# BRIDGES PÉCS

## MATHEMATICS, MUSIC, ART, ARCHITECTURE, CULTURE

## ART EXHIBITION CATALOG

2010

Celebrating the 13th Annual Bridges Conference in the City of Pécs
European Capital of Culture, Hungary

# BRIDGES PÉCS

## MATHEMATICS, MUSIC, ART, ARCHITECTURE, CULTURE

Bridges: Mathematical Connections in Art, Music, and Science

Pécs Cultural Centre

Pécs 2010 European Capital of Culture

## ART EXHIBITION CATALOG 2010

Robert Fathauer and Nathan Selikoff, Editors
Tessellations Publishing

# BRIDGES PÉCS

## SCIENTIFIC ORGANIZERS

**George W. Hart**
Department of Computer Science
Stony Brook University
New York, USA

**Reza Sarhangi**
Department of Mathematics
Towson University
Towson, Maryland, USA

**Kristóf Fenyvesi**
Jyväskylä University, Finland
Pécs Cultural Center
Pécs, Hungary

**György Darvas**
Symmetrion
IRO Hung. Acad. of Sci.
Budapest, Hungary

## PÉCS CULTURAL CENTER ORGANIZERS, PÉCS, HUNGARY

Andrea Lakner Brückler, Zoltan Rózsa, Jolán Somlyay, Éva Gergely, Edit Lajtai
Bernadett Dékány Kónya, Edith Kiss, Katalin Judit Gerdei, Zsófia Stiller, Dávid Barkóczi
Gabriella Kollár, Balázs Kajor, Péter Molnár, Béla Fenyvesi, András Bodó
Ibolya Kovács, Róbert Lovas, László Guth

## REGIONAL ORGANIZERS

**Slavik Jablan**
Mathematical Institute
Belgrade, Serbia

**Ferhan Kiziltepe**
Yıldız Teknik Üniversitesi
Istanbul, Turkey

**Zsuzsa Dárdai**
Mobile MADI
Museum Foundation, Hungary

## BRIDGES WORKSHOPS: CREATIVITY AND LEARNING

**Mara Alagic**
Wichita State University
Wichita, Kansas, USA

**Paul Gailiunas**
Newcastle, England

## BRIDGES VISUAL ART EXHIBITION

**Anne Burns** (Juror)
Long Island University
New York, USA

**Robert W. Fathauer** (Curator)
Tessellations Company
Phoenix, Arizona, USA

**Nat Friedman** (Juror)
University at Albany
New York, Albany, USA

**István Orosz** (Juror)
West Hungarian University, Sopron
Budakeszi, Hungary

**Nathan Selikoff** (Webmaster)
Digital Awakening Studios
Orlando, Florida, USA

## CONFERENCE WEBSITE AND ELECTRONIC CORRESPONDENCE

**George W. Hart**
Stony Brook University
New York, USA

**Craig Kaplan**
University of Waterloo
Canada

**Nathan Selikoff**
Digital Awakening Studios
Orlando, Florida, USA

## CONFERENCE ADVISORY BOARD

**Craig Kaplan**
David R. Cheriton School of
Computer Science, University of
Waterloo, Canada

**Carlo H. Séquin**
EECS, Computer Science
University of California
Berkeley, USA

## ART EXHIBITION COMMITTEE

**Ergun Akleman**
Visualization Sciences Program
Department of Architecture
Texas A&M University
College Station, Texas, USA

**Robert Fathauer** (Chair)
Tessellations Company
Phoenix, Arizona, USA

**George W. Hart**
Department of Computer Science
Stony Brook University
Stony Brook, New York, USA

**Reza Sarhangi**
Department of Mathematics
Towson University
Towson, Maryland, USA

**Edith Kiss**
Pécs Cultural Center
Pécs, Hungary

**Anne Burns**
Department of Mathematics
Long Island University
Brookville, New York, USA

**Nat Friedman**
Department of Mathematics and Statistics
University at Albany
Albany, New York, USA

**István Orosz**
Art and Design Department
Sopron University
Budakeszi, Hungary

**Nathan Selikoff**
Digital Awakening Studios
Orlando, Florida, USA

**Kristóf Fenyvesi**
Jyväskylä University, Finland
Pécs Cultural Center
Pécs, Hungary

## EDITORS

**Robert W. Fathauer**
Tessellations Company
Phoenix, Arizona, USA

**Nathan Selikoff**
Digital Awakening Studios
Orlando, Florida, USA



ISBN: 9780980219197
ISSN: 1099-6702

Printed by Reálszisztéma Dabas Printing House, Managing Director: Magdolna Vágó

Published in the framework of Pécs 2010 European Capital of Culture program organized by Hungarofest Nonprofit Ltd., Managing Director: Rita Rubovszky.

Published by Tessellations Publishing, Phoenix, Arizona, USA (©2010 Tessellations).
Distributed by *MATHARTFUN.COM* (http://mathartfun.com) and *Tarquin Books* (www.tarquinbooks.com).

Cover Artworks: Krystyna Burczyk, Francesco De Comité, Bjarne Jespersen, Antal Kelle, Mohammad Yavari Rad, Sean Stewart, and Suman Vaze

Cover Design: Ergun Akleman

CD-ROM Production: Craig S. Kaplan

# TABLE OF CONTENTS

# PREFACE

Bridges 2010, in Pécs, Hungary promises to offer another exciting and inspiring installment of the annual series of math and art conferences that have been held since 1998. After visiting the USA (several times), Canada (twice), Spain (twice), Britain, and the Netherlands, we are very pleased to be in Eastern Europe for the first time, in the beautiful city of Pécs, Hungary. Pécs has long been a center of learning, as the home of the largest and oldest university in Hungary, dating back to 1367. The city has a long history of Roman, Ottoman, Turkish, and Hungarian culture since its founding in the early second century. Remains of its early history are recognized as a UNESCO World Heritage Site. For 2010, Pécs is being recognized by the European Union as a Capital City of Culture, and the Bridges Conference is proud to be part of this celebration of its cultural life and development.

Hungary is the home of many great mathematicians and artists who will be celebrated in various ways during the Bridges Conference. For example, the artist Victor Vasarely, the designer Marcel Breuer, and the mathematician János Bolyai will each be discussed in presentations during a special Hungarian Day at the conference. The inventor and professor of architecture Ernő Rubik will lead a special discussion about Rubik's Cube and other puzzles he has designed. And the international award winning Hungarian mathematician, László Lovász, will open the Bridges Conference with a plenary talk about the beauty of mathematics.

The Bridges Pécs conference has received enormous support from the Pécs Cultural Center. We thank its director Andrea Lakner Brückler and staff members, especially Kristóf Fenyvesi, for all the local arrangements they have organized. In preparation for the arrival of Bridges, they have been holding an annual art-math conference series, entitled Pécs – Ars GEometrica (PAGE), since 2007 and running a mathematics education program, entitled Experience Workshop, since 2008. In addition, we thank György Darvas for making many local arrangements and invitations.

Pécs is the home of the world famous Zsolnay Porcelain Manufactory, a center for historical and contemporary ceramics and porcelain. To celebrate the arrival of Bridges in Pécs, Dániel Erdély curated and organized the ScienTile Exhibition at the Zsolnay Cultural Center. A panel of judges reviewed and selected the entries. We would like to thank him, his jurors, Simon Erdély, András Fodor, and the Director of the Zsolnay Porcelain Manufactory, Péterné Marosy Katalin, for bringing this exhibition to reality.

The proceedings book has grown in both size and quality. For the first time in the history of Bridges, the number of accepted articles published in the proceedings has surpassed one hundred! This jump is due to an overall increase in the number of submitted articles. The program committee that oversaw the reviewing process spent many hours studying and discussing the articles, with input from an army of external reviewers. To limit the proceedings to a single volume, many submissions were restricted in length. Fortunately the EasyChair system worked well to streamline the process. We are grateful to the University of Manchester, England, for providing this service.

The growth of the community interested in mathematics and art and other connecting fields also shows itself in the large draw of the Art Exhibition, which this year hosts seventy-four artists from all over the world. This important component of the annual Bridges conference is a juried exhibition that is also captured in a marvelous catalog showing all selected works in color photographs. We are very grateful to Robert Fathauer along with Anne Burns, Nat Friedman, and István Orosz for organizing this event and for jurying the many submissions. We also thank Edith Kiss of the Pécs Cultural Center for helping with logistical challenges and the hanging of the exhibition in Pécs. We thank Ergun Akleman for designing the Proceedings cover and Art Exhibition Catalog cover using artwork selected from the exhibition. Nathan Selikoff is especially thanked for creating a new online system for Exhibition submissions and automatic catalog generation, and for taking over general maintenance of the extensive Bridges website.

The conference also keeps growing in several other directions due to the creativity and special effort of many dedicated individuals. This is most visible in the special Bridges Nights program:

- For our Theater Night this year, the Bridges Conference will present The Secret Life of Squares. Karl Schaffer and Erik Stern, both college professors, along with company dancer Saki, show the connections among disciplines through their highly physical, engaging choreography using humor and entertaining audience interactions. Their art addresses symmetry, number sense, the history of ideas and, ultimately, how we think.

- Dmitri Tymoczko, a music professor at Princeton University, is the curator of Music Night, a public concert of accessible music inspired by mathematical themes. It will feature composers such as Fernando Benadon, Clifton Callender, Adrian Childs, and Noam Elkies. These new works will be presented in a concert performance with an explanatory introduction about their mathematical connections. We would like to thank the performers of the musical pieces, the Ávéd-Fenyvesi Quartet, the Handbell Choir of the ANK Primary SchooI of Pécs, and Katalin Gál Poór. We also thank Vi Hart for organizing a separate informal session of music by conference participants.

- More artists and educators than ever are using movies, videos, and animations for different purposes ranging from education, industry, and art. An important objective of the Bridges Organization is to introduce participants to innovative and integrative techniques that promote interdisciplinary work in the fields of mathematics and art. The Math/Art One-Night Film Fest is a new feature of the conference and a new venue for talented and creative minds around the world.

The authors, the artists, and others who come to learn and enjoy the conference through many venues of talks and exhibitions are visiting this year from about thirty different countries around the world. Many others who would have loved to, but could not attend, will still be reached by conference products such as the Proceedings, the Art Exhibition Catalog, and the Bridges website, http://bridgesmathart.org/. It records and documents many facets of this conference: the papers, the art work, and photographs taken by participants. Thus, in a virtual way, those who miss these exciting days in Pécs will still be connected and those who do attend can revisit their memories repeatedly.

The Bridges Organization Board of Directors
http://www.BridgesMathArt.org/

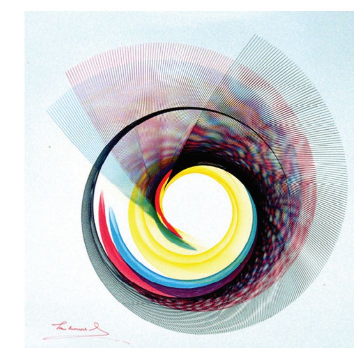
# IVAN MOSCOVICH

Retired
Nijmegen, The Netherlands
i.moscovich2@chello.nl

## STATEMENT

Invented and patented the "Harmonograph of Moscovich", an analog computer which was one of the key exhibits at the milestone "Cybernetic Serendipity" art exhibition in 1968, at I.C.A. in London.

The "Harmonograms of Moscovich", the unique original creations of the harmonograph were exhibited in the 60's and 70's at dozens of exhibitions and one-man-machine shows all around the world.



## HARMONOGRAMS OF MOSCOVICH

*Analog computer originals. 24 x 24 inches. 1968.*

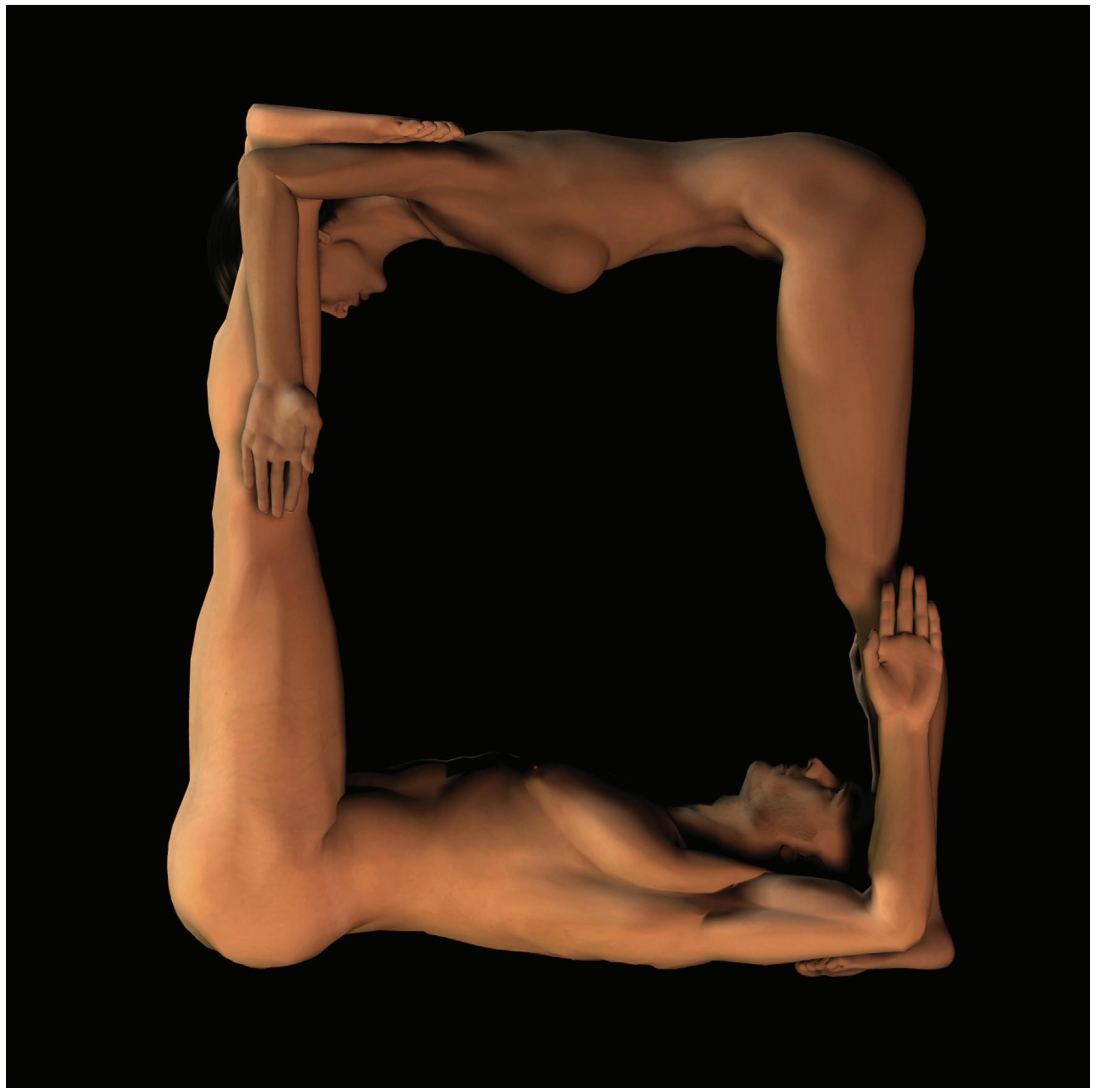
Creations of the patented "Harmonograph of Moscovich" one of the key exhibits at the "Cybernetic Serendipity" milestone art exhibition, held at the I.C.A. in London in 1968, acclaimed as the best math art of the time.

# MIKE NAYLOR

Norges Teknisk-Naturvitenskapelige Universitet
Trondheim, Norway
abacaba@gmail.com
www.nakedgeometry.com

## STATEMENT

My artwork currently focuses on imagining and expressing mathematical forms and ideas with the human body.

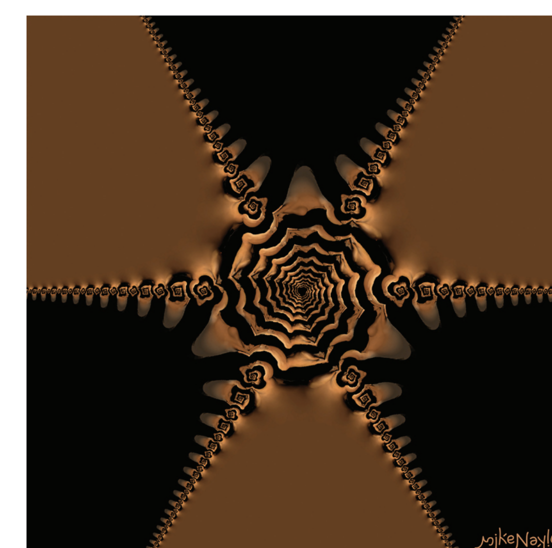


## MELT INTO YOU

*Digital Prints. 4 frames, 12" x 12" each. 2010*

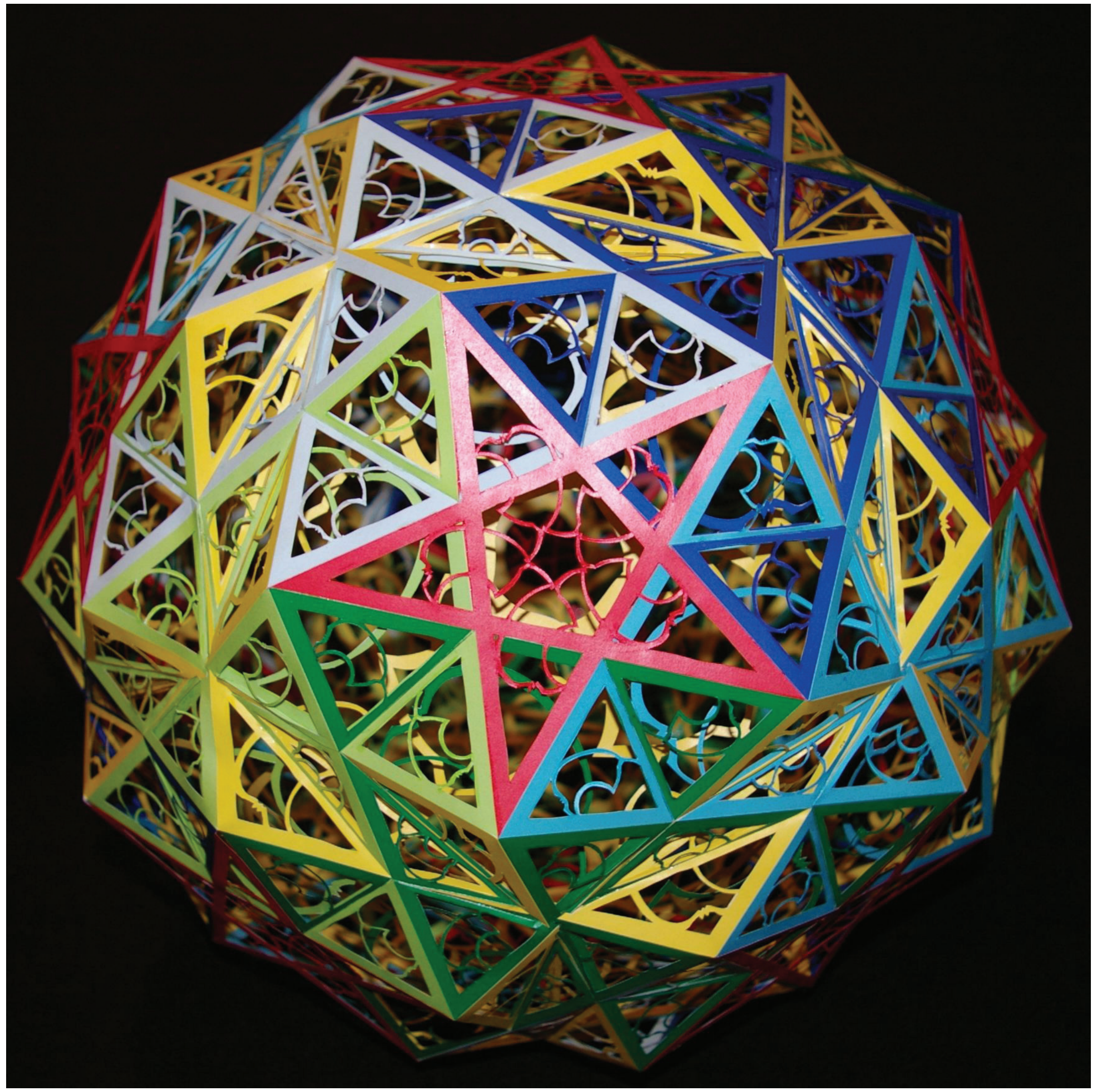
"Melt into you" is a series of 4 prints depicting the mathematical voyage of two figures which blend into one. The work is an example of the Droste effect, a recursive artistic effect in which a picture contains a smaller version of itself. It is named for Droste cocoa power, a Dutch chocolate product that in 1900 featured on its packaging a picture of nurse holding a package of the cocoa, which has a picture of the nurse holding a package of cocoa, and so on. "Melt into you" starts with an image of 2 people, which is transformed by a uniform radial scaling of the image and then joined to a similar copy of itself. The effect is then enhanced by applying fractal algorithms to achieve successively surreal effects.





# ULRICH MIKLOWEIT

Essen, Germany
www.polyedergarten.de



## STATEMENT

The objects of my art are paper polyhedron models, most preferable uniform ones. The nets are constructed on a computer and printed on white paper of 80 g/m2. They are cut out with scissors and knives and assembled with glue. My initial motivation came from pictures of M. C. Escher.

## SNUB DODECADODECAHEDRON

*Xerographic paper. 380 mm Diameter. 2008.*

The Snub Dodecadodecahedron (Wenninger Number 111) is made of 12 pentagons (yellow), 12 pentagrams (red) and 60 triangles (each twelve in light green, dark green, light blue, dark blue and light grey). So seven colours were needed. The model was created with Stella 4D. It consists of 924 facelets.



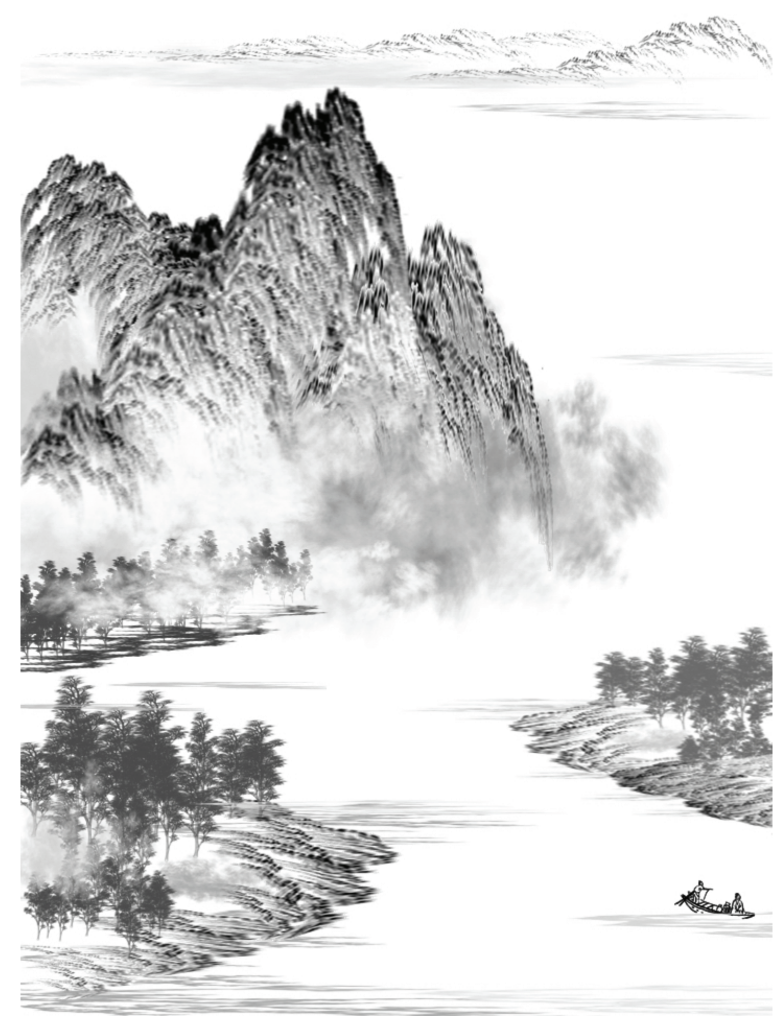
# MINGJANG CHEN

Center for General Education, National Chiao Tung University
Hsinchu, Taiwan
mjchen@mail.nctu.edu.tw

## STATEMENT

A new method by using Structural Cloning Method (SCM) and Leaping Iterated Function System (LIFS) to explore chaotic patterns in Landscape Paintings is presented. 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. SCM and LIFS together build a bridge between mathematic and aesthetic, and they then make fractals more tractable. Supported by mathematics and digital technology, it is already a breakthrough to draw visual elements. However, it is much more challenge to convey a natural feeling in such a painting without the feeling of mathematics.

