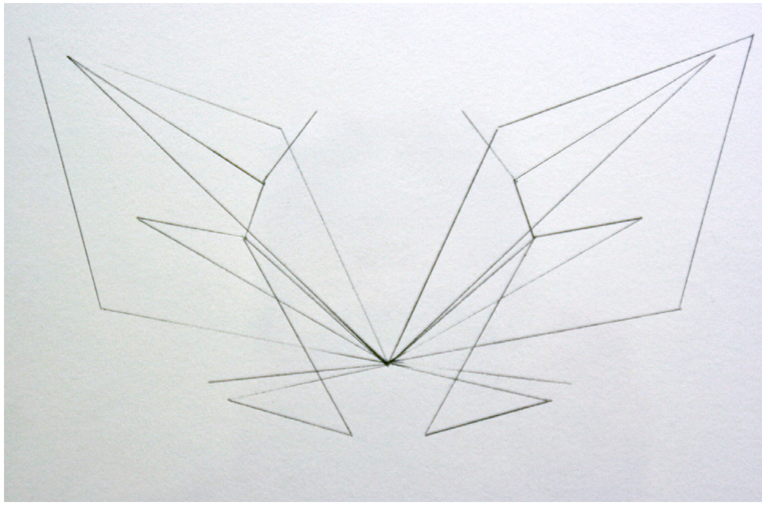
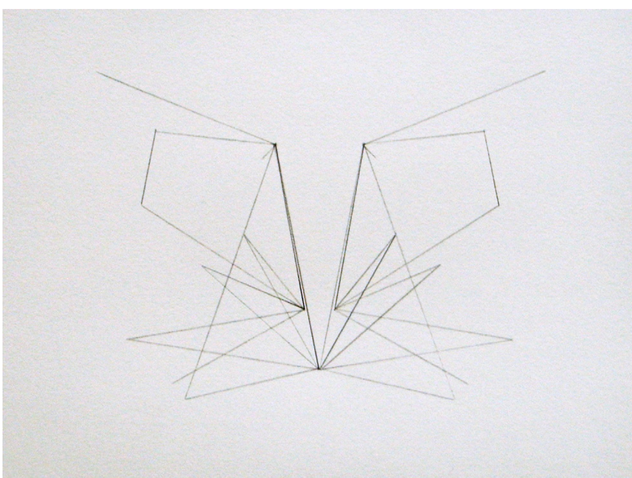
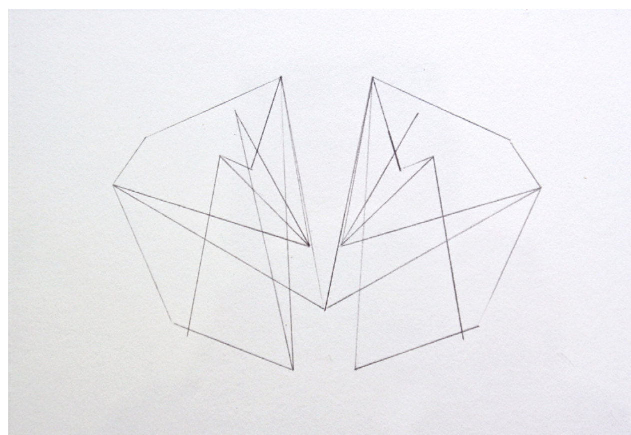


Overwhelmed / Solace
8"x8"
graphite on paper
2012



Stupidity / Intelligence
8"x8"
graphite on paper
2012



Admiration / Contempt
8"x8"
graphite on paper
2012

Through my work I explore perceived structure and the duality of the vital yet completely arbitrary nature of the systems present in our lives. I am interested in how culture influences the way we physically and psychologically maneuver through the world, and through employing various methods of making and interacting I explore the roles that culture, tradition, and ethos play in the way we communicate and interpret relationships. My practice is heavily research driven and is a result of continual travel and exploration into sociological, psychoanalytical, spiritual, and relational ideologies.

Overwhelmed / Solace, Stupidity / Intelligence, Admiration / Contempt · This work is part of a series of visual meditations on the symmetry groups of the two-dimensional Euclidean plane. This print focuses on the symmetry group p4 (orbifold signature 442) and its presentation by a particular set of three generators (generators {a,b,c}, with the relations aaaa = bbbb = cc = abc = 1). In the main section of the image, a network of connected dots forms a stylized Cayley diagram for this presentation of p4, while the small motifs at the bottom describe the local features of the orbifold for the symmetry group (in this case, one 2-fold and two 4-fold gyration or "cone" points). The image is constructed from multiple hand-drawn elements and natural textures which are scanned and digitally manipulated to form a composite image and subsequently output as an archival digital print.