## CHAOTIC LANDSCAPE PAINTING



*Digital print by PowerPoint*
*22" x 17"*
*2010*

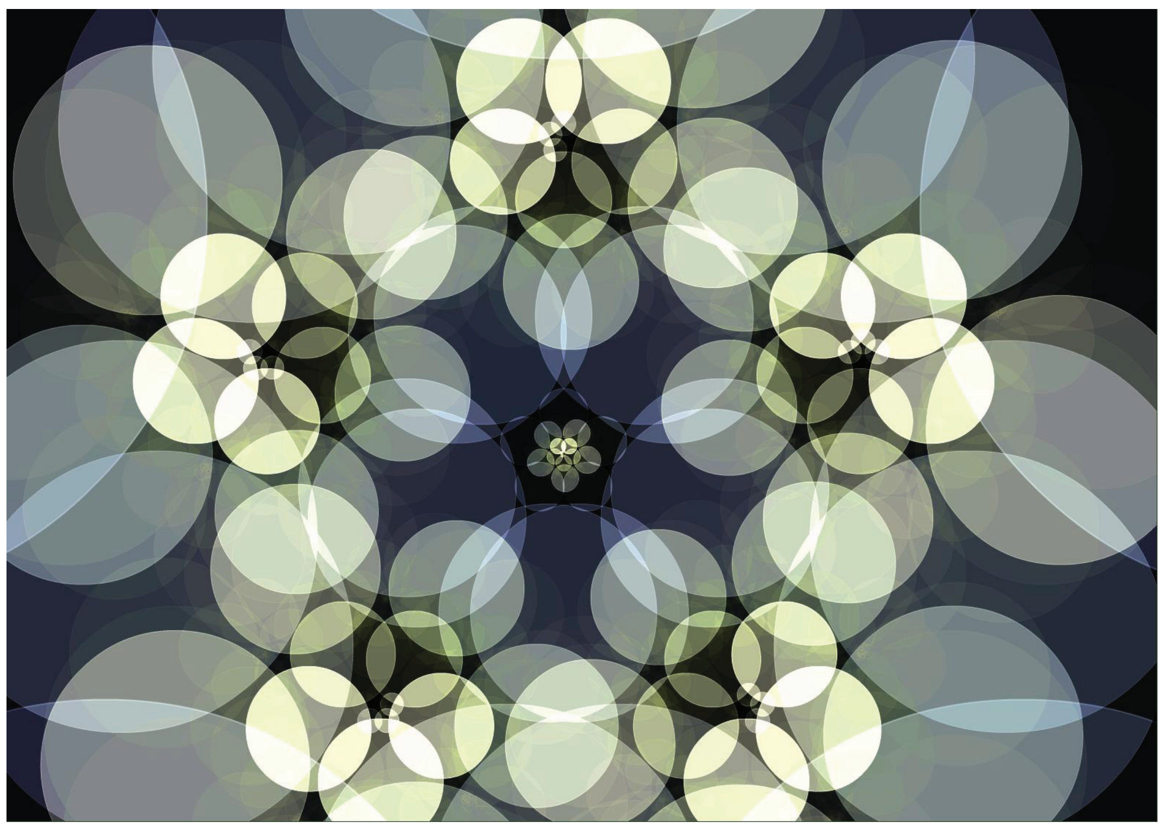
Structural Cloning Method (SCM) is a visual interface to define different combinations of geometry transformations and Leaping Iterated Function System (LIFS) is an improved version of Iterated Function System. Instead of exponential growing loading while iterating; LIFS takes only constant computing resources. From the viewpoint of visual design, SCM and LIFS together build a bridge between mathematic and aesthetic, and they then make fractals more tractable. In this artwork, all the visual elements, including mountains, rock, tree, grasses, ripples, fog, etc., are designed by multiple generators in LIFS in a few leaping iterations, following by a sequence of manual geometrical transformations. Some chaotic patterns can be adapted from others, for example, ripples can be adapted from mountain and cloud. However, it is much more challenge to convey a natural feeling in such a painting without the feeling of mathematics.

# ANNE BURNS

Long Island University
Brookville, New York, USA
aburns@liu.edu
www.anneburns.net

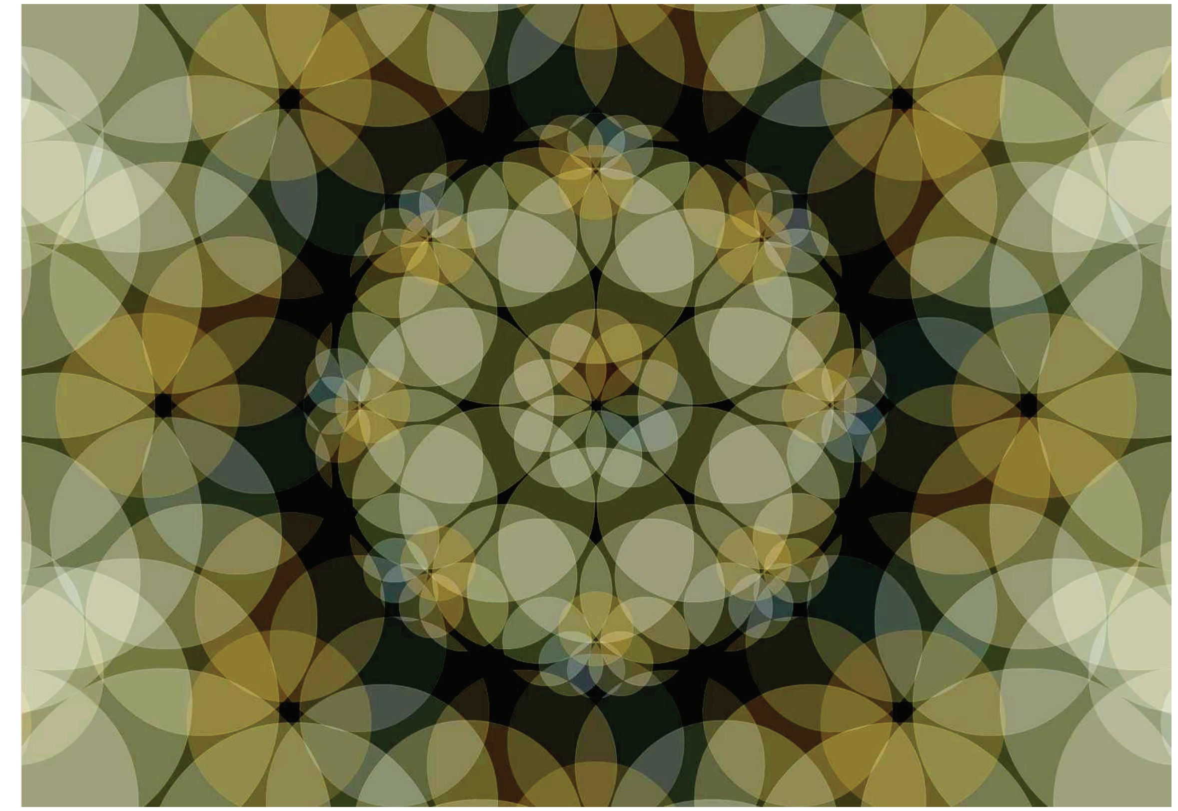
## STATEMENT

Almost all of my computer-generated art is a result of a recursive process. I am fascinated by recursion and the complexity that can be achieved by repeatedly applying a simple transformation to an initial object and changing the parameters at each stage. My Bridges 2010 entries are all variations on the same theme, an iterated function system, but with different parameters and different color assignments.



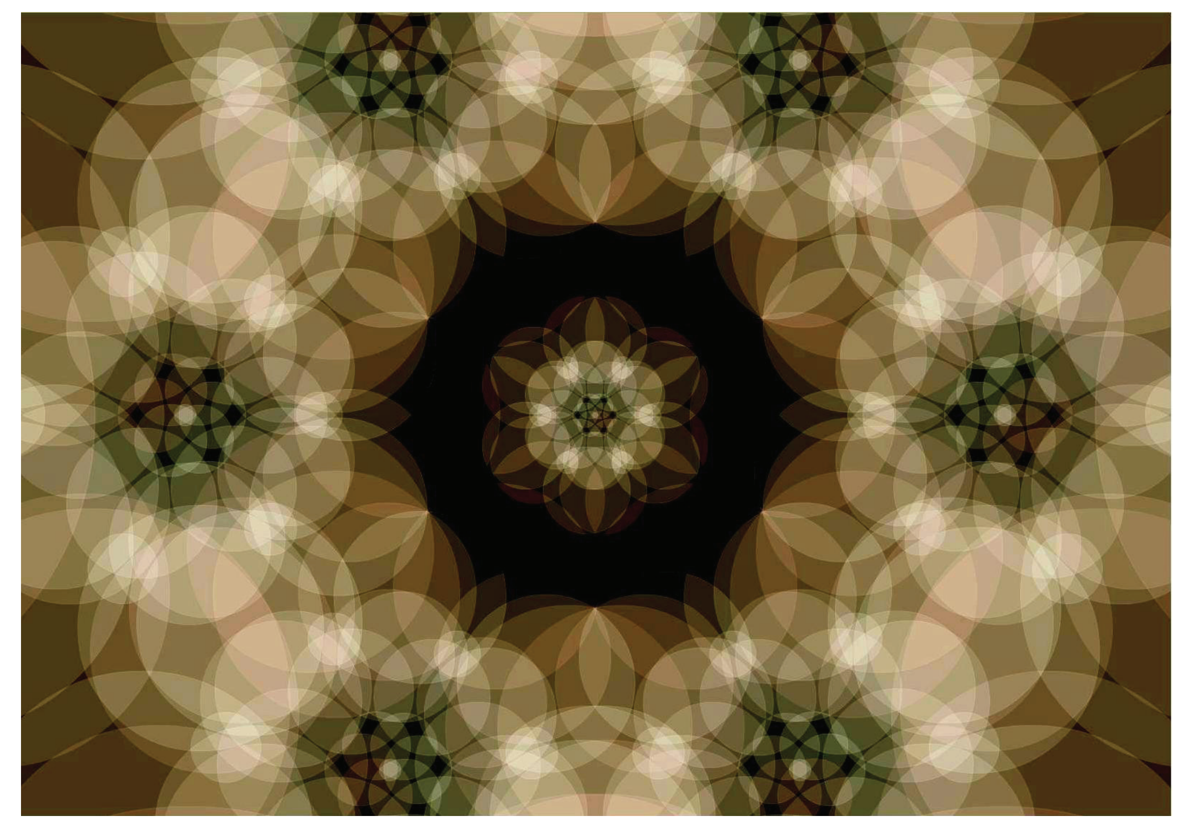
## CIRCLES-FIVE

*Digital Print. 13" x 19". 2009.* An Iterated function system with five-fold symmetry.



## CIRCLES-EIGHT

*Digital Print. 13" x 19". 2009.* An Iterated function system with eight-fold symmetry.



## CIRCLES-SIX

*Digital Print. 13" x 19". 2009.* An iterated function system with six-fold symmetry.

# ANDREIA HALL & PRUDÊNCIA LEITE

University of Aveiro
Aveiro, Portugal
andreia.hall@ua.pt

## STATEMENT

We are interested in linking Mathematics with Art using different mediums. Presently we are using patchwork and quilting techniques to reproduce mathematical elements. For instance, we used Voronoi diagrams, fractals and symmetry to create patchwork patterns. The present work explores Voronoi diagrams resembling floral designs.

## FLORAL VORONOI I

*Vintage fabrics, sewing threads and accessories. 55x55 cm. 2010*

## FLORAL VORONOI II

*Vintage fabrics, sewing threads and accessories. 55x55 cm. 2010*

This work uses patchwork and quilting techniques and is based on a Voronoi diagram which was built in such a way that it resembles a floral picture with two big flowers. Voronoi diagrams are a special kind of decomposition of the plane into regions (cells) determined by the smallest distance to a specified discrete set of points (called the Voronoi sites). In this work, the Voronoi sites are creatively explored through sewing and application of other material such as lace and felt.



# ANDREIA HALL & DULCE ABREU

University of Aveiro/Jardim Infância da Chave - Gafanha da Nazaré
Aveiro, Gafanha Nazaré, Portugal
dulcepnabreu@gmail.com

## STATEMENT

The Department of Mathematics of the University of Aveiro hosts a project on non-formal teaching of Mathematics which is developed in interaction with the surrounding community, in particular primary and pre-schools. In this project we create stories concerning certain mathematical concepts and we invite children to participate in the elaboration of the scenarios for the stories. One of the stories concerns geometric solids. Several children were asked to create platonic solids which become sculptures in an invented city, made up of many three dimensional shaped buildings. In addition they also recreated the existing music hall of Oporto, Casa da Música, intended for the imaginary city. The present work results from a joint collaboration with the Pre-school Chave of Gafanha da Nazaré.

## CASA DA MÚSICA, OPORTO, PORTUGAL

*(top) Mixed medium and painted cardboard. 35cm x 25cm x 23cm. 2010.*

This work is a small scale plastic recreation, performed by 5 and 6 years old children, from Pre-school Chave of Gafanha da Nazaré, Portugal, of the existing music hall of Oporto, Casa da Música. The building is a outstanding example of an irregular polyhedron.

## PLATONIC SOLIDS

*(bottom) Mixed medium on cardboard. 50 x 50 x 15 cm. 2010.*

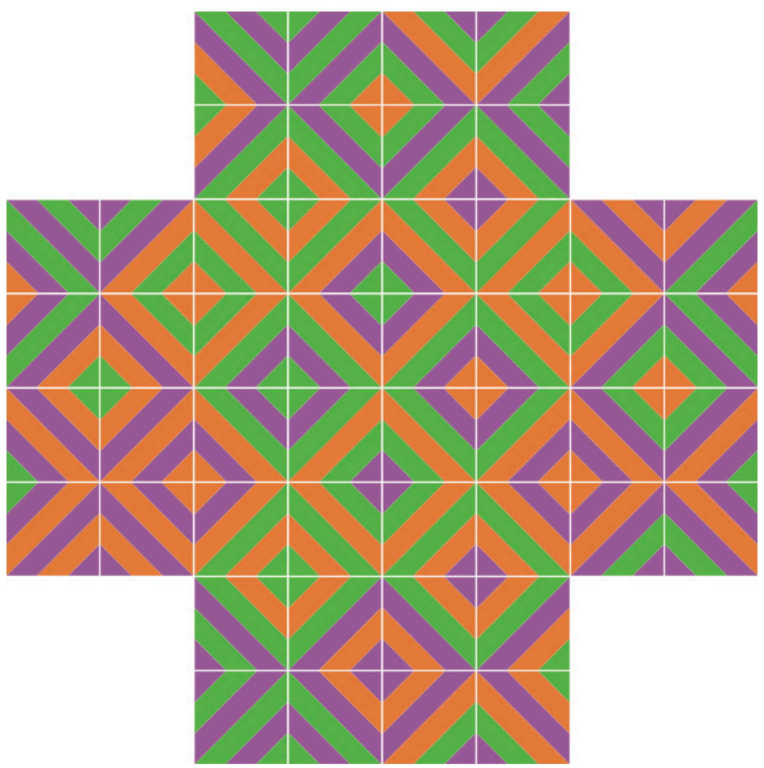
This is a set of Platonic solids, created by 3 to 6 years old children, from Pre-school Chave of Gafanha da Nazaré, Portugal. The set is intended for an imaginary city where each building has a different form. The Platonic solids represent sculptures which stand in a main public square.

# ANNA VIRÁGVÖLGYI

Budapest, Hungary
viragvolgyi.anna@gmail.com

## STATEMENT

I intended to make elements wear on itself the features of the entire set which include them. To find these elements I start out from a marked state. The marked state here is a cylinder striped by various colours. Elements are congruent squares (they may be considered words, codes, propositions, concepts, cells, etc. as well). There are ornaments on cylinder include each combinatorial possible square with the same number of stripes continuously. In consequence of its origins certain elements can cohere (fit together) and others do not cohere. By occasionally rearranging the squares various constraints of coherence of elements are accepted or rejected. So the shape and inner structure of the resulting pattern visualise coherency. (Coherency is examining like the criteria of beauty and truth.)

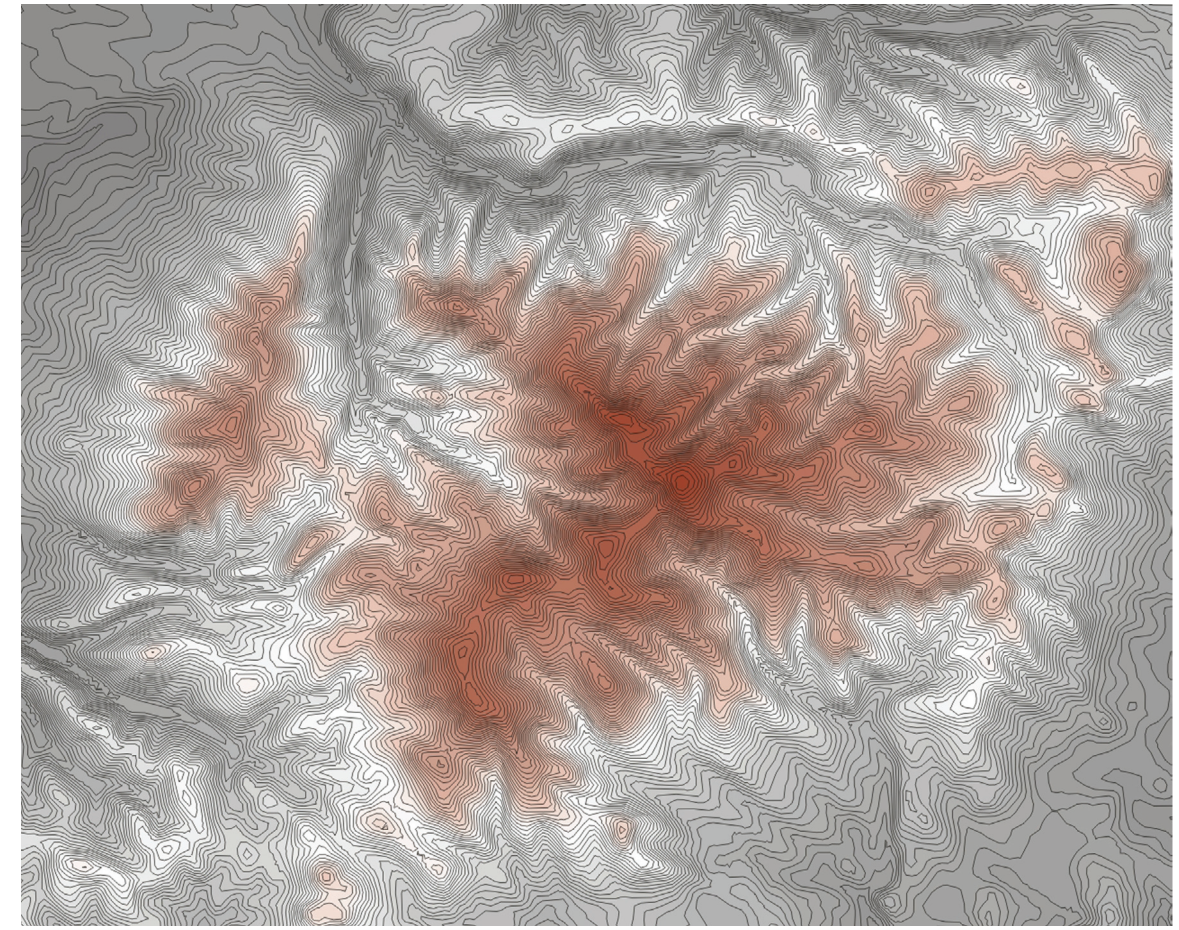


### 48 DIFFERENT SQUARES

*Digital print on canvas. 18" x 18". 2008.*

This is a pattern of 48 different squares. Albeit the arrangement of the squares is not regular, since all the elements are different, the whole surface is symmetrical. There are several inner pattern with identical outer form. Other changes in the neighborhoods of the elements engender different outer shapes. There are innumerable patterns possible on the plane and on surfaces of solid figures as well.

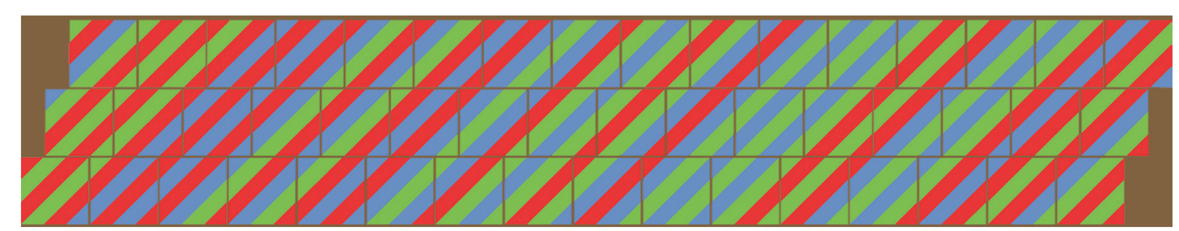




### PILIS

*Digital print. 12" x 15". 2010.*

This is a special picture of our favourite place of excursion. The level lines of the tourist-map were vectorized and shaded according to the scale of height. Coauthor Szécsi József



### A UNIVERSAL CYCLE

*Digital print. 6" x 18". 2008*

A picture of an unwrapped cylinder. The universal cycle "a b c a b a b a b c b c b c a b c a b c b c a c b a c a b a c b c a c a c a b a b c a c a b c b" includes all possible words of length six from the alphabet (a, b, c) in which no letters of the alphabet are paired. The picture is created by substituting stripes for letters of the universal cycle. Due to of the nature of universal cycles all possible diagonal striped square tiles (with six stripes—each differ from its neighbour) can be found in this picture.

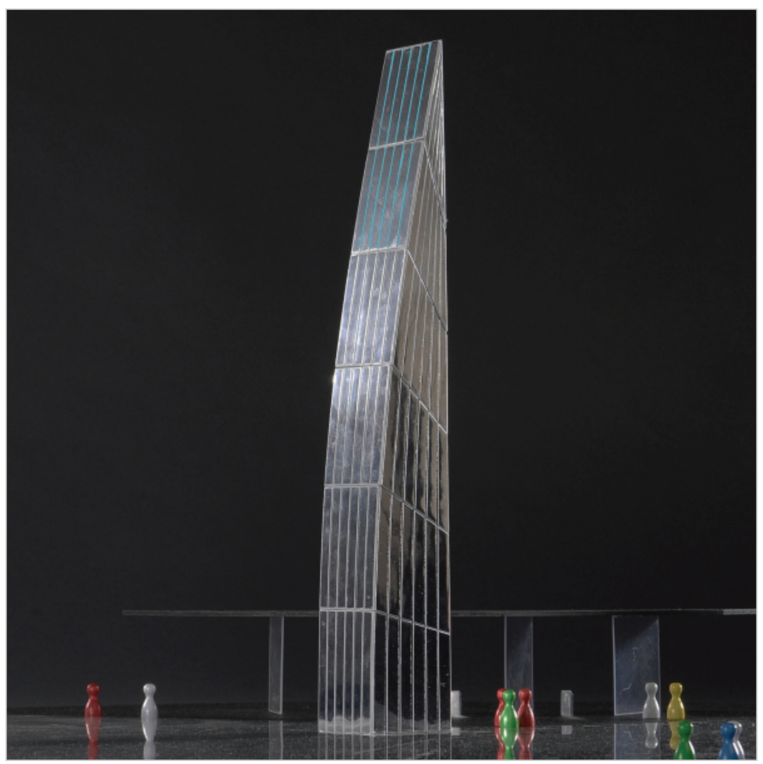
# ANTAL KELLE

ArtFormer Studio, Hungarian Art Association
Budaörs, Hungary
antal@kelle.hu
www.artformer.com

## STATEMENT

I create my geometrical objects on the one hand with traditional sculpture making methods and on the other hand with high technology that allows for interactivity and animation. I work with "everyday" geometrical solids and constructions, but I take parts of them and deform and project them. I make several new movable objects which are then transformed from abstract forms to organic forms and vice versa.

## INDIAN DESIRE

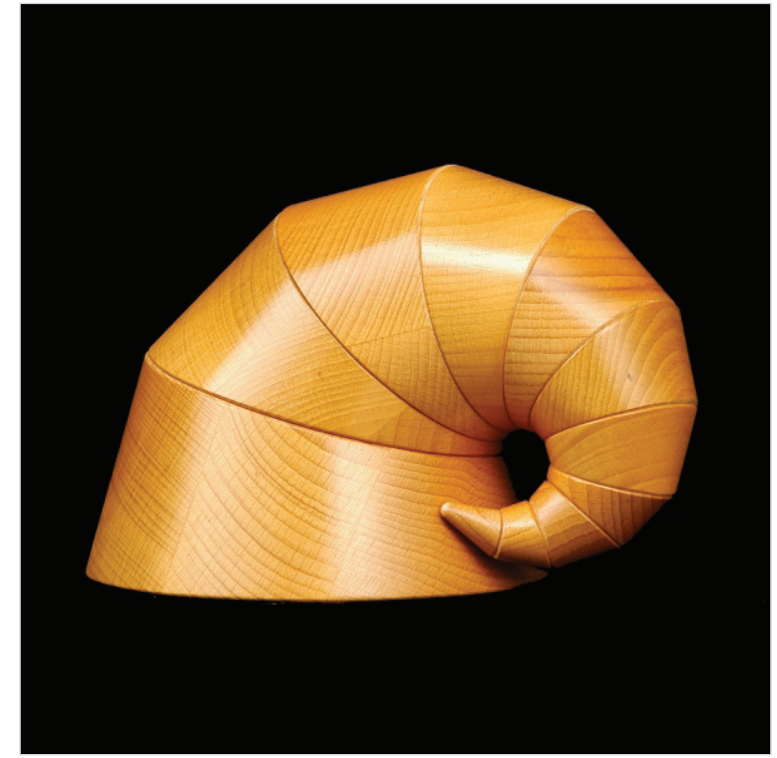


*Interactive moving sculpture model (3D). Stainless steel + paint wood + acril glass + monitor. 24" x 24" x 24". 2007*

This is a model of an 80 foot tall moving steel tower to be built in Ahmedabad, India. The shape of the column came from the traditional Hindu temples and Muslim mosques (such as Cutab Minar). I combined and abstracted these forms into a non-regular prism, cutting it into six pieces. The moving steel sculpture will twist, change shapes, and change colours, controlled by the observer (with the help of sophisticated powered robotic motors and special software).



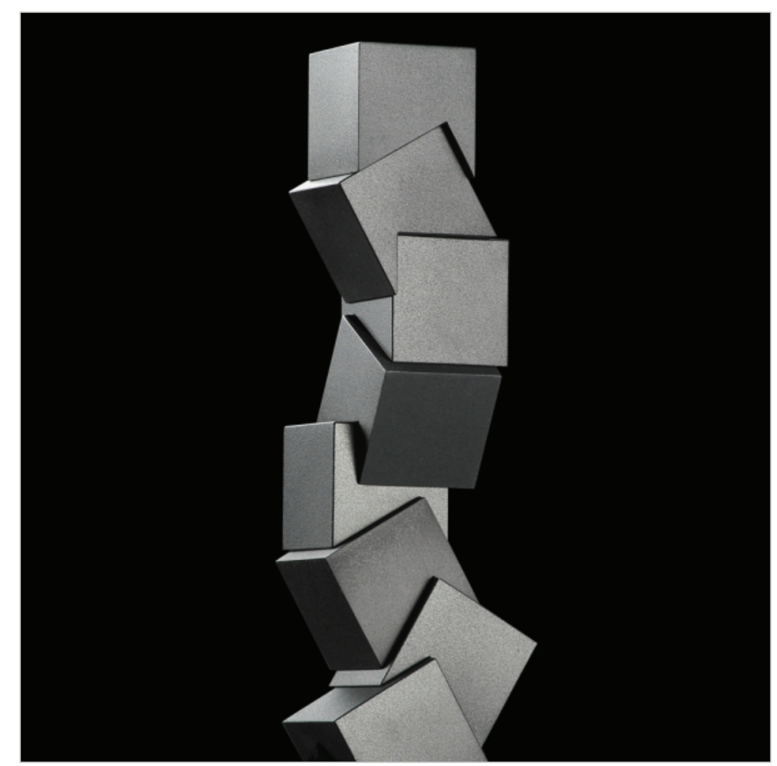
## HELIX INTERACTIVE COMPOSITION 3D



*Varnished beech wood, with moving structure inside
400 x 400 x 400 mm (3D)
2000*

Helix Interactive Composition 3D is made up of two similar parts. Both of them are movable as they are made up of 10 flexible segments. The starting forms were simple sections of deformed cones. The segments were arranged consecutively, adjoining each other along boundaries. The segments are movable and the boundaries move continuously, maintaining the connectivity of the composition.

## KREABAU



*Painted wood. 50 x 25 x 25 cm (3D work). 2000*

This object is a set of basic geometrical solids combined with each other. They are deformed spheres, cylinders and cubes. They have individual properties, such as direction. There are many possibilities for building cubist sculptures.

# RAYMOND ASCHHEIM

Polytopics
Issy les Moulineaux, France
raymond@aschheim.com
polytopics.com

## STATEMENT

As one of a few Hypersculptors, I'm using mathematics, computer science, and rapid prototyping technologies, to produce sculptures of high dimensional objects. To exhaust the fact that they includes an other dimension, I make them electomagnetically levitate and freely floating in our space, without any physical link to the earth. My hyper sculptures illustrates my NKS-E8 Theory of Everything, It says that the void is an hypercrystal made of a trivalent network. From Set theory, topology gives a data structure, which gives a geometry. Then data defaults creates forces and matter following Lisi's E8 model. I exposed in intersculpt biennale since 2003, and in Grand Palais' 2009 Art en Capital. I'm trying to express what the universe is on its fundamental level, searching for the Truth, and luckily, finding Beauty.

## HYPERMERIDIAN

*Rapid prototyping rendered, as SLS, magnets, levitation. 16" x 12" x 12". 2010.*

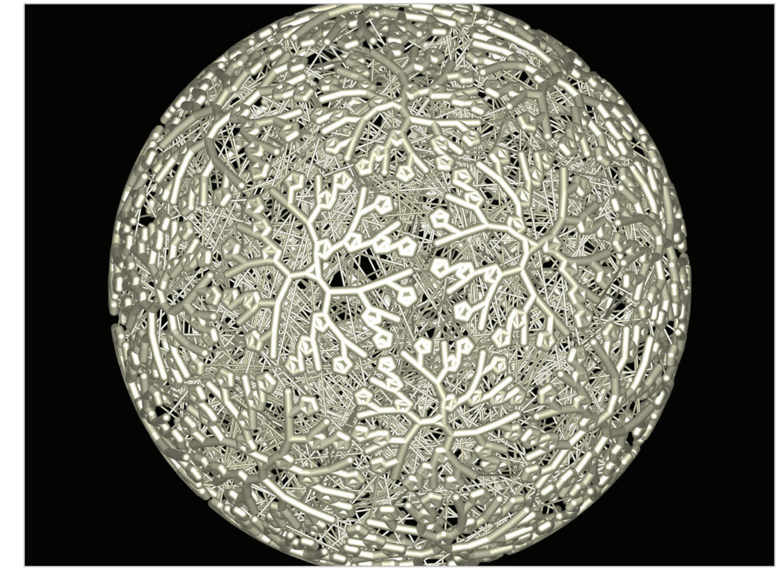
HyperMeridian Projection of S3 meridians. 24 great circles of S3, forming a regular orthogonal grid in phase space of the hypersphere, excluding the lines, are stereographically projected into E3, the Euclidian space.



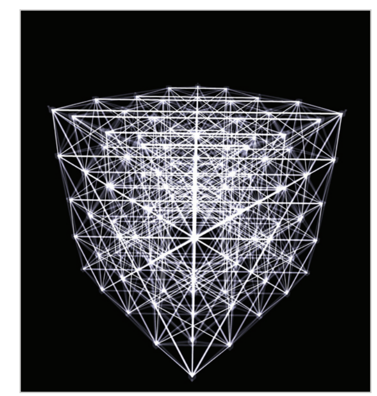
## BRAINVERSE

*Alumide, magnets. 16" x 12" x 12". 2010.*

BrainVerse is a minimal model of universe. It's a trivalent network of 32 neurons. Each neuron has a triple tree structure and holds 24 internal and 24 external bits. The externals are connected to other neurons. This NKS set-theoretically network offers E8 symmetry and encodes all particles of Lisi's model, 48 bosons and 3 family of 64 fermions.



## HYPERDIAMOND



*Transparent Acrylic, Objet technology. 8" x 8" x 8". 2010.*

HyperDiamond is a four dimensional lattice with F4 symmetry, composed of 125 cubes. Two intertwining networks, one of all even coordinates, and the other of all odds coordinates, are mixed so that each cube is linked to 24 first order neighbours and 24 second order neighbours. Neighborhoods have the symmetry of the 24-cell regular polytope, and its dual, itself rotated and scaled by square root of two. This space-time crystal build a manifold compatible with general relativity when curvature is added. Internal dimensions, inside the cubes, by replacing the 48 valence by a trivalent internal network hold naturally E8 symmetry encoding standard model with 3 fermion families and massive neutrinos + gravity. Curvature comes from internal defects in the cubes and defines fermions and bosons, and their dynamic.

## Μη μου τους κύκλους τάραττε (DO NOT DISTURB MY CIRCLES)

*Polychrome Resin, Magnets, Magnetic fields. 7" x 6" x 6". 2009.*

Μη μου τους κύκλους τάραττε, « Do not disturb my circles», was the last sentence of Archimede. This art piece is in his honor. It has the shape of the most known Archimedean solid, the truncated icosahedron, also used as a soccer ball, and also realized in nanotechnology as a C60 molecule, the buckyball, one of the smallest mathematical sculpture. But it is made only of circles, of two different sizes, 12 for the pentagonal faces, and 20 for the hexagons. The bottom circle includes a magnet. All the sculpture is in metastable electromagnetic levitation, and is slowly rotating around a vertical axis. The 32 circles are conceptual views of the 32 neurons in a minimal 4 dimensional checkerboard lattice brainverse on S3. It encompasses 24-cell symmetry, and hidden e8 algebraic structure, the code for a Theory of Everything.

# AURORA

Woodstock, New York, USA
info@FlyingRainbowLasagne.com
www.FlyingRainbowLasagne.com

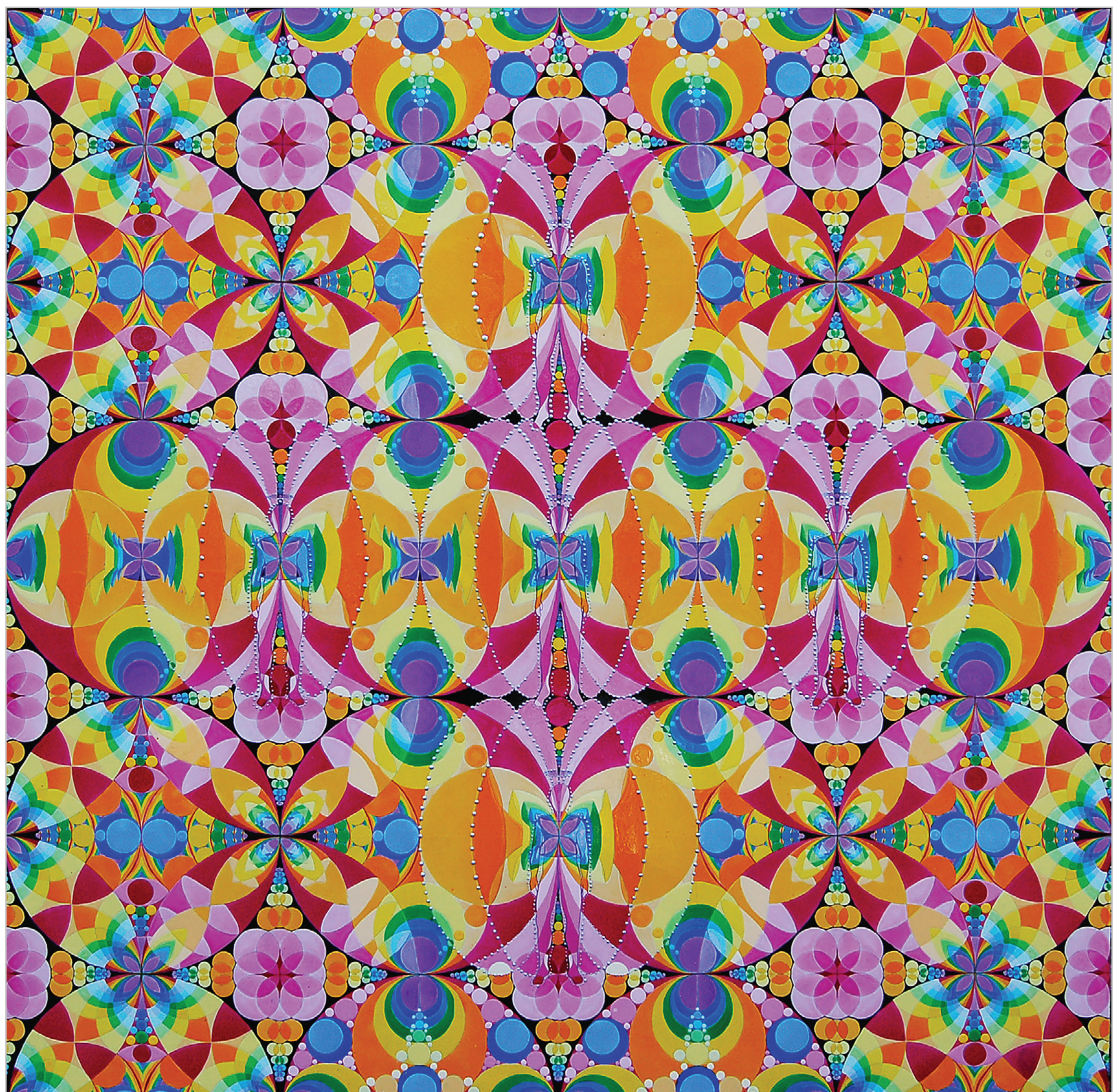
## STATEMENT

I focus on depicting the energetic building blocks of the universe, the grid upon which the molecules of the physical world are arranged. The recurring patterns and use of the colors of the rainbow are intentional and significant as they are the "grammar" of the universal language which is expressed in every aspect of nature. None of my work is computer generated, and this is important because my challenge as an artist and human being is to embody these sacred geometries and then express those forms through the movement of my physical body.

## CHILDREN OF TRUE HUMANITY

*Acrylic paint on wood. 48" x 48" (or digital print 24 x 36, or digital projection if possible). 2010.*

This painting is all about the intersection of the abstract human energy field and the anthropomorphic (two-armed, two-legged, one-headed) human form. Unlike other paintings where I use a more literal 'translation' of these ideas onto the 2D surface (and spheres appear as flat, overlapping circles) "Children..." uses tricks of perspective and subtle uses of color to create the illusion of rounded spheres and volumetric vortexes and their various intersections. In terms of math, "Children..." explores the recurring themes of color, shape, and proportion as it applies to light waves. There is an inner consistency to each painting, where a circle of a particular diameter is always associated with a particular color, and the colors are always arranged according to ROYGBIV (the rainbow). The lobe-like shapes in the painting arise from use of the Mobius Transformation, a recurring theme in all of these paintings.





## LARGE QUANTUM FROTH

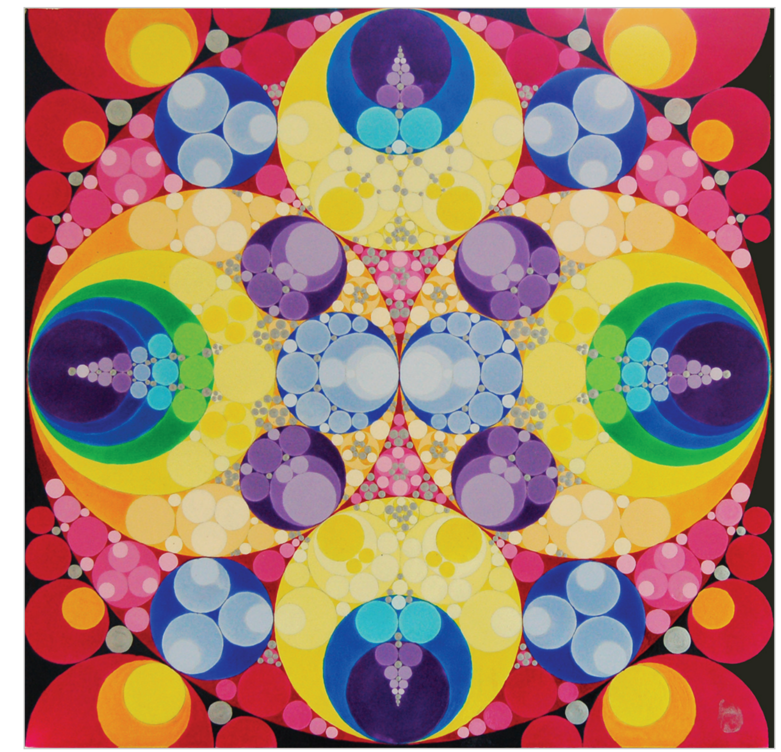
*Acrylic paint on wood. 48" x 48" original (24" x 24" print). 2009.*

"Large Quantum Froth" depicts the relationship of light wavelengths and how they interact. This piece also explores a pattern of circle packing and how it relates to a Mobius transformation-inspired impossible grid. (The grid is impossible because, although it does not look so to our eye, all of the angles are right angles.) This painting is built upon a set of rules. There are no straight lines, and all lines are circles. In some areas, no lines may cross, in others, lines may cross but circles may only overlap or nest next to one another as described by the Mobius transformation. Each circle's diameter is associated with a particular color of the rainbow, and the circles maintain the same proportional relationship to one another at every level of scale throughout the image. This pattern of bubbles within bubbles mimics the arrangement of matter down to its smallest level.

## QUANTUM FROTH

*Acrylic paint on wood. 24" x 24". 2009.*

"Quantum Froth" explores a series of internally-consistent rules. In this painting, there are no straight lines. All lines are circles, and there are no endpoints. No lines may cross. Each circle's diameter is associated with a particular color, and the diameters relate to each other proportionally. Red is always the largest circle, as red is the longest wavelength, with orange being $\frac{1}{2}$ of red, yellow $\frac{1}{3}$, down to violet $\frac{1}{7}$. These color proportions are consistent on every scale (red will always be the largest, violet always $\frac{1}{7}^{th}$ of red)



## BEATIFIC

*Acrylic paint on wood. 24" x 24". 2009.*

"Beatific" is another painting built upon a set of internally-consistent rules. In this painting, there are no straight lines. All lines are circles. Lines may cross. Circles are only allowed to overlap as an expression of the Mobius transformation. All circles must be tangential to other circles. The recurring themes of color, shape, and proportion are presented here (as in "Quantum Froth") as a literal rendering of the physical relationship of light waves to one another.

# BJARNE JESPERSEN

Naestved, Denmark
bj@lommekunst.dk
www.lommekunst.dk

## STATEMENT

I use creative geometry to bring new life to old traditions of "magic wood-carving", 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.

## GREAT TETRAKNOT

*Wood (elm). 95 x 95 x 95 mm. 2002*

A compound of four trefoil knots oriented as the faces of a tetrahedron. Its symmetry is that of the tetrahedron, but without mirror reflections.

## DOUBLE STAR

*Wood (pear). 45 x 45 x 45 mm. 1974.*

Two cubic edge frames are tied together with a half twist to each pair of edges, then reshaped to resemble Keplar's Stelle Octangula, the well known compound of two regular tetrahedra.

## MEMENTO MORI

*Wood (briar). 50 x 50 x 71 mm. 1981.*

The traditional ball in cage theme is combined with a classical motif from renaissance art and inspiration from Japanese netsuke carvings. The cage is a rhombic dodecahedral edge frame.

## PUZZLE BALL

*Wood (beach). 58 x 58 x 58 mm. 1995.*

People often mistake my magic balls for puzzles. This gave me the idea to make one that really looked like a puzzle. The six familiarly shaped pieces correspond to the surfaces of a cube, but clearly the fourfold symmetry of the cube has been broken, leaving only twofold and threefold axes. Some of the mirror planes of the cube are also missing. All cuts meet at the centre, causing the pieces to separate, yet, because of their conic shape they do not fall apart. Some people find this hard to understand.

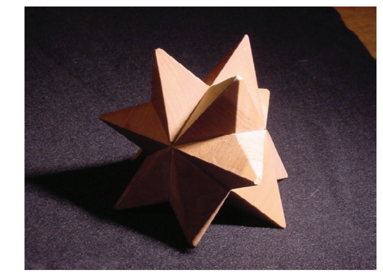


# BOB SIDENBERG

Minneapolis, Minnesota, USA
silkkmountainbob@hotmail.com
www.silkmountain.net

## STATEMENT

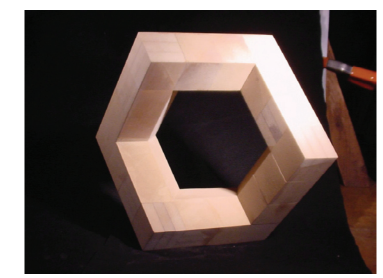
Since 1968 I have been exploring connections and intersections among 3-D geometric shapes. At the beginning I divided a cube along its diagonal into three identical shapes and started building. From that block many shapes emerged, notably the rhombic dodecahedron, the rhombic hexahedron, and many, many variations up and down the continuum. Recently, I've been examining the way cubic and hexahedral lattices intersect, fill space and expand to infinity.



## BRUCESTAR

*Poplar. 8" x 8" x 8". 1975.*

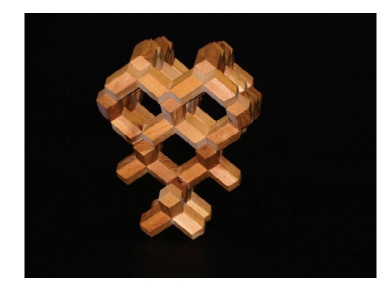
This piece begins an exploration of the intersection of hexahedral and cubic solids within a tetrahedral frame.



## HEXNUT

*Wood. 24" x 24" x 24". 1992.*

This is what happens when a bunch of rhombic hexahedra get together and decide to go for a walkabout.



## LATTICE I

*Pine. 12" x12" x12". 2002.*

This expansion of the rhombic dodecahedron will grow infinitely through space, assuming there are enough trees on the planet to keep it going.

## FULL HOUSE

*Pine, Cedar. 18"x 18" x 18". 2006.*

Two lattices converge and fill all space, leaving no room for the rest of us. Luckily, I've only cut enough pieces to fill the shop.

# BOB ROLLINGS

Toronto, Ontario, Canada
bobsturn@bell.net

## STATEMENT

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's 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 polyhedra.

## FUN WITH POLYHEDRA

*(top) Wood. Originally 4" to 9" spheres. 2010*

All of these polyhedra were originally spheres and lathe turned using hand held turning tools. They were held in a cup chuck and each face in turn was faceted then hollowed out to a precise depth leaving the centre spike in place. When all faces have been addressed in this manner, the centre core which replicates the outer surface, is released and has independent movement. The five platonic solids and icosidodecahedron shown here are: • Tetrahedron: made of Becote from a 4" diameter sphere • Hexahedron: made of Babinga from a 4" diameter sphere • Octahedron: made of Cocabola from a 4" diameter sphere • Dodecahedron: made of Cocabola from a 4" diameter sphere • Icosahedron: made from a Thura burl from a 5" diameter sphere • Icosidodecahedron: made of Maple from a 9" diameter sphere

## AN EASTER ISLAND CONFERENCE

*(bottom) Wood. Originally 4" to 5" spheres. 2010.*

These are second generation streptohedrons and express a hollowed out version of their predecessors. I am choosing to give them the generic name of incurve streptohedrons. They have been hand tuned in two pairs of two as curved funnel shapes then split apart and reassembled in their current form. From left to right they are: • White maple with black textured engraving – 3 ¾" diameter • Brazilian rosewood – 3 ¾" diameter • Satinwood – 5" diameter



# MOHAMMAD YAVARI RAD

Johns Hopkins University
Baltimore, Maryland, USA
yavarirad@yahoo.com

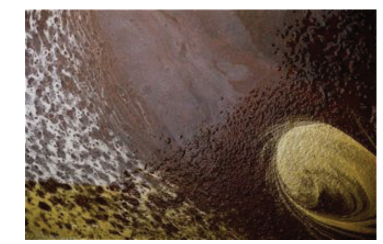
## STATEMENT

I am a physician and my specialty is Physical Medicine and Rehabilitation. I have been taking photographs for over 20 years. I am interested in patterns, movements and light in our environment and try to capture the harmony and/or contrast of those elements.

## ATTRACTORS 1

*Photography. 12"x 12". 2000.*

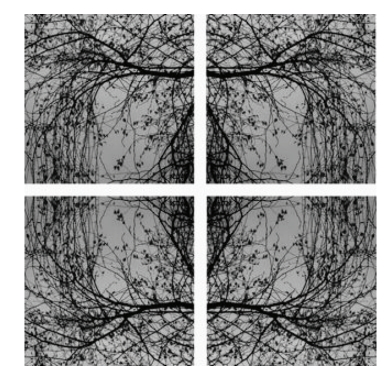
This pattern, created by by pollens and slow movement of water through and around some objects, shows some strange attractors.



## ATTRACTORS 2

*Photography. 12"x 12". 2000.*

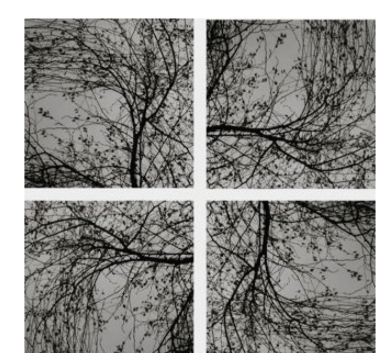
This pattern, created by pollens and slow movement of water, shows an attractor.



## EXPRESSION 1, COMING TOGETHER

*Photography. 12"x 12". 2005.*

This mosaic picture, using mirror images (reflexion) of tree branches, expresses the sense of closeness and inclusiveness.



## EXPRESSION 2, SPREADING

*Photography. 12"x 12". 2005.*

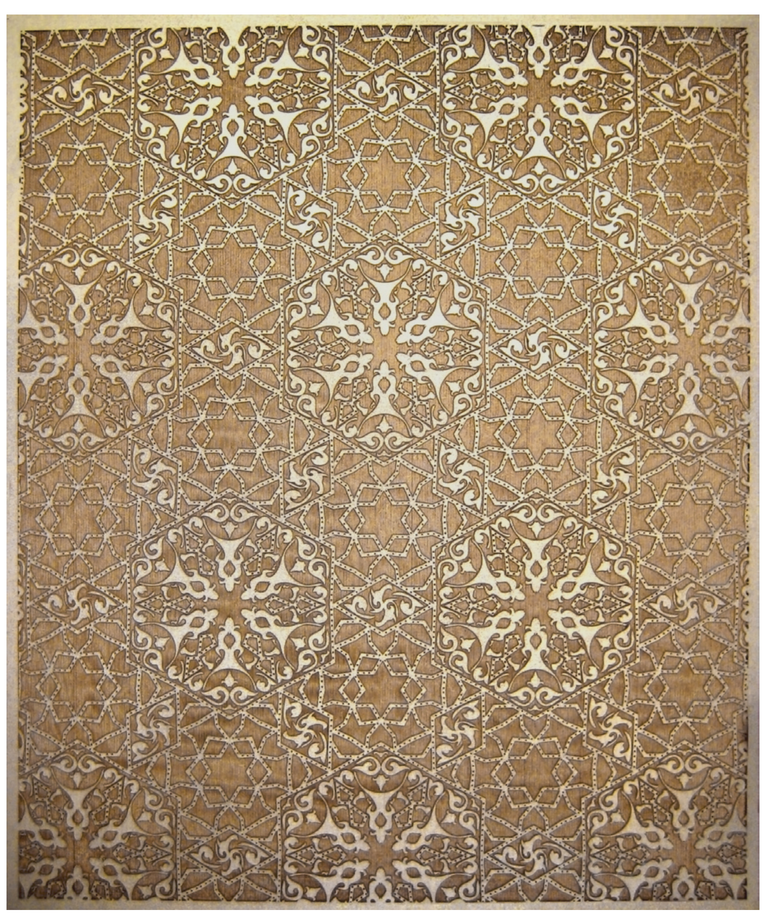
This mosaic picture, using rotated pictures of the same tree branches arranged in a different way, expresses the sense of spreading.

# BRIONY THOMAS

School of Design, University of Leeds
UK
b.g.thomas@leeds.ac.uk

## STATEMENT

As a designer, with a background in textiles, I am fascinated by the fundamental concept of symmetry and its application in the creation of patterns. This recent work explores the possibilities of patterns repeating in three-dimensions, around the faces of mathematical solids.



## REIDUN #1

*(top) Painted and etched wood composite. 170 x 160 x 155 mm. 2010.*

Inspired by a novel approach to the description of viral capsid assembly proposed by Twarock, the faces of this rhombic triacontahedron are tessellated with kites, darts and rhombs. The Islamic-inspired design used on the two types of face tiles was also inspired by biological imagery adapted by Twarock, which is reminiscent of Islamic interlace patterns.

## REIDUN #2

*(bottom) Painted and etched hardboard. 367 x 300 mm. 2010.*

This piece was created through manipulation of the virology-inspired tiling used in Reidun #1. The tiling has been manipulated in the plane to form a p6m repeating design.



# ART SCOTT

Semasiographic
Menlo Park, California, USA, Verdant Planet Earth
art@semasiographic.com

## STATEMENT

Trying to express: Peace Love and Happiness, PLH; Only One Earth, OOE (consider the alternatives)

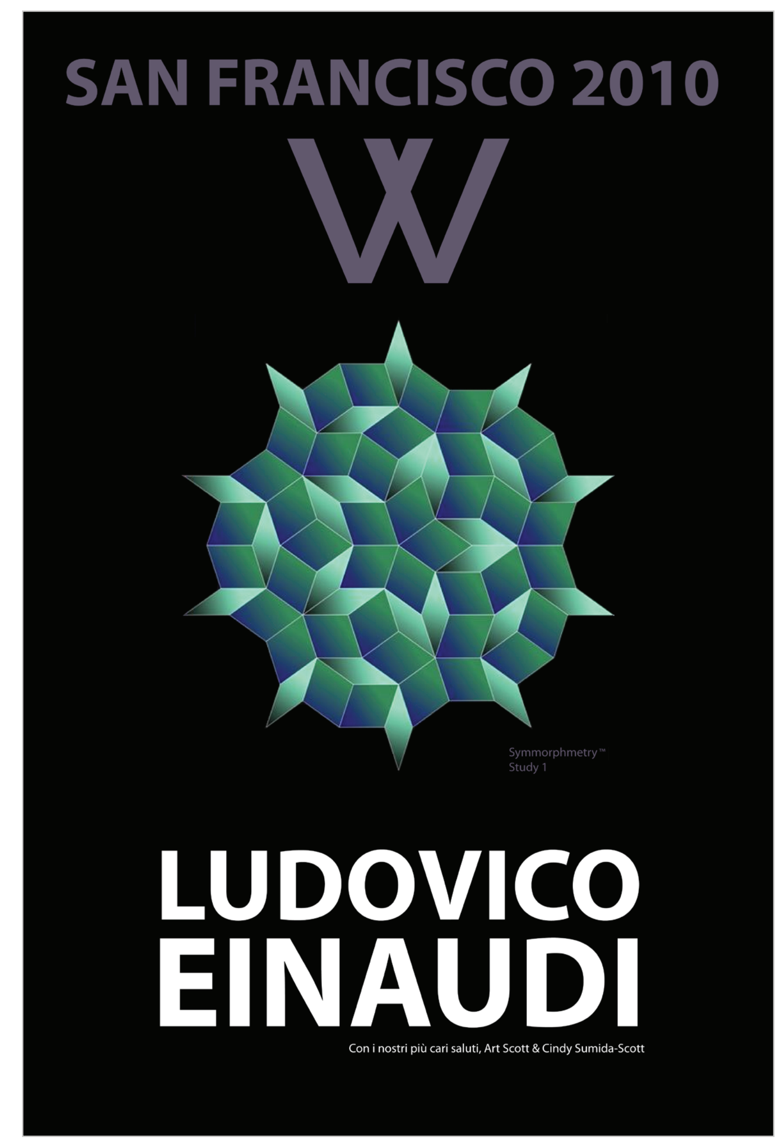
Aesthetic: Indigenous "New World" abstract art; Symmetry; Motion

Techniques: Symmorphmetry Study 1—Microsoft F# (hybrid functional language), .NET WPF
Poster—Adobe Illustrator, Photoshop
Exploring and pushing the creative envelope of eXtreme manycore architectures

## UDOVICO EINAUDI—CON I NOSTRI PIU CARI SALUTI, WITH SYMMORPHMETRY STUDY 1 GRAPHIC

*Archival Inkjet Print. 18 x 12. 2010.*

Ludivico Einaudi Concert Poster with Symmorphmetry Study 1 Penrose Rhomb Image



# KRYSTYNA BURCZYK

Zabierzow, Poland
burczyk@mail.zetosa.com.pl
www.origami.edu.pl

## STATEMENT

I graduated from Jagiellonian University in Krakow, Poland in 1983 in pure mathematics. I am a math teacher with more than 20 years experience.

I started my interest in origami in 1995. My mathematical background pushed me towards geometric models. A mathematical structure of origami model and folding process as well as relation of origami to mathematics have been in the center of my interest from that time. I am also interested in educational applications of origami and I promote origami as a powerful tool for maths' teaching. I had lectures and workshop on this topic at KOTE (Conference on Origami in Therapy and Education), Poland and Didaktik des Papierfalten in Freiburg, Germany.

I am an author of five origami books and several booklets.

I participated in the large international origami exhibition "Masters of Origami" in Salzburg 2005 and Hamburg 2007. My works were also placed by Nick Robinson in his book The Encyclopedia of Origami and by Origami USA in its calendar.

## JUST SQUARES

*(below) Origami, 210 pieces of square paper. 21 cm x 21 cm x 21 cm. 2009.*

Mathematically this model is a snub dodecahedron, one of Archimedean solids. The model resulted from looking for the simplest model (measured by number of crease lines). It is a minimal model as it contains no crease line.



## RED IN WHITE

*Origami, paper, 24 red squares and 24 white rectangles, no glue. 15 cm x 15 cm x 15 cm. 2010.*

This model is based on a rhombic cubooctahedron. One of the recent results of a study on minimal (by number of creases) origami models.

## RECTANGLES & SQUARES

*Origami, paper, 150 red squares and 60 white rectangles. 20 cm x 20 cm x 20 cm. 2009.*

This model is based on the snub dodecahedron structure. It is one of the results of a study on how different shapes of paper influence final models.

## METAMORPHOSIS: BUTTERFLIES

*Origami, paper, 30 squares for each object, no glue. 15 cm x 35 cm x 35 cm. 2009.*

These models are based on the icosahedron structure. This set is one of the results of a study of how small changes of a single crease position influence the shapes of the final models.

# MIKE FIELD

University of Houston
Houston, Texas, USA
mikefield@gmail.com
www.math.uh.edu/~mike

## STATEMENT

In my efforts in computer art, graphics and design, I work with chaotic-non-deterministic-dynamical systems and often make use of symmetry.

Although the time evolution of these systems seems random and haphazard, long-term time averages often reveal complex and intricate symmetric structure that can lead to a harmonious and beautiful design.

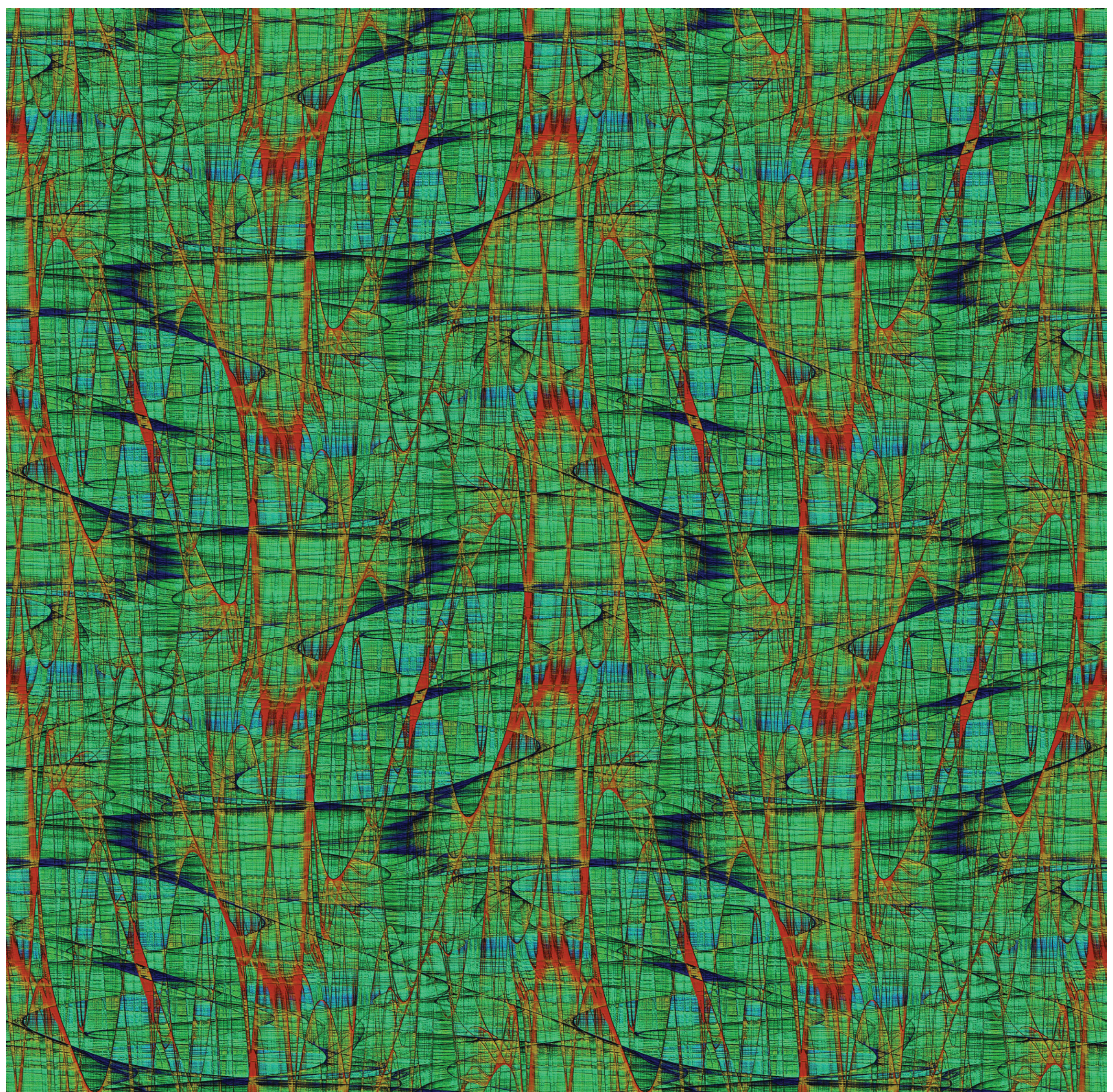
In this way, the images I create are simple instances of the statistical regularity through which we experience the workings of the universe.

I am particularly interested in using mathematical ideas to create desired artistic effects. Two of the submitted images use some new algorithms I have been working on recently for colouring complex fractal images.

## ITERATIONS 2006

*(below) Digital print on canvas. 18" x 18". 2006.*

A two-colour quilt of type p4g/pgg. Created used a deterministic torus map and lifting the resulting symmetric pattern on the torus to a repeating pattern on the plane. Printed on canvas. Shown as part of John Sims recent Rhythm and Structure exhibition at the Bowery Poetry Club, NY.



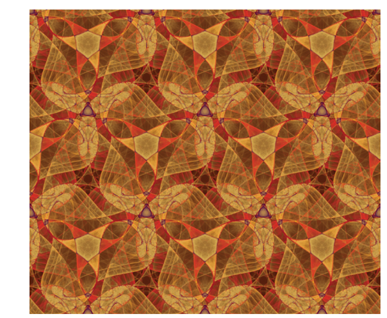


## BUTISITART

*Digital print on canvas. 22" x 22". 2007.*

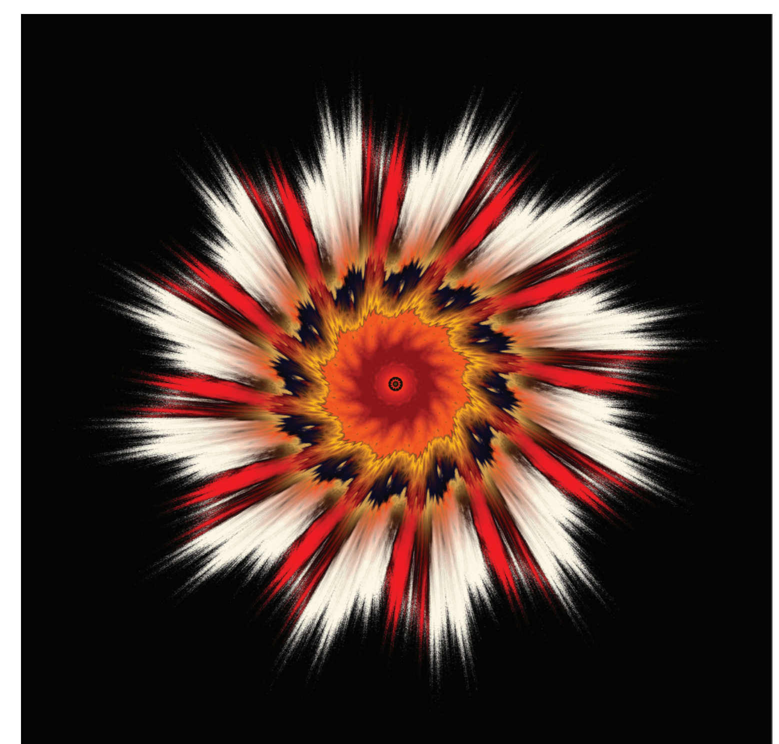
This is a complex fractal image which is a composite of the Sierpinski triangle and another symmetric fractal with 11-fold symmetry. The construction of this image required the development of new software and coloring algorithms—an ongoing project to create new classes of visually interesting objects.

## CLOWNINGAROUND



*Digital print on canvas. 26" x 24". 2010.*

A repeating two-color pattern of type p3m1/p3 created using a deterministic torus map and lifted to the plane as a repeating pattern. Much of the effect of this images gets lost in low res/small image file.



## EXPLODINGFRACTAL

*Digital print on canvas. 24" x 24". 2010.*

A complex fractal object with an underlying 12-fold symmetry. The image was colored using algorithms related to type of coloring I use for 2-color quilt patterns. Note: Pretty well most of the detail and interest in this picture gets lost in a low resolution image...

# DOUG DUNHAM

University of Minnesota Duluth
Duluth, Minnesota, USA
ddunham@d.umn.edu
www.d.umn.edu/~ddunham

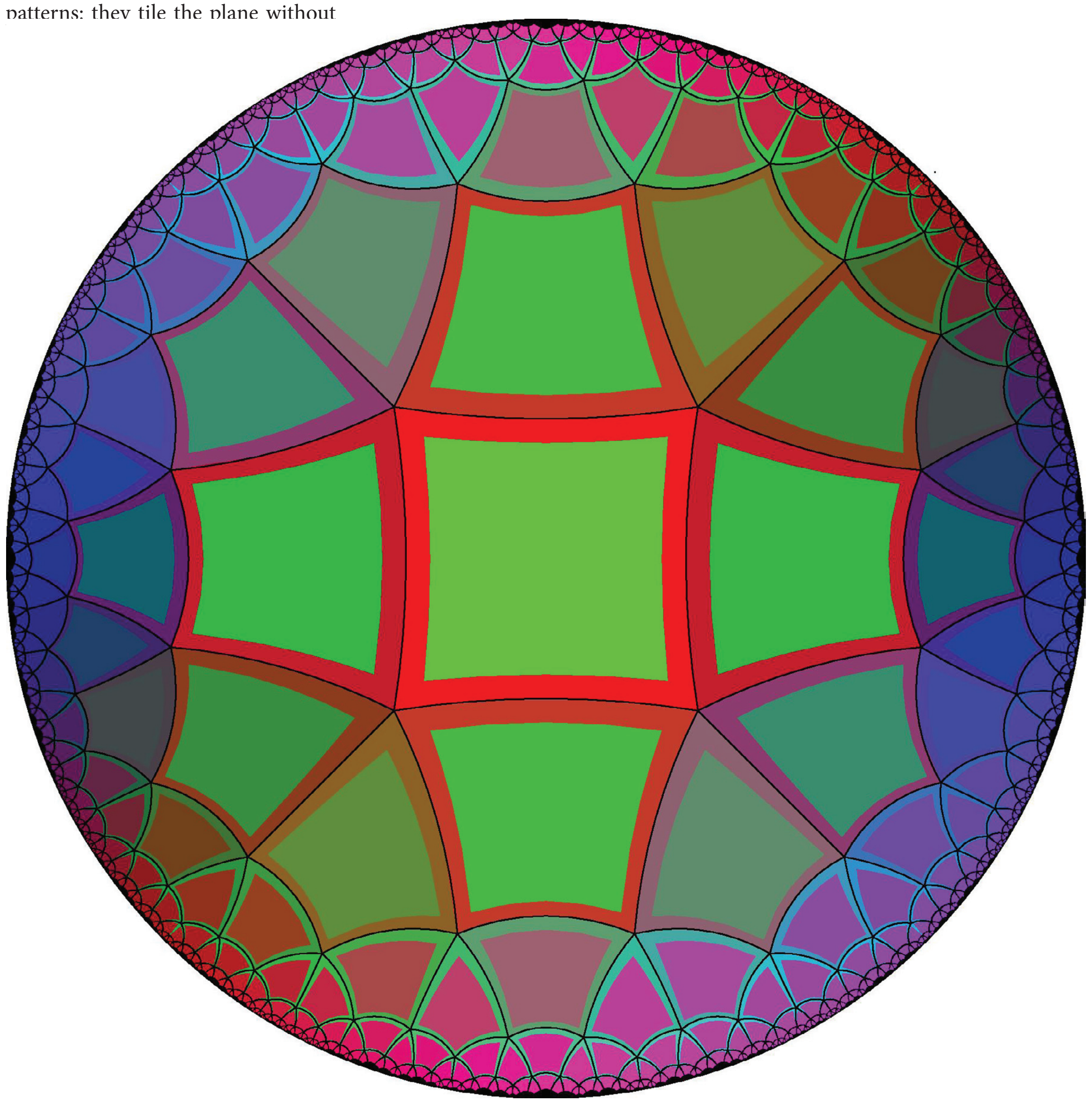
## STATEMENT

The goal of my art is to create aesthetically pleasing repeating patterns in the hyperbolic plane. These patterns are drawn in the Poincare circle model of hyperbolic geometry, which has two useful properties: (1) it shows the entire hyperbolic plane in a finite area, and (2) it is conformal, i.e. angles have their Euclidean measure, so that copies of a motif retain their same approximate shape as they get smaller toward the bounding circle. Most of the patterns I create exhibit characteristics of Escher's patterns: they tile the plane without gaps or overlaps, they are colored symmetrically, and they adhere to the map-coloring principle that no adjacent copies of the motif are the same color. These patterns are designed using an interactive drawing program and then rendered by a color printer. The two major challenges in creating these patterns are (1) to design appealing motifs and (2) to write programs that facilitate such design and replicate the complete pattern.

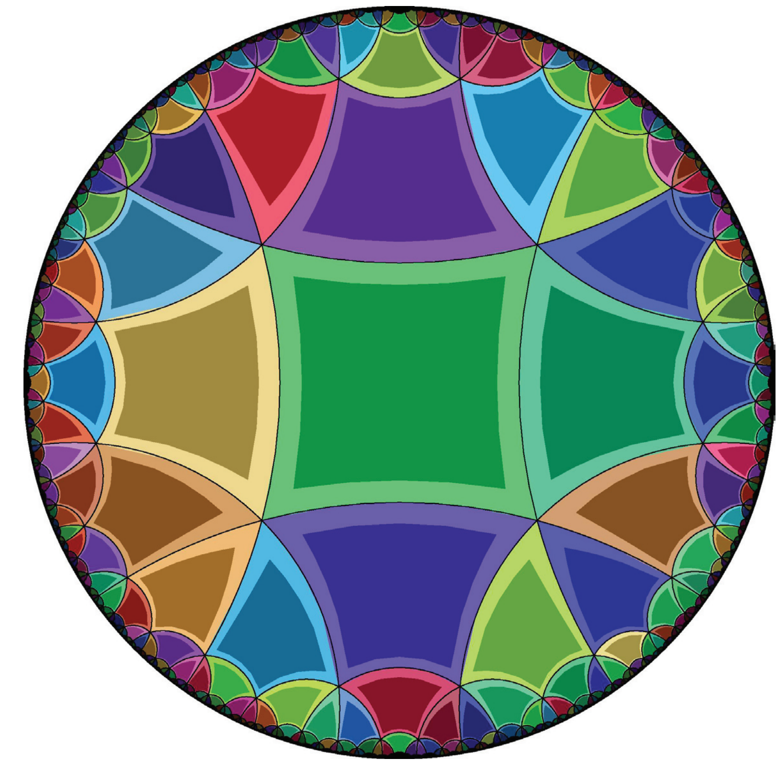
## SMOOTHLY COLORED SQUARES 45

*Color printer. 11 by 11 inches. 2010.*

This is a hyperbolic pattern of bordered squares, in the style of Victor Vasarely's square grid patterns. It is based on the regular tessellation {4,5} of the hyperbolic plane, with five squares meeting at each vertex. Vasarely's square grid patterns were based on the familiar {4,4} tiling of the Euclidean plane.





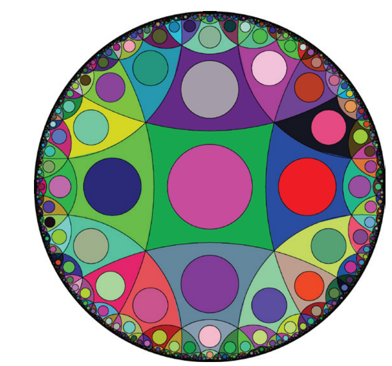


## RANDOMLY COLORED SQUARES 46

*Color printer. 11 by 11 inches. 2010.*

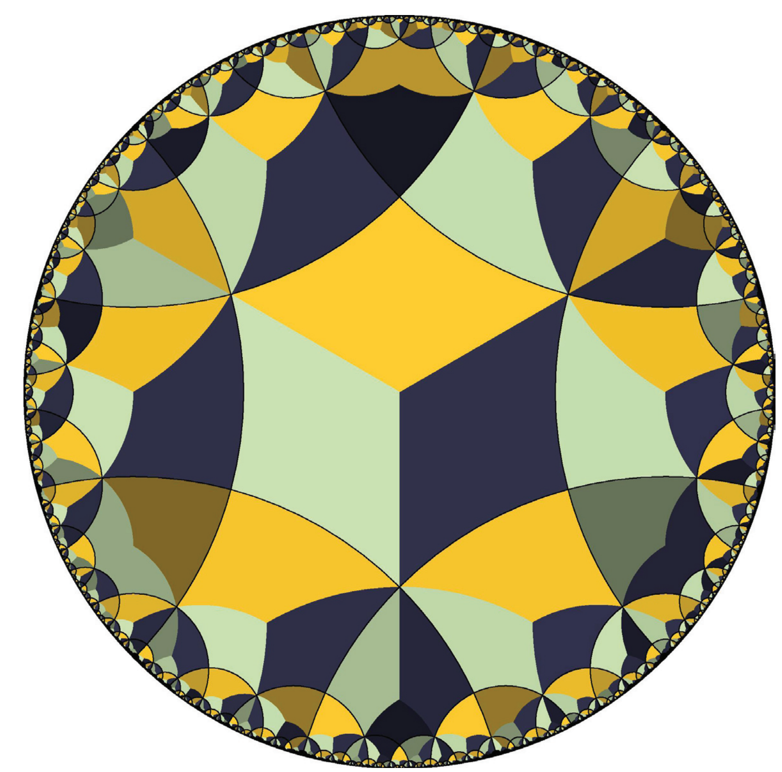
This is a hyperbolic pattern of randomly colored bordered squares, in the style of some of Victor Vasarely's randomly colored square patterns. It is based on the regular tessellation {4,6} of the hyperbolic plane, with six squares meeting at each vertex. Some of Vasarely's related patterns were based on the distorted {4,4} Euclidean grids.

## RANDOMLY COLORED CIRCLES 46



*Color printer. 11 by 11 inches. 2010.*

This is a hyperbolic pattern of randomly colored circles within randomly colored squares, in the style of Victor Vasarely's similar patterns in the Euclidean plane. It is based on the regular tessellation {4,6} of the hyperbolic plane, with six squares meeting at each vertex. Vasarely's related patterns were based on the familiar {4,4} tiling of the Euclidean plane.



## HEXAGONS WITH THREE COLORS

*Color printer. 11 by 11 inches. 2010.*

This is a hyperbolic pattern of hexagons filled with three quadrilaterals of different colors, in the style of one of Victor Vasarely's hexagonal patterns. It is based on the regular tessellation {6,4} of the hyperbolic plane, with four hexagons meeting at each vertex. The quadrilaterals are shaded according to which one of three "light sources" they most directly face.

# ELAINE KRAJENKE ELLISON

West Lafayette High School, Purdue University
West Lafayette, Indiana, USA
eellisonelaine@yahoo.com
www.mathematicalquilts.com

## STATEMENT

The appreciation and demystification of mathematics is a common thread that runs through my mathematical art. Drawing, bronze, painting, glass, and photography were mediums I had investigated prior to 1980. In the early 1980's, I settled on fabric to tell my mathematical stories. Mathematical quilt topics range from 2000 B.C. to the mathematics of the present time. I have quilted over 45 mathematical quilts! Most of the quilts are small, as I travel with them. Many ideas for quilting were discovered at Bridges Conferences. Thank you Bridges!


## MATHEMATICAL HARMONY

*Fabric quilt, dye, paint. 30.5 " X 45.5". 2008.*

Inspired by Dmitri Tymoczko's work on mathematics and music, this work of art was generated to bring the relationships of music and mathematics to the forefront. Music, like mathematics, has an abstract notation that is used to represent abstract structures. Pythagoras 570 B.C.E.-490 B.C.E. is said to have discovered the harmonic progressions in the notes of the music scale. An example of this discovery was made with a string that was stretched and then half the string length was stretched. Both strings were plucked. The shorter string sounded exactly one octave lower than the longest string. The Pythagoreans investigated other string relationships, always finding who number relationships between the notes. This reinforced their thought that "number is everything."




*Fabric quilt, thread painting. 36" x 36". 2009.*

## TILED TORUS

Tiled Torus was inspired by the work of John Sharp, Craig S. Kaplan, M. C. Escher, and Huff. Each of these individuals are interested in tiles that morph from one tile to another. I found I became intrigued with parquet deformations and began to work on designs that could be quilted. What began as a quilt to be pieced, quickly turned into a quilt that was to be appliqued. In order to get the polygons to look sharp, the applique technique had to be used. Quite by accident, this tiling turned out to be a torus that could be cut and laid flat. The left and the right sides of the pattern complete to comprise a cylinder, as do the top and the bottom of the design.

# DÁNIEL ERDÉLY

Spidron Bt., Option Ltd
Budapest, Hungary
edan@spidron.hu
www.spidron.hu

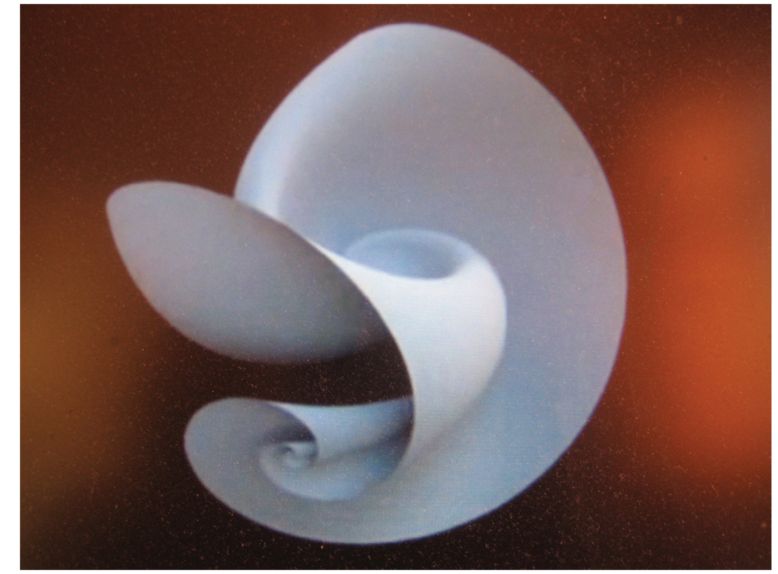
## STATEMENT

My task is to research and develop a geometrical basis of thinking, establish human communities, link art and science.

## SPHIDRON DEFORMATION OF A DISC 1

*Pastel on paper. 240 x 320 mm. 2010.*

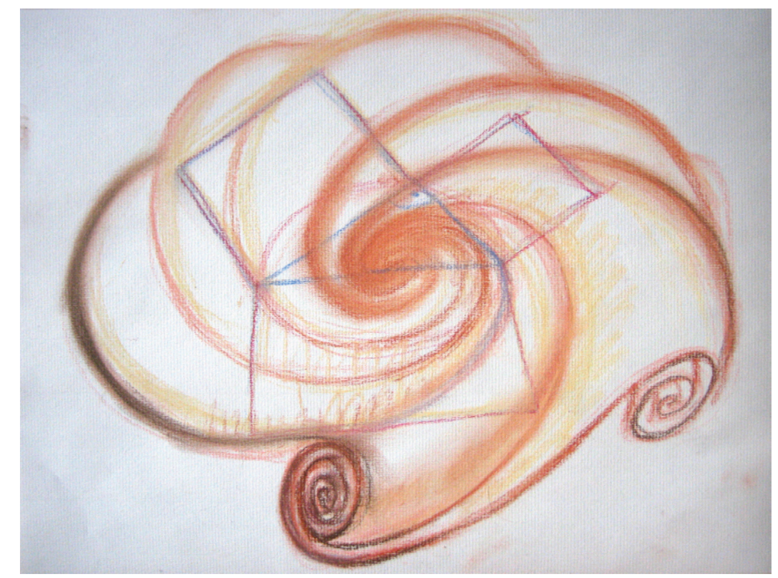
I have found the only possible 3D deformation of the Euclidean plane which—regarding of the 9 vertices of the basic shapes of the Pythagorean Theorem, like the triangle and the squares—is preserving the validity of the theorem. The triangle in the 2D plane is rotating and shrinking, but its proportions and angles don't change. I tried to make some drawings to demonstrate this interesting swirling deformation.



## HEXNUT

*Computer graphic. 240 x 320 mm. 2010.*

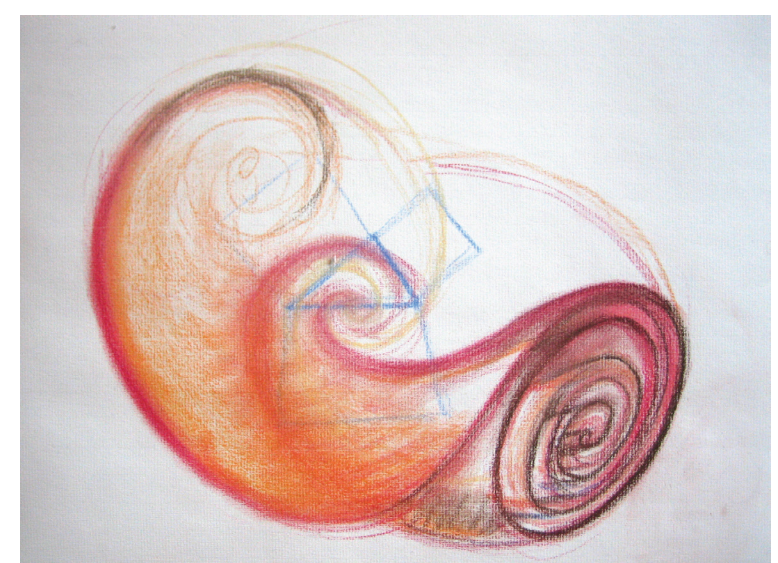
This work of art is a joint effort of Mr. János Erdős and me. János made excellent animations of the deforming sphidron discs. You can read more about our investigations here: www.spacecollective.org/edanet



## LATTICE I

*Pastel on paper. 240 x 320 mm. 2010.*

The arms of the Sphidron disc are rotating around themselves. The longer distance from the center increases the measure of the rotation. Here the change of the rotation is continuous while in the case of Spidrons it is discrete. All of he spiral arms remain on their own plane, but these planes on which they lie on can be lifted up and pushed down alternately. This way you can make more and more dense surfaces.



## FULL HOUSE

*Pastel on paper. 240 x 320 mm. 2010.*

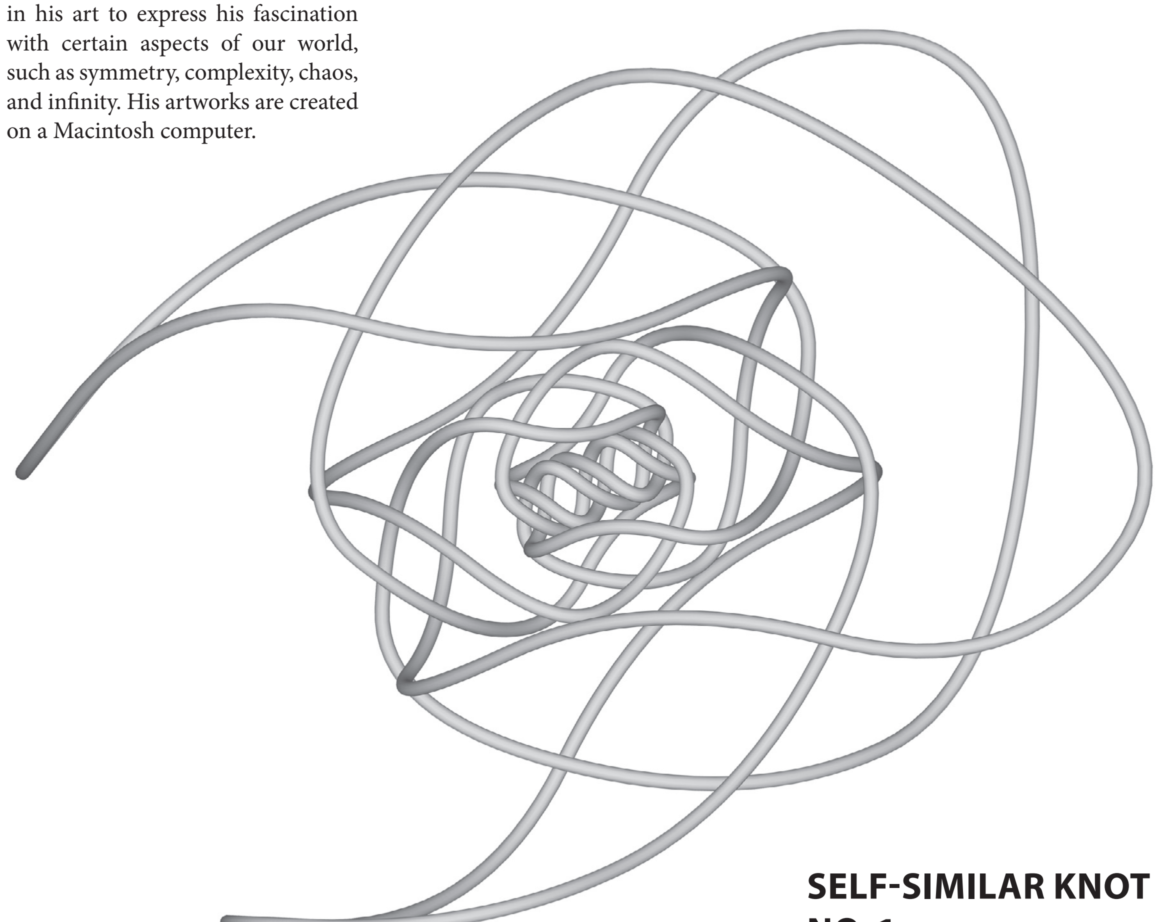
To make this deformation possible, you have to change your previous imaginations on the plane. It is a little more complicated, as the elements of the plane are not points with 0 dimension, but they do have dimensions, what make possible their rotation and sliding. I call them "spoint". While two of the adjacent "spoints" remain neighbours, the rest of them can be changed. Just like in the case of a simple pearl-string where every bounce has only and maximum two permanent neighbors.

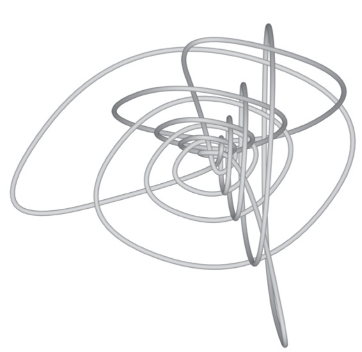
# ROBERT FATHAUER

Tessellations Company
Phoenix, Arizona, USA
tessellations@cox.net
www.tessellations.com

## STATEMENT

Robert Fathauer makes limited-edition prints inspired by tiling, fractals, and knots. He employs mathematics in his art to express his fascination with certain aspects of our world, such as symmetry, complexity, chaos, and infinity. His artworks are created on a Macintosh computer.





## SELF-SIMILAR KNOT NO. 2

*(left) Digital print. 13" x 13". 2009.*

This starting knot had nine crossings and was configured as a trefoil knot nested inside another trefoil knot. Six iterations were carried out in order to achieve the knot shown here.

## SELF-SIMILAR KNOT NO. 1

*(above) Digital print. 13" x 16". 2009.*

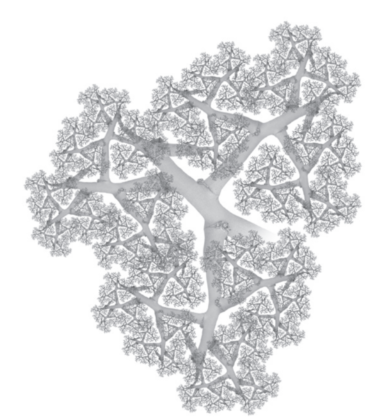
A starting knot was created that possessed sufficient geometric regularity to allow iterative replacement of a portion of the knot with a scaled down copy of the knot. Three such iterations were carried out to obtain the knot shown here. The path of the strand, specified as a series of Cartesian coordinates, was smoothed out so that strand in the final knot curves gracefully, as opposed to being a series of straight line segments that change angle abruptly. The knot was constructed using the program KnotPlot and then exported to Photoshop for touching up.



## SLOT CANYON ABSTRACTION NO. 2

*Digital print. 12" x 16". 2009.*

This image was created by reflecting and overlapping four copies of a photograph of Lower Antelope Canyon, a sandstone slot canyon near Page, Arizona. Working in Photoshop, the levels of each color channel were adjusted separately in different regions of the image to heighten the value and color contrasts.



## FRACTAL TREE NO. 10

*Digital print. 13" x 15". 2010.*

This fractal tree was constructed by graphically iterating an arrangement of a composite photograph of a small region of a tree. Multiple photographs of the region were required in order to obtain good focus throughout. The original photographs were digitally altered to achieve the desired shape and to allow smooth joining of the different photographs. The resulting composite photograph served as the starting point for the fractal tree. With each iteration, three copies of the current tree were scaled down, rotated by varying degrees, and joined seamlessly to the starting composite photograph. Lightening of the earlier generations was carried out to provide a sense of depth. A sufficiently large number of iterations was performed so that the image is virtually indistinguishable from the image that would result after an infinite number of iterations.

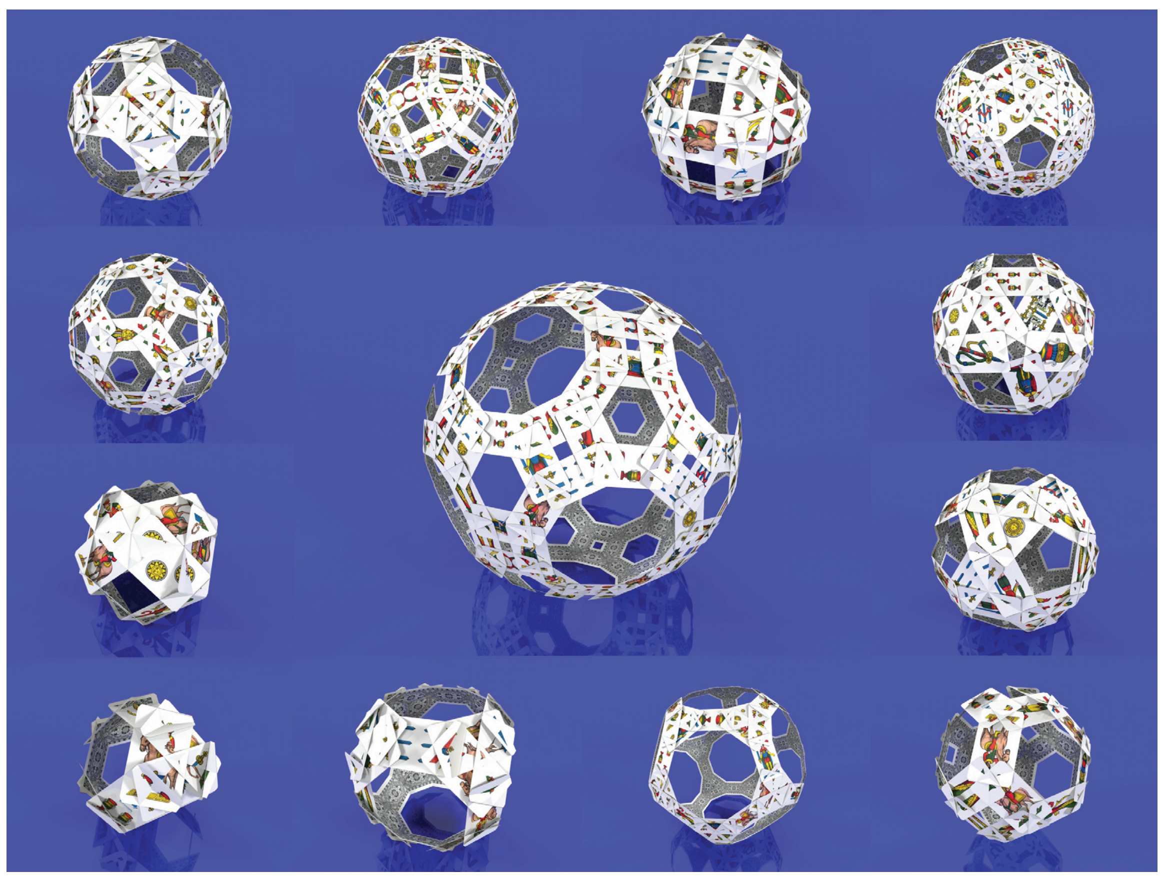
# FRANCESCO DE COMITÉ

University of Sciences and Technology of Lille (France)
Mouscron, Belgium
francesco.de-comite@univ-lille1.fr
www.flickr.com/photos/fdecomite

## STATEMENT

I am interested in visual representation of mathematical concepts, especially those implying some (a lot of) algorithmic and programming efforts. I have no 3D intuition, hence to understand geometric concepts, I need to get a representation of them, either using rendering (PovRay), or by building models, mainly with paper: my copy of Wenninger's Polyhedron models is full of needle holes and notes...

George Hart is a great source of inspiration, and trying to redo his works is a great motivation.

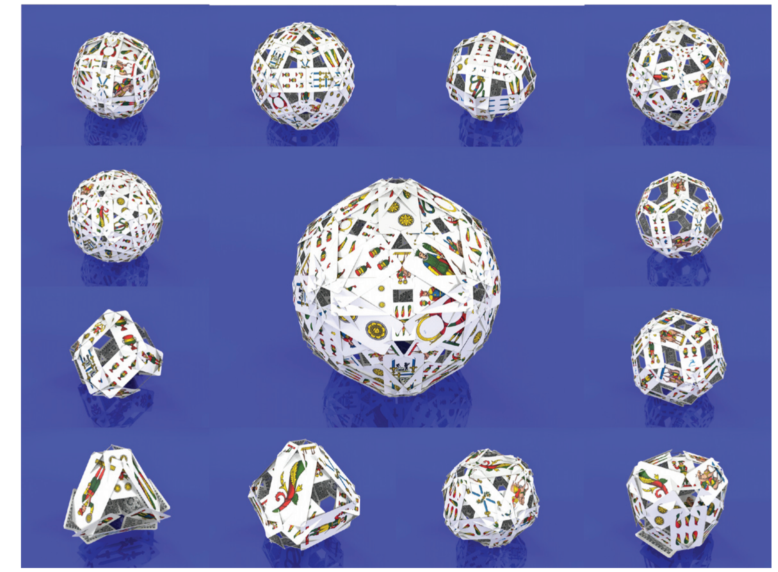


## FOLLOWING THE EDGES OF ARCHIMEDEAN SOLIDS

*Digital photo on paper. 24" x 36". 2009.*

Virtual slide-together objects, using napolitan playing cards. Each card is following an edge of the polyhedron. Each slide-together corresponds to one of the 13 Archimedean solids. Using the information gathered during the process, one could be able to determine the place and length of the cuts leading to real world models...

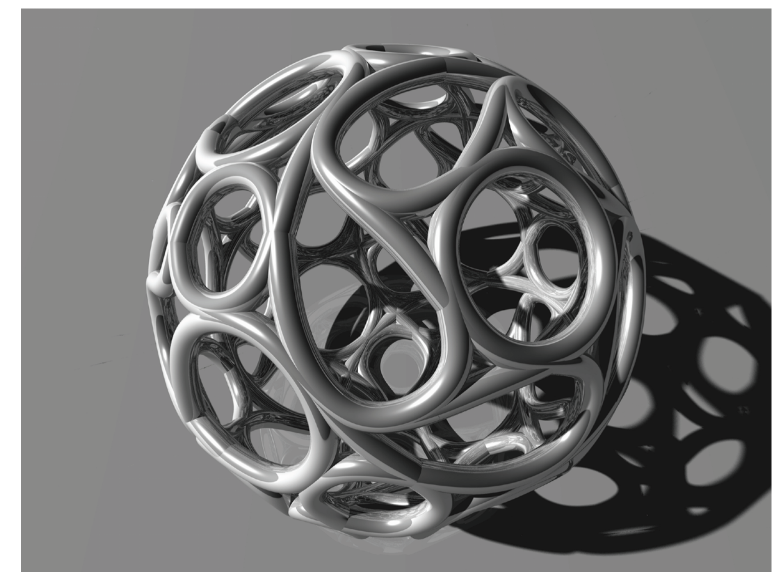




## FOLLOWING THE EDGES OF CATALAN SOLIDS

*Digital photo on paper. 24" x 36". 2009.*

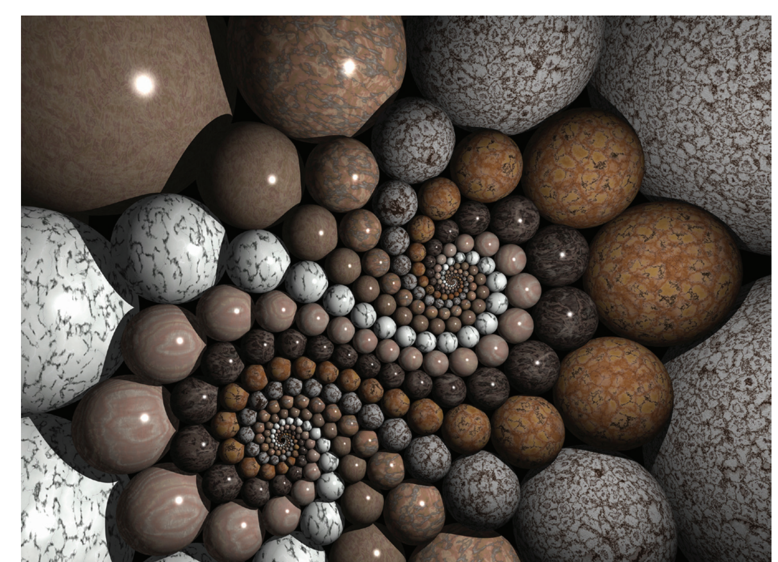
Virtual slide-together objects, using napolitan playing cards. Each card is following an edge of the polyhedron. Each slide-together corresponds to one of the 13 Catalan solids. Using the information gathered during the process, one could be able to determine the place and length of the cuts leading to real world models...



## A COMPOUND OF FIVE HAMILTONIAN CIRCUITS ON A RHOMBICOSIDO-DECAHEDRON

*Digital photo on paper. 24" x 36". 2009.*

A compound of five Hamiltonian circuits on a rhombicosidodecahedron.



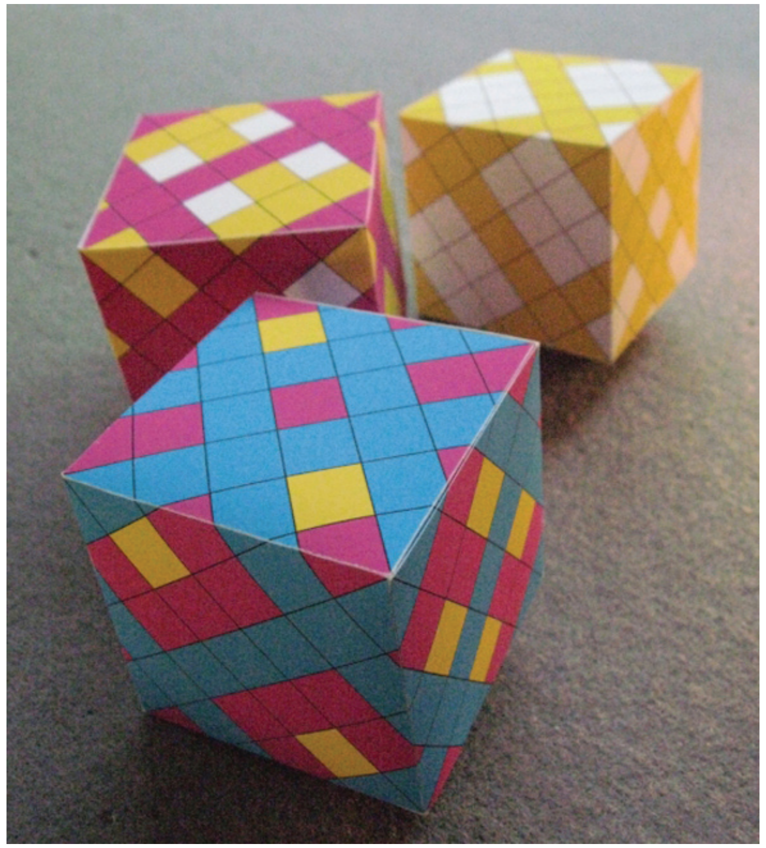
## STONES SPIRALS

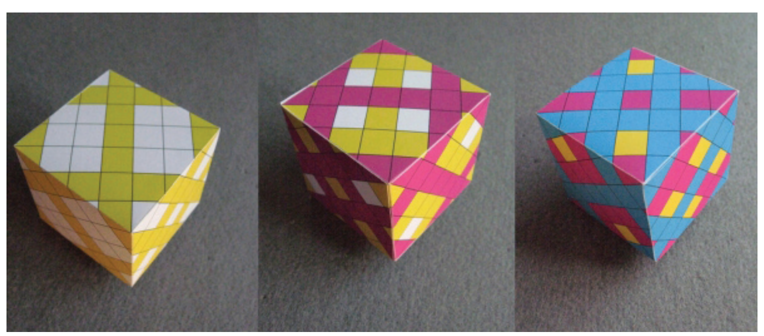
*Digital photo on paper. 24" x 36". 2008.*

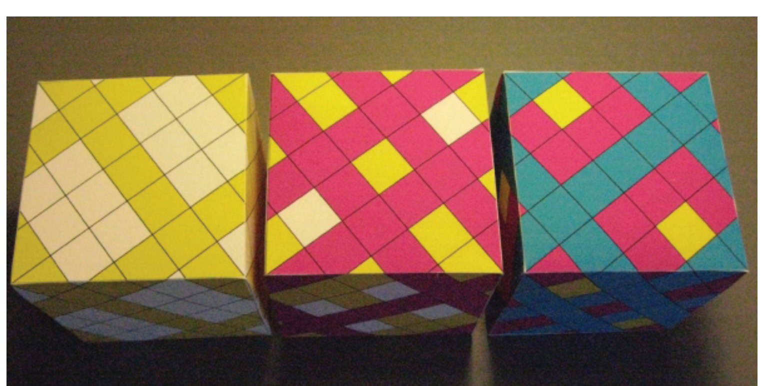
A Doyle's spiral followed by a circle inversion. Rendered with PovRay.

# FELICITY WOOD

Basketmakers' Association, UK
Oxford, UK
felicity.wood@tesco.net
www.felicitywood.co.uk







## STATEMENT

I started by exploring cubes made from paper strips woven on the skew. However, weaving a cube is quite time consuming and as I became increasingly intrigued by the symmetry and other characteristics of these cubes, I decided to take a short cut by making cubes from nets printed onto card. What would have been the weaving elements are shown as continuous bands, as if wrapped around the cube at that particular angle of skew. Seen as a group, I think these cubes are visually pleasing and invite further exploration by turning in the hand.

## CUBES WRAPPED ON THE SKEW [WITH ONE, TWO AND THREE BANDS]

*Inkjet printed paper, cut, folded and glued. Three cubes, each 50mm x 50mm x 50mm. 2010.*

My paper for Bridges 2007 http://www.felicitywood.co.uk outlined the way in which cubes woven on the skew fall into several groups, each with its own characteristics. The three cubes constructed for 2010 are made from printed nets – as if they are wrapped by coloured bands. Each band is a continuous loop of the same length. In the case of a cube wrapped with bands at a slope of 3 in 4 (3,4 cube), three bands are required to cover the cube. The cubes have rotational symmetry. With any face on top, if they are rotated 180 degrees, the pattern is the same. Other cubes falling into this same category are the 2,3 cube, the 1,4 and the 2,5. Photographs of further examples, a copy of the original paper, and a summary of results may be seen in an accompanying file.



# OLIVIER PERRIQUET & LOU GALOPA

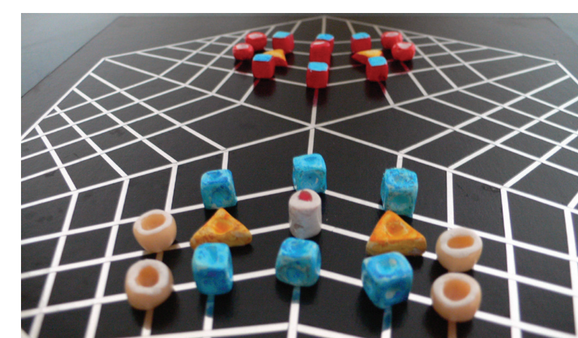
CENTRIA and GRLMC, None
Spain, Portugal
olivier@perriquet.net
cesium-133.net

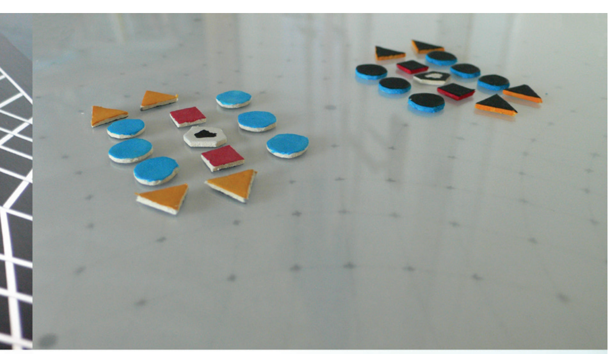
## STATEMENT

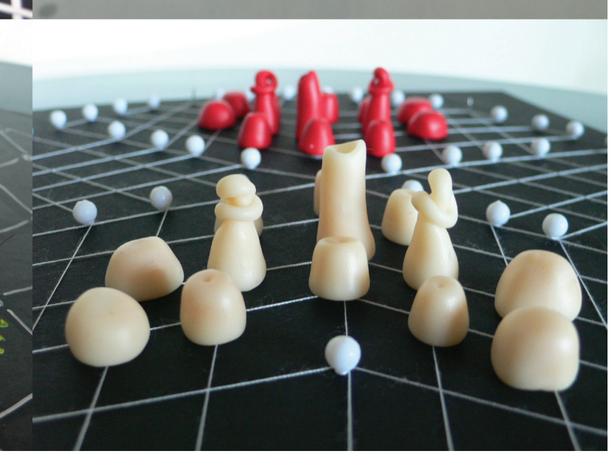
//// After an initial training in pure mathematics, computational biology and visual art, Olivier Perriquet is currently both a scientific researcher in bio-informatics and computational linguistics, and also exhibits and lectures as a media artist. His artistic work is inspired by the scientific approach and spans different fields an techniques such as expanded cinema, video or interactive installation/performances, addressing questions related to game/play, language or complexity. //// Lou Galopa's artistic work has a connection with Fluxus: the humor, the utopias and the endless link between art and life. Visual relations, interconnections, double images and word plays have an important role in her works. They often have a humoristic, ironic or sarcastic character but can also reveal even tragic notions. Lou Galopa lives in Strasbourg and Paris. She studied at Ecole supérieure des arts décoratifs de Strasbourg and is a member of the artist group Interim. ////

## ALPHA

The artistic purpose of our work dwells not in the object itself but in the relations that it creates within the public and in the resulting experience: the public « enact » the artwork by their active participation. In combinatorial abstract games, such as Chess or Go, the player's posture has something similar to the posture of a mathematician demonstrating a theorem, such games are indeed likely to stimulate similar schemes of thought, resulting internally in a similar experience and, externally, in a physical attitude characteristic to that kind of activity. Beyond the solitary experience involved in pure abstract thinking, the framework imposed by a two-player game is also a mise-en-scene of an agonistic (but nonetheless playful) « relation in thoughts » between two persons. The specific game we propose is the award winning combinatorial game « Alpha » inspired from non-Euclidean geometry, created in 2008 by GaalN.







*Combinatorial game [credits http://wigglycreatures.com for version 05-Animals]*
*Board 1. Reversible 24cm x 24cm x 2cm; Board 2. Hexagonal 24cm x 24cm x 2cm; Board 3. Geometric_A 20cm x 21cm x 0.2cm; Board 4. Geometric_B 21cm x 21cm x 0.2cm; Board 5. Animals diam 29cm x 0.2cm*
*2008*

# PAUL GAILIUNAS

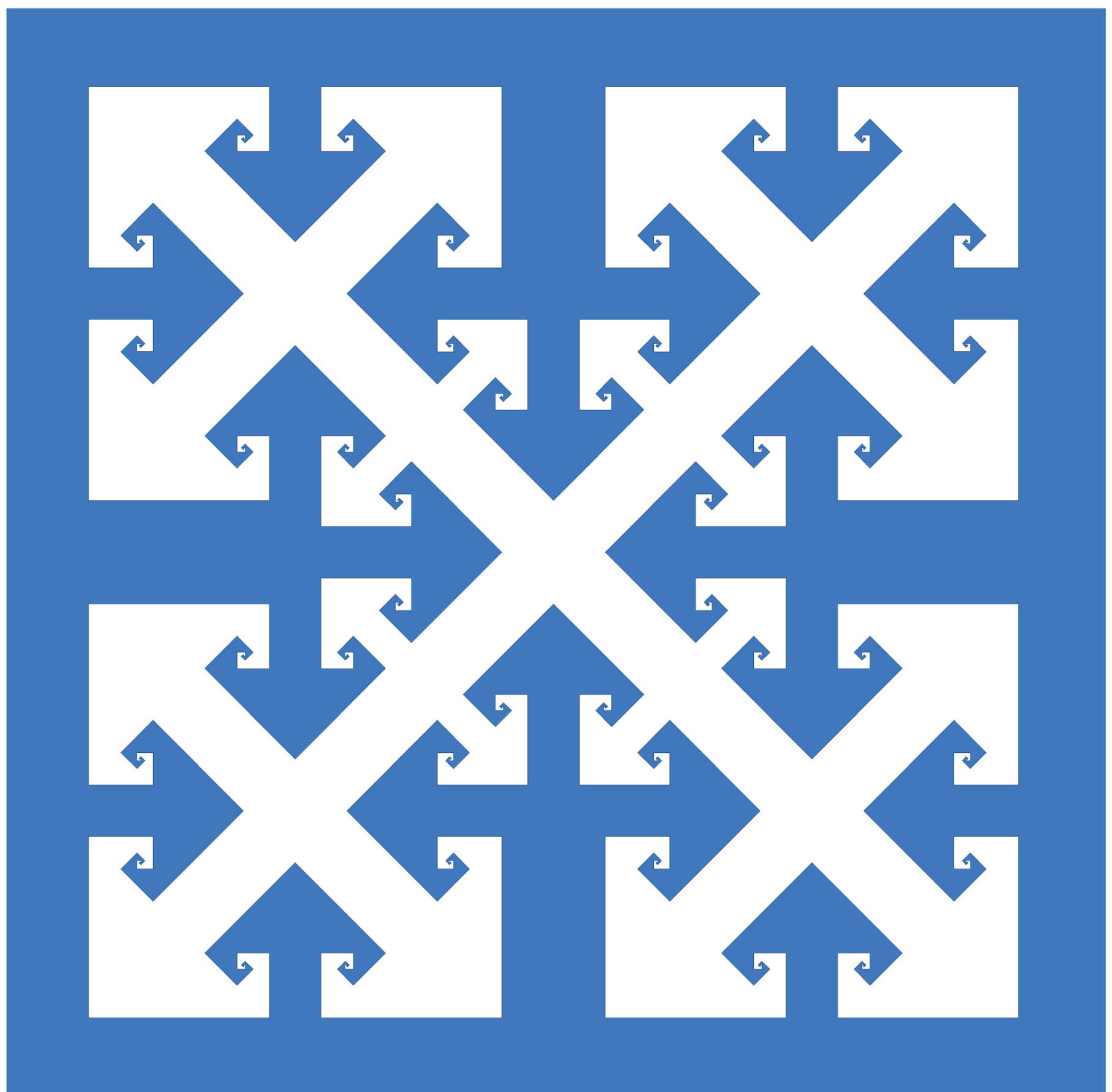
Newcastle, UK
paulgailiunas@yahoo.co.uk

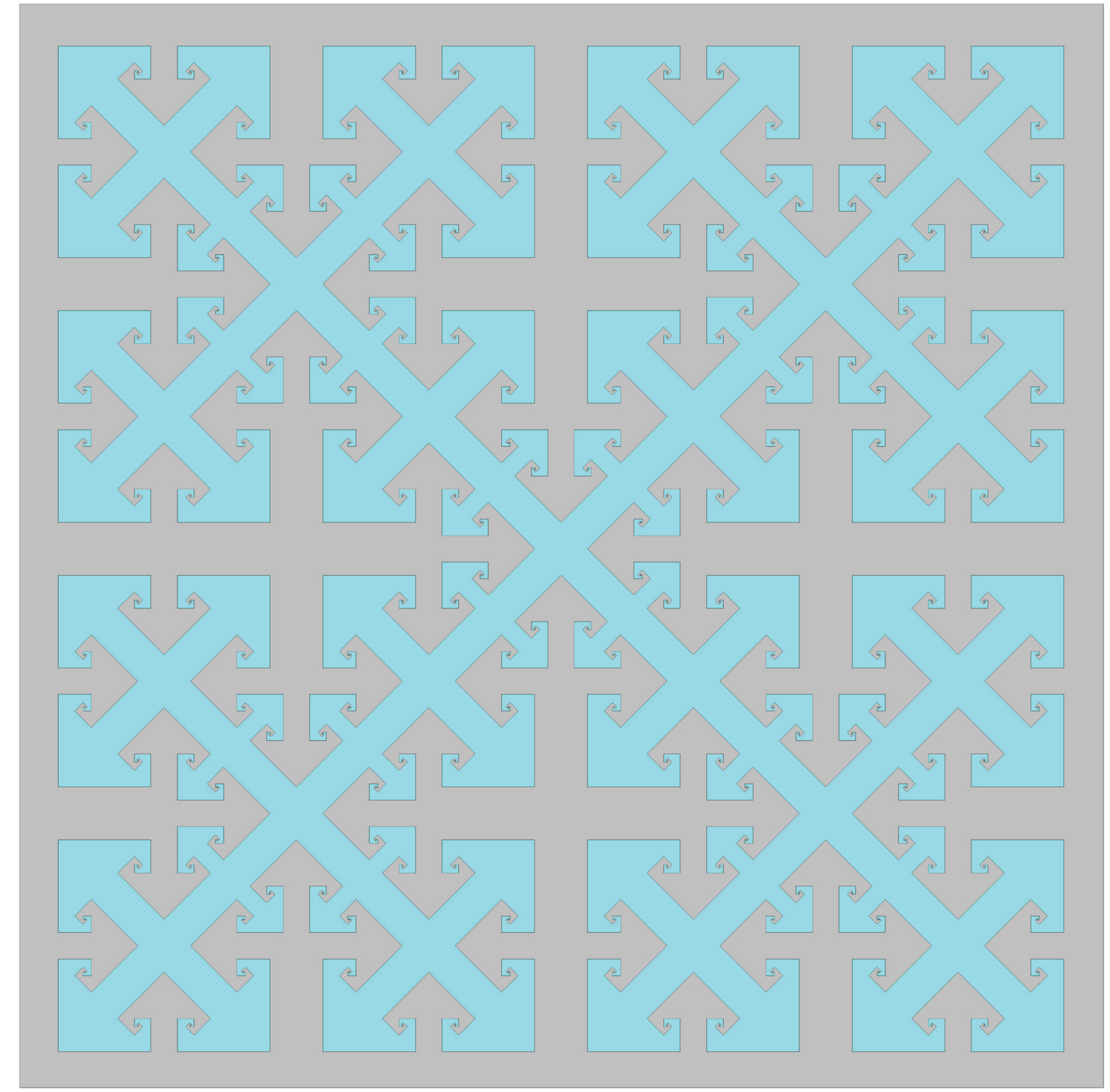
## STATEMENT

I am interested in all types of mathematical art, and have attended every Bridges conference since 2000, submitting work for the exhibitions since 2007.

I work in both 2-D and 3-D, although often the three-dimensional ideas exist only as electronic images. My creative thinking seems to gravitate towards tilings and polyhedra, with a preference for images and objects that allow multiple interpretations, typically figure/ground relationships, although that is not an exclusive interest. For example at Bridges in 2008 I presented a family of visually interesting surfaces related to the lemniscate.

Bookbinding takes up a significant amount of my time and I presented some bindings based on knot designs at Bridges London in 2006, and I exhibited my binding of an edition of The Hunting of the Snark at Leeuwarden in 2008. Other examples of my work can be seen in the gallery at www.societyofbookbinders.com.





## ANGLESEY ARROWS 2

*(opposite) Digital print. 12" x 12". 2010.*

The design is based on a thousand year-old cross base found on the island of Anglesey, Wales. The underlying structure is related to the Cesaro fractal and the box fractal. In the original Celtic design the arrowheads must occur in several different shapes for the pattern to work, but by using square approximations to logarithmic spirals it becomes possible to have a single shape of arrow-head.

## ANGLESEY ARROWS 3

*(above) Digital print. 12" x 12". 2010.*

The underlying structure of the Anglesey Arrow images allows recursion to any depth. This image is generated by carrying out one further iteration beyond that implied by the Celtic original.

# GARY GREENFIELD

University of Richmond
Richmond, Virginia, USA
ggreenfi@richmond.edu
www.mathcs.richmond.edu/~ggreenfi/

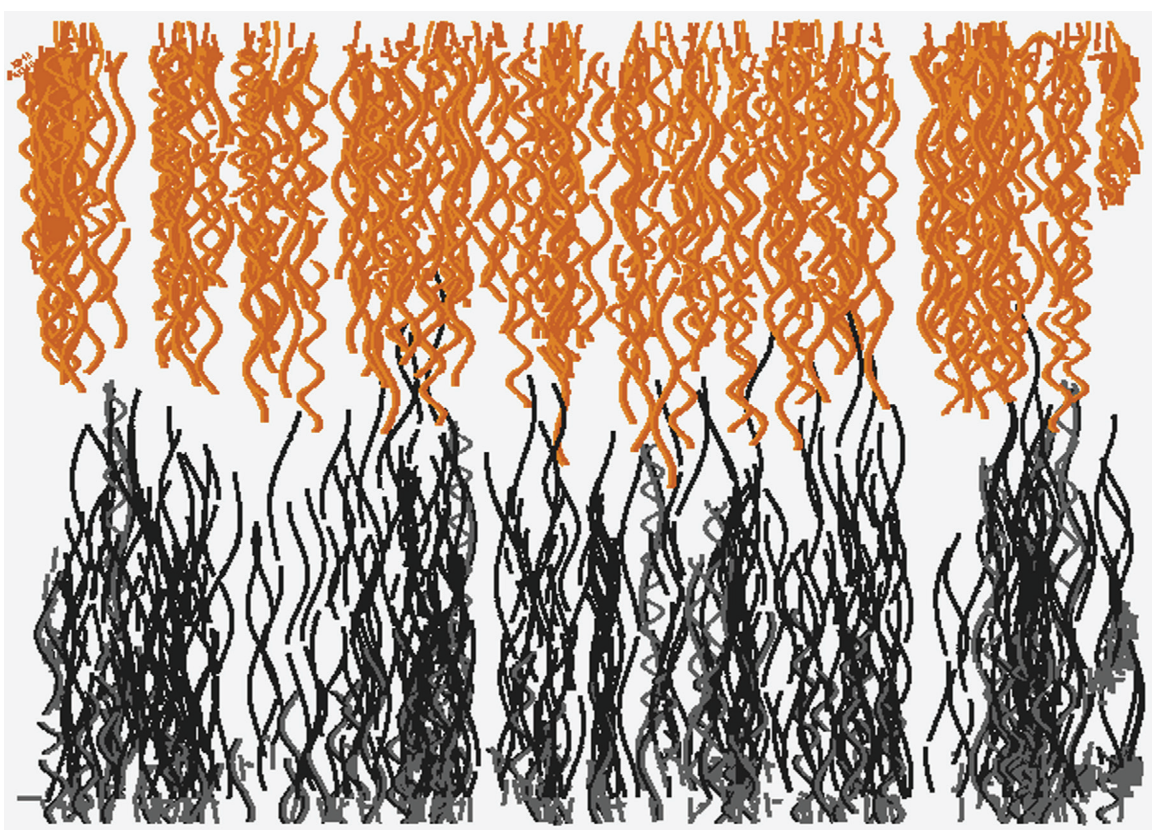
## STATEMENT

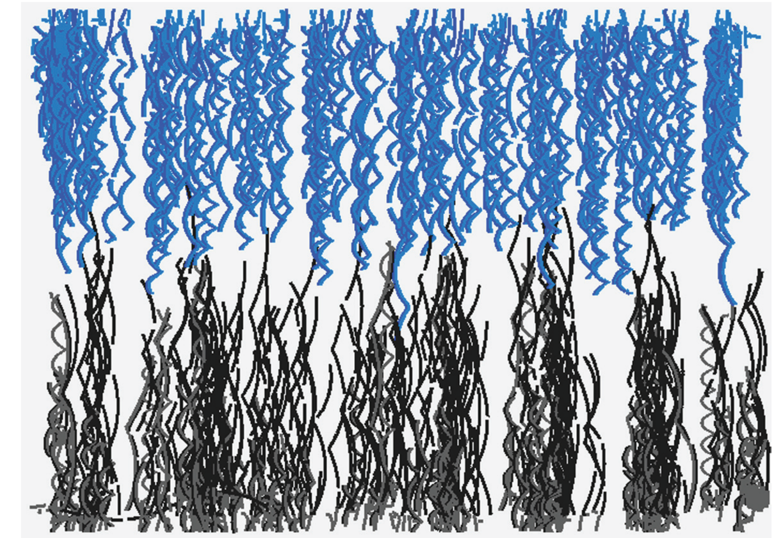
Many of my computer generated algorithmic art works are based on simulations that are inspired by mathematical models of physical and biological processes. In exploring the space of parameters that govern the simulation, I try to focus the viewer's attention on the complexity underlying such processes.

## ROBOT DRAWING #21091

*Digital Print. 5" x 7" (unframed). 2010.*

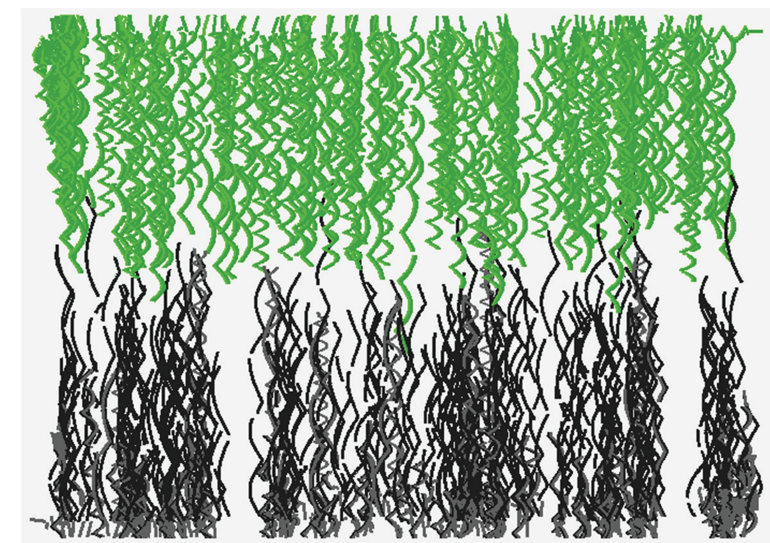
This series of drawings uses 48 (simulated) drawing robots that each have the capability of drawing periodic curvilinear paths while traveling in a straight line. The periods are determined by the robot's speed. Half the robots draw in black and half draw in color. Those drawing in black try to sweep up then down but remain within the bottom half of the canvas while those drawing in color try to sweep down then up but remain within the top half of the canvas. Placed in pairs opposite one another, thanks to collision avoidance and variations in speeds, drawing distances, turning patterns and re-orientation maneuvers over time an organized composition emerges that exhibits an interesting aesthetic with respect to mark making dynamics and detail.





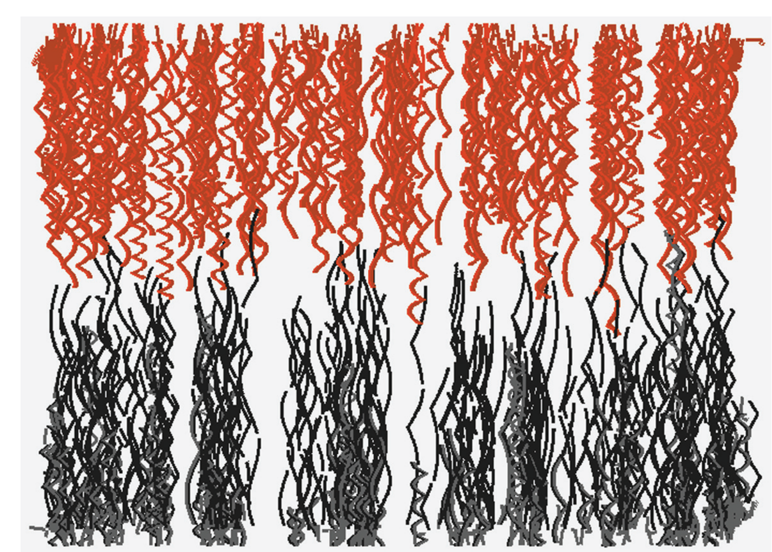
## ROBOT DRAWING #21550

*Digital Print. 5" x 7" (unframed). 2010.*



## ROBOT DRAWING #22298

*Digital Print. 5" x 7" (unframed). 2010.*



## ROBOT DRAWING #22992

*Digital Print. 5" x 7" (unframed). 2010.*

# HENRY SEGERMAN

Department of Mathematics and Statistics, University of Melbourne
Melbourne, Australia
henry@segerman.org
www.segerman.org

## STATEMENT

Henry Segerman is a postdoctoral mathematician. His mathematical research is in 3 dimensional geometry and topology, and concepts from those areas often appear in his work. Other artistic interests involve procedural generation, self reference, ambigrams and puzzles.

### SPHERE AUTOLOGLYPH

*PA 2200 Plastic, Selective-Laser-Sintered. 10.4 cm x 10.4 cm x 10.4 cm. 2009.*

The surface of this self-referential sphere is tessellated with 20 copies of the word "SPHERE". The design was sketched on paper (at Bridges 2009), then a single copy of the word recreated in Adobe Illustrator and imported into Rhinoceros 3D. The flat design was then projected onto a sphere, modified to account for the curvature of the sphere, then copied to form the tessellation. Finally, pipes were constructed around the curves, converted to a mesh and then the mesh sent to Shapeways.com for 3D printing.

### TORUS AUTOLOGLYPH

*PA 2200 Plastic, Selective-Laser-Sintered. 10.1 cm x 10.1 cm x 3.5 cm. 2009.*

The surface of this self-referential torus is tessellated with 16 copies of the word "TORUS". The design was originally intended for display on a torus with a flat Euclidean metric. However, that design, made from curves in Adobe Illustrator and imported into Rhinoceros 3D, was projected onto the usual embedding of a torus in 3 dimensional space, using Rhinoceros 3D's "Sporph" command. Finally, pipes were constructed around the curves, converted to a mesh and then the mesh sent to Shapeways.com for 3D printing.

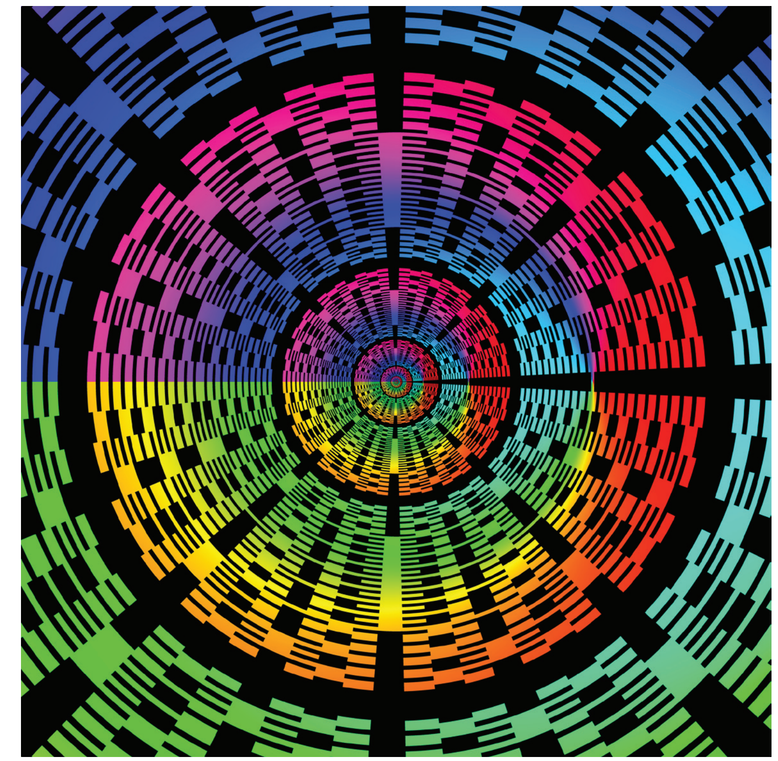


# IAN SAMMIS

UC Davis
Davis, California, USA
isammis@math.ucdavis.edu
math.ucdavis.edu/~isammis

## STATEMENT

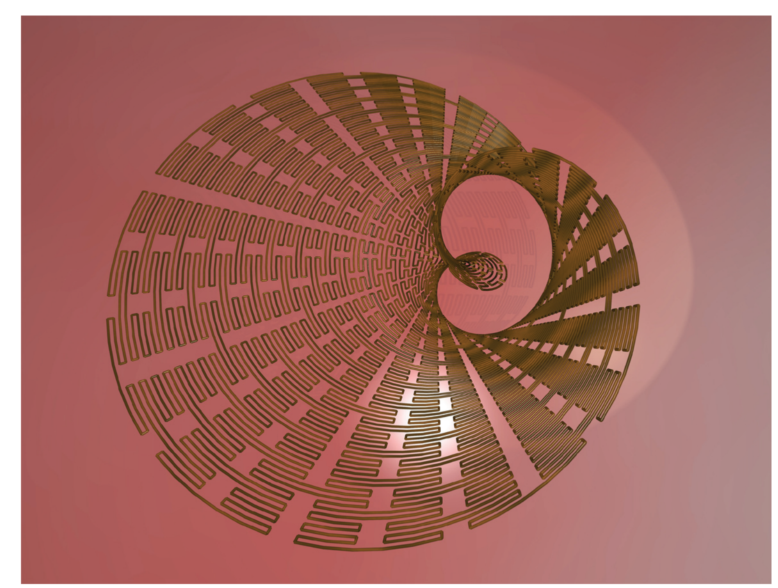
Translating mathematics into art, and making that art as aesthetically pleasing as possible, seems to be the best way to for me understand the mathematics itself. The process of trying to make the art look the way I intend forces me to think in very different ways about the underlying mathematics.



### EXPONENTIAL MOORE

*Digital print on canvas. 24" x 24". 2010.*

The Moore curve is a closed space-filling curve. By placing an infinite line of Moore curves on the complex plane and applying exp(z), one fills a series of annuli. This work illustrates the effect for one of the curves in the sequence whose limit is the Moore curve. I have colored the interior of each curve by angle from the curve's center, to make the effect of exp(z) more obvious.



### MÖBIUS PEANO

*Digital print. 11" x 14". 2010.*

This Peano Curve, unlike the Moore curve, does not close on itself. By placing along a Möbius strip, though, one can make the final point fall adjacent to the initial point, forming a single closed loop.

# ISTVÁN MUZSAI

MOME = Moholy-Nagy Art and Design University
Budapest, Hungary
muzsai@theycom.hu
www.theycom.hu

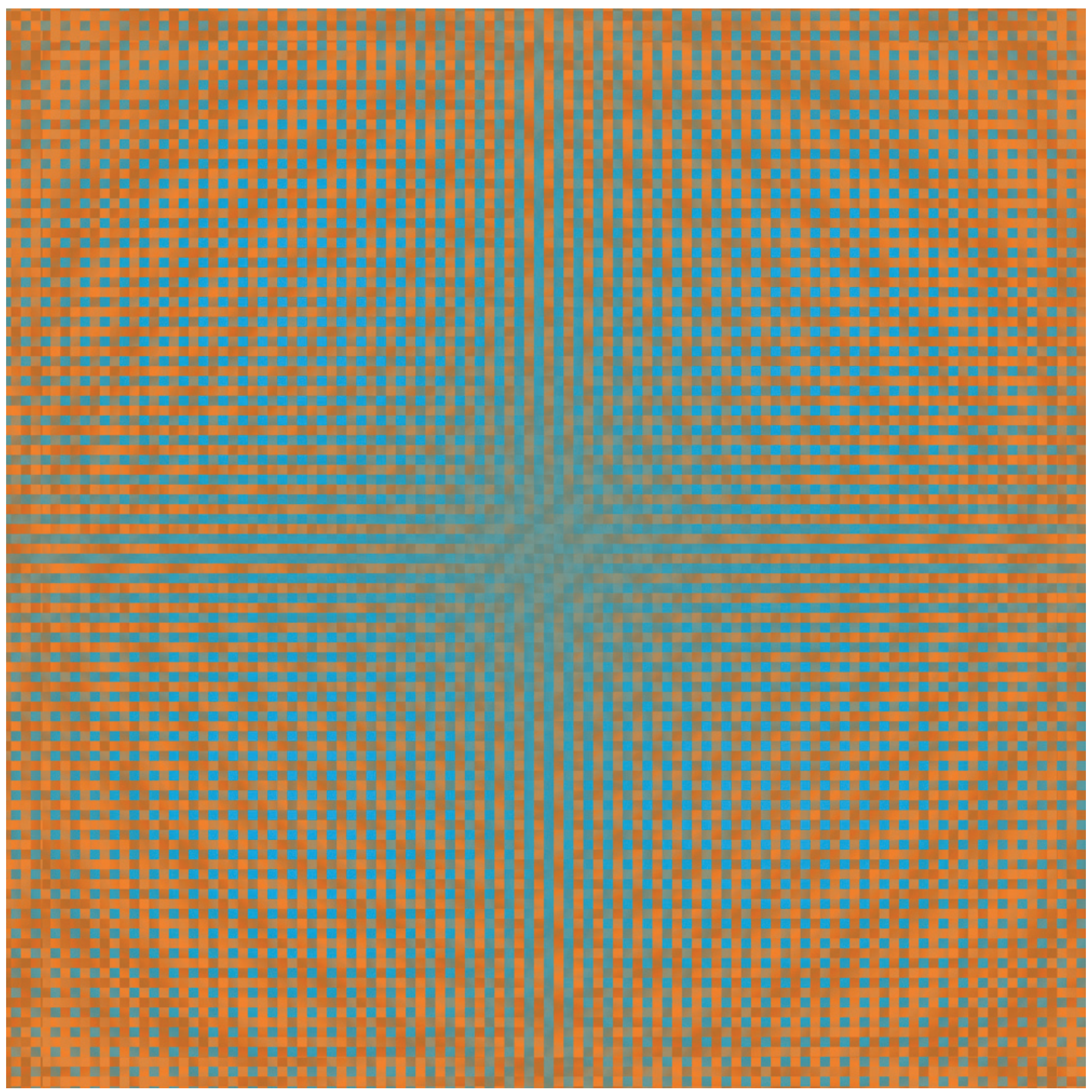
## STATEMENT

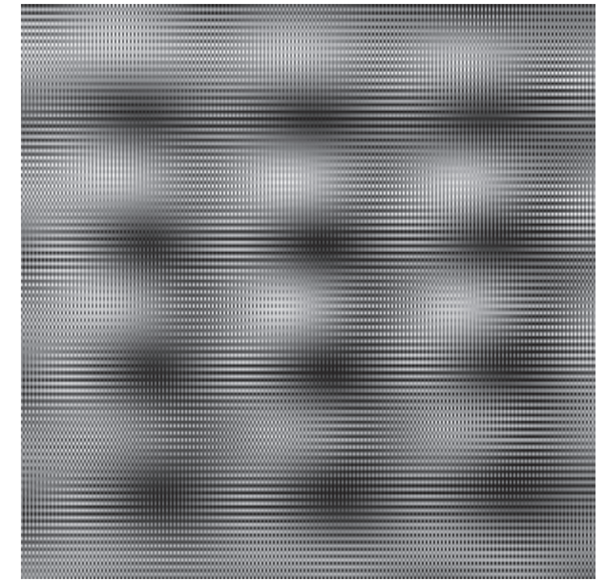
If Architecture is the art of proportions in 3D (but it says is frozen Music), and the Music is the art of the permutation of time in 4D, then sacred Geometry is the art of Time and Space via multidimensionality. These three disciplines form a quantic triangle, a living hyperplane whereat my two dimensional artistic being exists non-linear as a little self-similar scale independent spatiotemporal fractal... ;-)

## ODRANOEL REDIVIVUS

*Digital print on canvas. 24" x 24". 2004.*

OPART style—the effect is based on phenomena of complementary contrast. Nonetheless the artwork is composed by using only beige and cyan squares, a hidden system of tunnel-like interwoven archilinear structures appears on the viewer's retina, but coloured in a third, unused colour, in pink! A sensible-virtual-spiritual system in a perceptible-material-existing one. According to Kant: A priori in a posteriori.... 4D Subspace from 2D.





## DYEAR

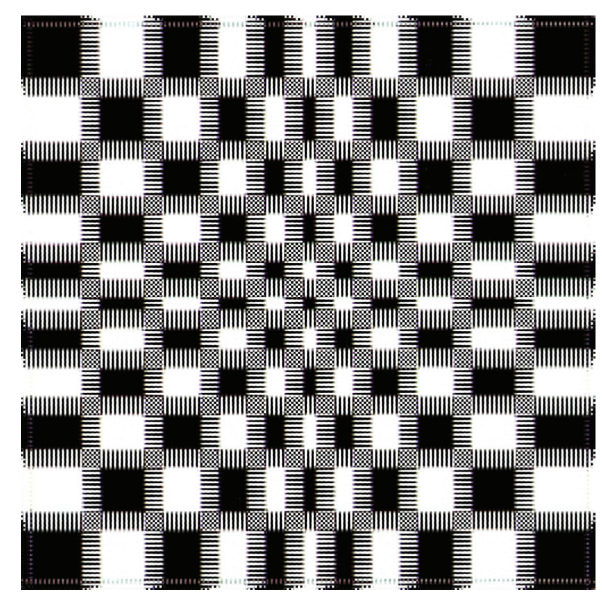
*Digital print on canvas. 24" x 24". 2004.*

OPART style—black and white artwork with a composite optical illusion effect based on the following: Hoffmann grid + proximity/connectedness/similarity/continuity perceptual organization-grouping principles + checker-shadow illusion. De facto twelve bulbs are floating out from the 2D plane via 'incommensurability'.

## DBORDER

*Digital print on canvas. 24" x 24". 2000.*

OPART style—composite effect based on the so called Hoffman grid effect + White effect + peripheral perception effect. Between the horizontal color bars are flashing (un?) existing black (discrete) material nevertheless the back is white...



## CHESSFOREVER WITH VASARELY

*Digital print on canvas. 24" x 24". 1998.*

OPART style—black and white painting—based on the following : Zöllner illusion + Checker-shadow illusion + Hoffmann Grid. :-) Checkmate on all 100 tables, master Vasarely!!

# JACQUES BECK

Waterloo, Belgium
point.lumiere@gmail.com

## STATEMENT

The multisculpture that could be thought of as built by a generating point moving around into lines, surfaces and volumes must by essence be rested in sequence and be revisited on its multiple sides during the creation process. This ensures that more original views take shape from a collection of features available to the artist such as concavity, convexity, equilibrium and stability, material properties such as mass distribution, texture, color.

This complex iterative process can be mathematically simulated, analysed and developed before a real-world materialization. In a nutshell: a single sculpture that contains many. A central point explodes and radiates out. The interior gives way to the exterior and vice versa.

## COQUILLAGE (MULTISCULPTURE)

*Bronze. 300 X 250 X 150 mm. 2009.*

This is an example of my multisculpture concept. The image presents four views of the five different positions when the work is placed on a horizontal planar surface. There could be other positions when the work is placed on a different kind of surface (see text of the presentation).



# CHRISTOPHER CARLSON

Wolfram Research
Champaign, Illinois, USA
carlson@wolfram.com

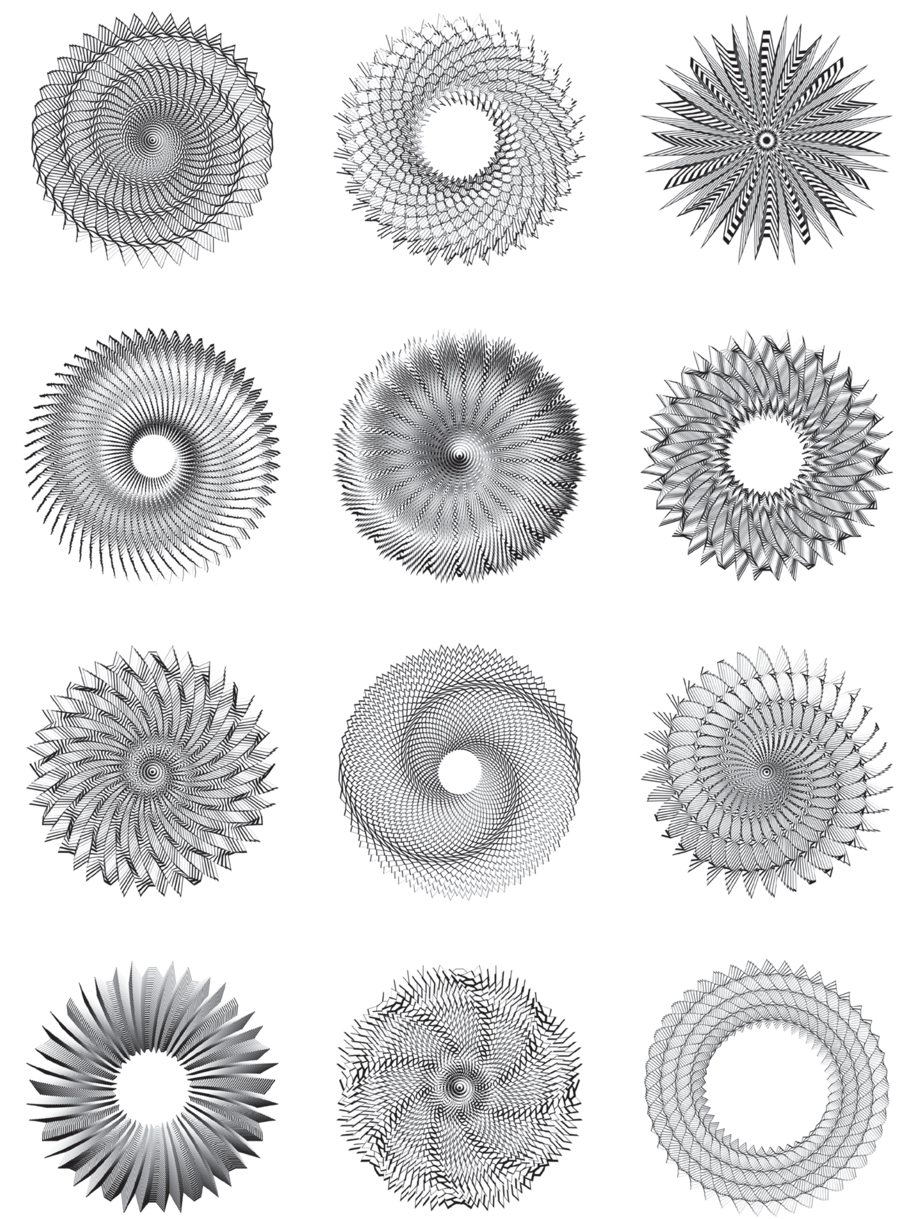
## STATEMENT

My passion is exploring graphical and geometric phenomena by computer. I typically explore parametric design spaces, but my aim is not to achieve particular results, but rather to set up the conditions for the unexpected to occur. The art is in designing the design spaces themselves, combining and recombining parameters until emergent properties conspire to yield new and surprising forms.

## BENZ-GRIGNANI PROGENY

*Digital Print. 29.5"x24". 2009.*

These forms are the result of an interactive exploration that started with straightforward parameterizations of the geometries of the Mercedes-Benz logo and a logo by Grignani. Combining "genetic material" from the separate parameterizations and incorporating the result of a significant programming mistake led to this unexpectedly rich family of organic forms.



# JAN W. MARCUS

Ars et Mathesis
Beverwijk, The Netherlands
info@janmarcus.nl
www.janmarcus.nl

## STATEMENT

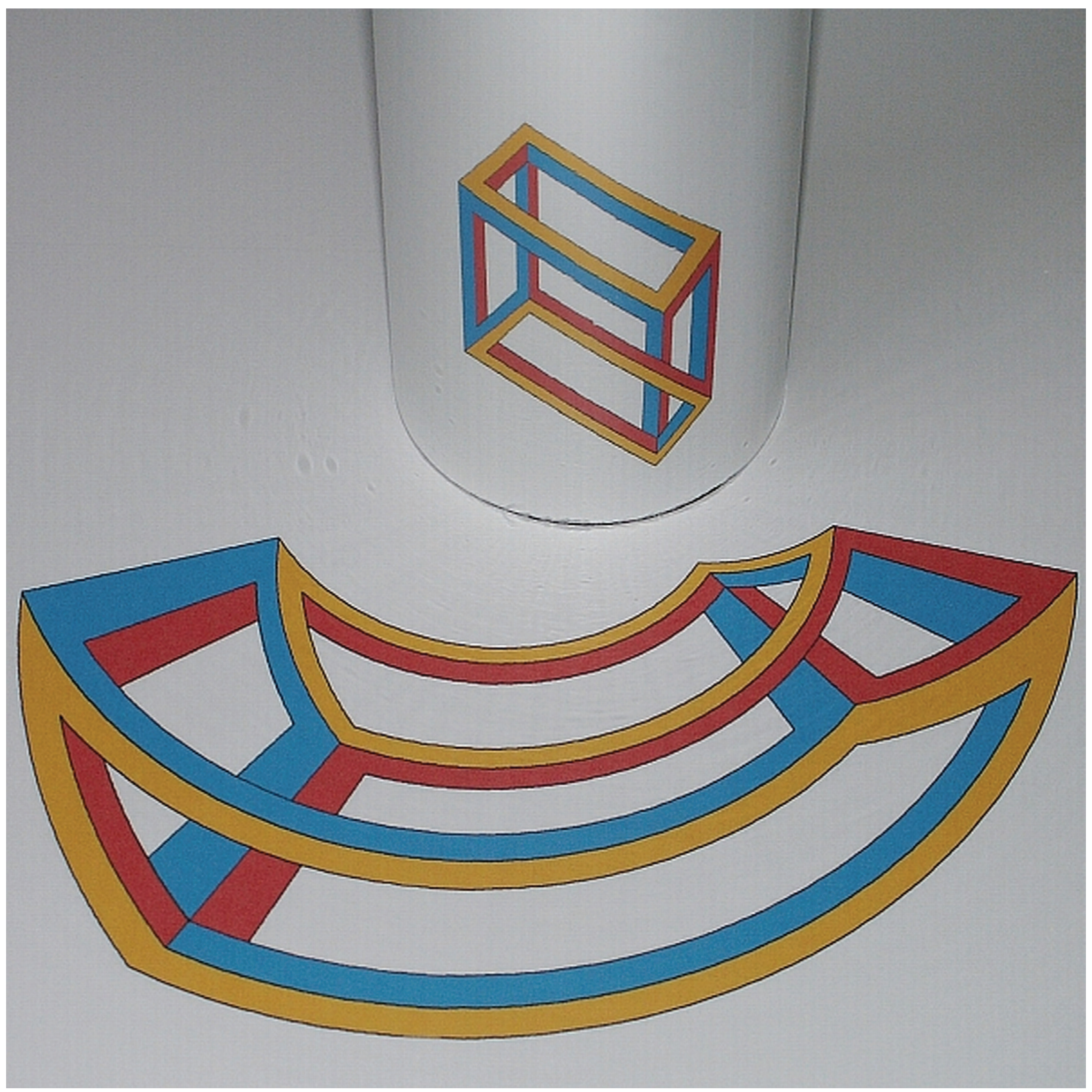
During my professional life as a civil engineer I became interested in tensegrities. Also M.C. Escher's impossible figures did have my interest. Combining tensegrities and impossible figures makes "impossible structures". Obviously for determining strength and stiffness of these solid structures, computers essential.

Same computer-models used in FEM-computer programs, can also be used to create Cylinder Anamorphosis. By translating and/or rotating these 3D models in a developed computer program, "impossible structures" become visible into the reflecting cylinder.

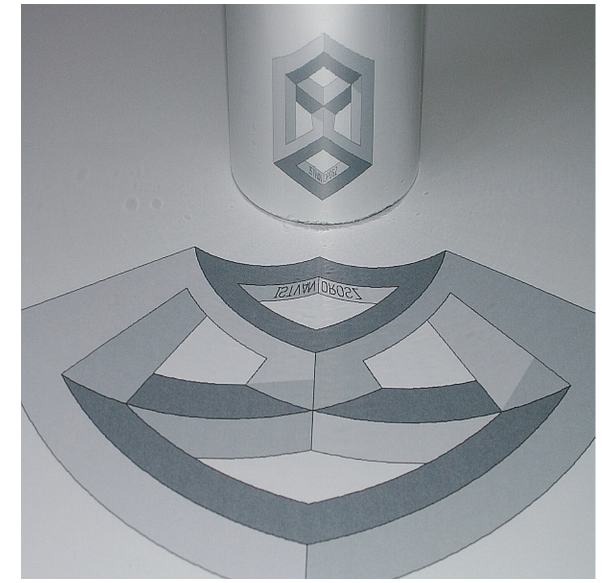
## CUBOID

*Inkjet print / reflecting cylinder. 200 x 300 x 210 mm. 2010.*

In the reflecting cylinder the impossible cuboid becomes visible.







## THE WALL III

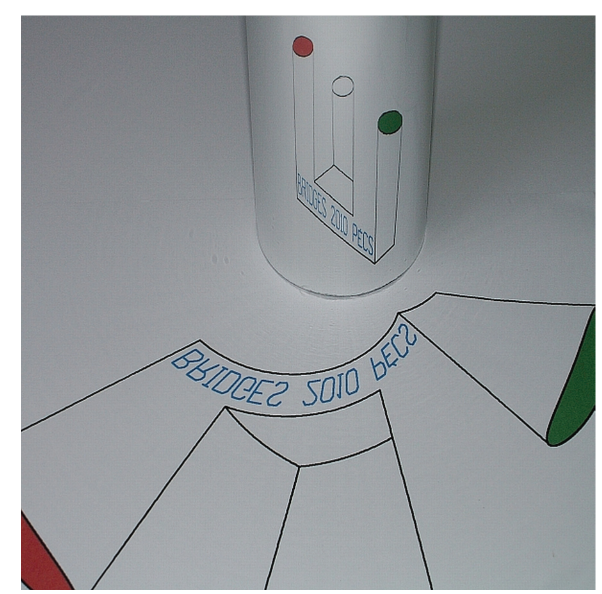
*Inkjet print / reflecting cylinder. 200 x 300 x 210 mm. 2010.*

In the reflecting cylinder Istvan Orosz's The Wall II becomes visible.

## ARCH

*Inkjet print / reflecting cylinder. 200 x 300 x 210 mm. 2010.*

In the reflecting cylinder an impossible arch becomes visible



## TRIDENT

*Inkjet print / reflecting cylinder. 200 x 300 x 210 mm. 2010.*

In the reflecting cylinder the impossible trident becomes visible

# JEAN CONSTANT

Northern New Mexico College
New Mexico, USA
jconstant@hermay.org
http://hermay.org/jconstant

## STATEMENT

Mathematics represent for visual artists universal the expression of abstract intelligence at its best. It is the fertile ground that inspires me to celebrate both our collective intellectual achievements and the unsurpassed qualities of its association with our more tangible environment.

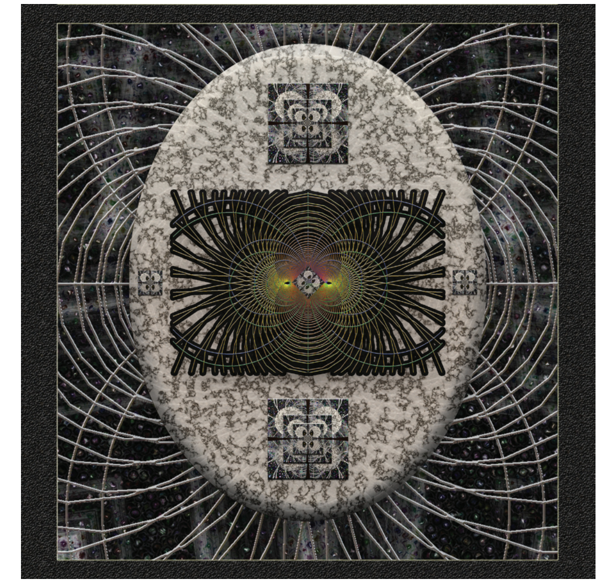
The development of computer technology pioneers in the field of mathematical visualization such as Dr Palais and his 3D XplorMath software have been of great help and inspiration in allowing me to pursue further my interest in that direction.

## CONFORMAL MAP #15

*Mixed media on canvas. 18"x18". 2009.*

Conformal maps are invaluable for solving problems in engineering and physics and are expressed in terms of functions of a complex variable. This visualization is part of a series reflecting on this phenomenon. The series was created with R. Palais 3D XplorMath software and is available at: http://www.hermay.org/jconstant/dconfmap/

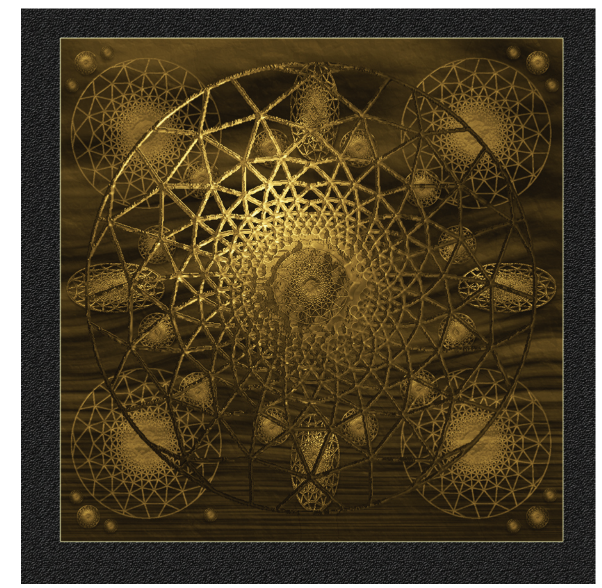




## BATIK CONSTRUCT

*Mixed media on canvas. 18"x18". 2009.*

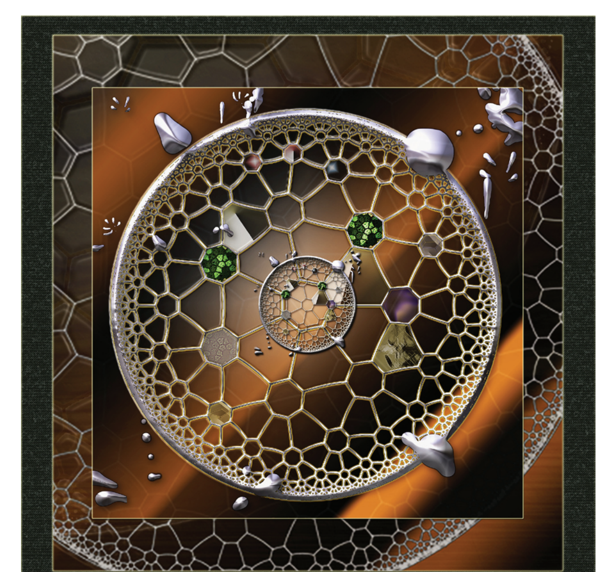
Part of a series on conformal maps (c.m. # 5). Created with 3D-XplorMath, a mathematical visualization software conceived by Dr. Palais and SeamlessMaker, an image processing utility developed by Géraud Bousquet. The 16 plates series is available at: http://www.hermay.org/jconstant/dconfmap/



## THE ORIGIN OF TIME

*Mixed media on canvas. 18"x18". 2007.*

Part of a series on hyperboles from the original templates of Bernie Freidin and created for a lecture at the Santa Fe Contemporary Art Center. Reflection on the nature of mathematics and its cultural connotation. In this particular example associated to Celtic art techniques, the object is turned or the patterns allowed to dissolve and reform themselves into different configurations. The 12 plates series is available at: http://www.hermay.org/jconstant/hyperboles



## THE JEWELER LOUPE

*Mixed media on canvas. 18"x18". 2007.*

Part of a series on hyperboles from the original templates of Bernie Freidin and created for a lecture at the Santa Fe Contemporary Art Center. Reflection on the nature of mathematics and its cultural connotation. This template revisits European high middle-age jewelry and stained glass window techniques. The 12 plates series is available at: http://www.hermay.org/jconstant/hyperboles

# JAMES MAI

Illinois State University, School of Art
Normal, Illinois, USA
jlmai@ilstu.edu

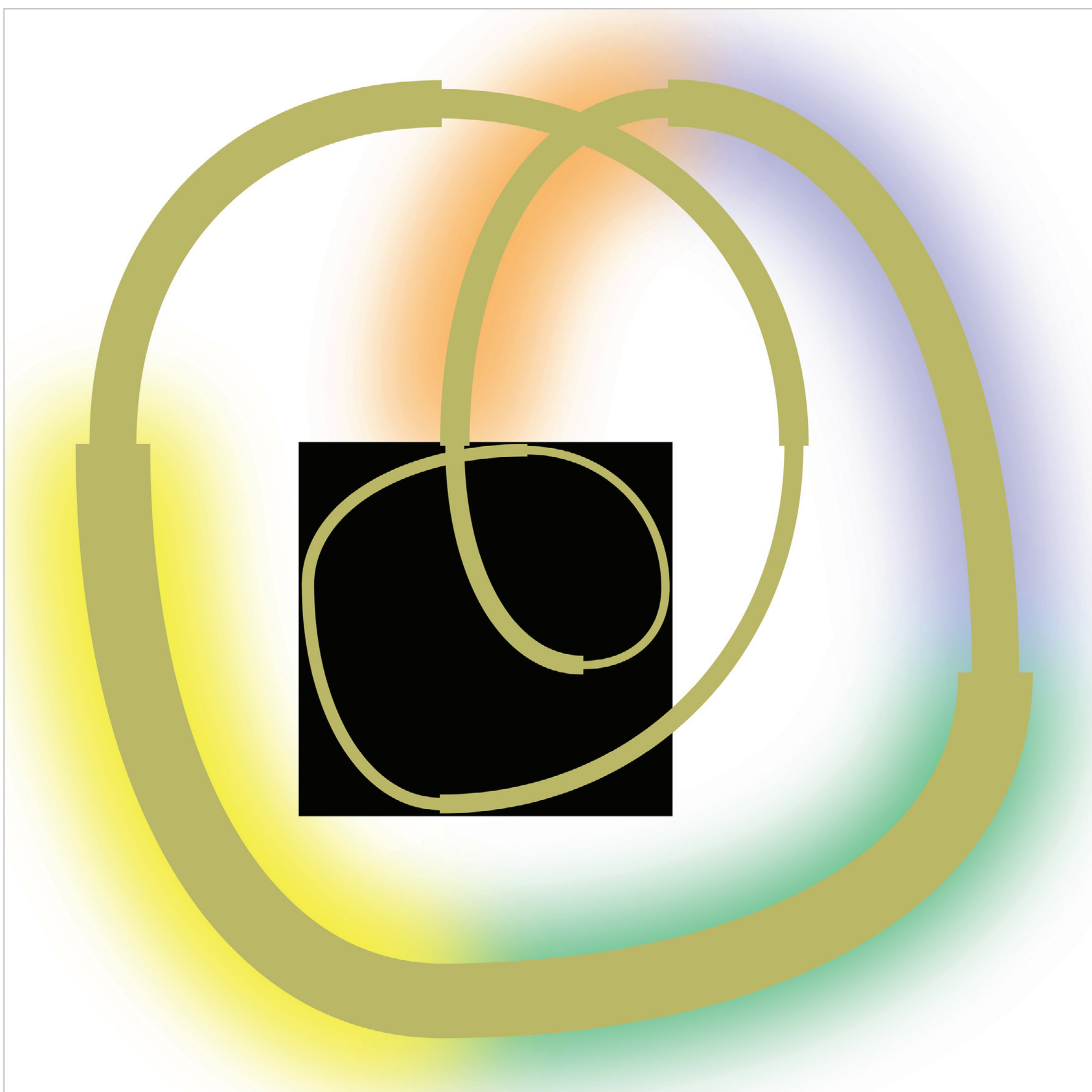
## STATEMENT

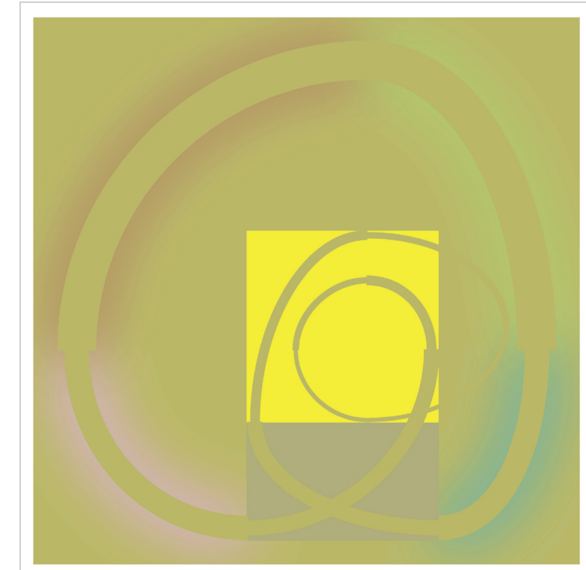
My work follows two primary directions: color-relativity functions and geometric composition. The color relativity work examines the structures of simultaneous color contrast illusions, whereby a constituent color appears to change its identity in different color contexts. Although this is a purely subjective perceptual experience, the principles by which the illusions function are objectively definable, and therefore manipulable by the artist. The geometric order of much of my work is built upon golden section relationships. Usually I work within a square format and divide that square by phi. Golden section divisions of the square permit me to compose my abstract paintings with similar shape relationships operating at different scales, proportions, and symmetries. Geometry in general, and golden section geometry in particular, is to my visual work what rhythm is to music or meter is to poetry.

## CIRCUITOUS GLOW (YELLOW ON WHITE)

*Digital print. 14" x 14". 2009.*

The loop in this composition is composed of quarter-circle arcs and quarter-ellipses of golden (phi) proportion. The overall square format is divided by phi divisions into smaller golden rectangles and squares, which determine the placement of the loop and its components. The yellow-ocher loop is physically the same color throughout, but changes its color in response to the varied colors surrounding it.

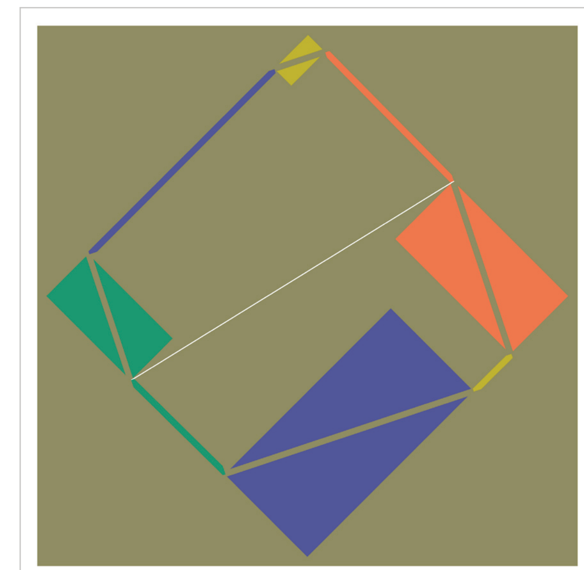




## CIRCUITOUS GLOW (YELLOW ON YELLOW)

*Digital print. 14" x 14". 2009.*

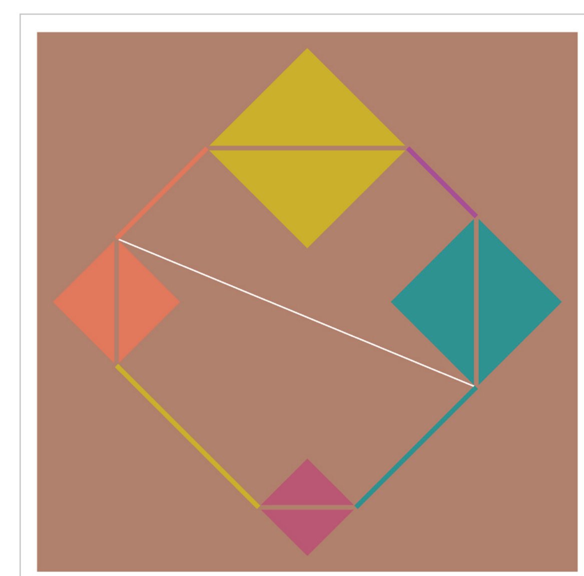
The loop in this composition is composed of quarter-circle arcs and quarter-ellipses of golden (phi) proportion. The overall square format is divided by phi divisions into smaller golden rectangles and squares, which determine the placement of the loop and its components. The yellow-ocher loop is physically the same color as the background, but changes its color in response to the varied colors surrounding it.



## ROOT INTERVALS (YELLOW)

*Digital print. 14" x 14". 2009.*

The colored 1x2 rectangles are separated by exactly the same distances as the length of their diagonals, forming a large tilted square. Each short, colored line has been "extracted" from the 1x2 rectangle of the corresponding color. The white axis defines a bilateral symmetry of the lines within the larger square. The yellow-ocher lines within the rectangles are physically the same color as the background, but the colored rectangles force those yellow-ocher lines to appear to change their color.



## ROOT INTERVALS (RED-ORANGE)

*Digital print. 14" x 14". 2009.*

The smaller colored squares are separated by exactly the same distances as the length of their diagonals, forming a large tilted square. Each short, colored line has been "extracted" from the square of the corresponding color. The white axis defines a bilateral symmetry of the lines within the larger square. The red-orange lines within the rectangles are physically the same color as the background, but the colored rectangles force those red-orange lines to appear to change their color.

# JOHN M. SULLIVAN

Technische Universität Berlin
Berlin, Germany
jms@isama.org
www.isama.org/jms/

## STATEMENT

My art is an outgrowth of my work as a mathematician. My research studies curves and surfaces whose shape is determined by optimization principles or minimization of energy. A classical example is a soap bubble which is round because it minimizes its area while enclosing a fixed volume.

Like most research mathematicians, I find beauty in the elegant structure of mathematical proofs, and I feel that this elegance is discovered, not invented, by humans. I am fortunate that my own work also leads to visually appealing shapes, which can present a kind of beauty more accessible to the public.

## MINIMAL FLOWER 3

*(opposite) Sculpture (3D FDM print). 3" x 4" x 4". w2001.*

"Minimal Flower 3" shows a nonorientable minimal surface spanning (like a soap film) a certain knotted boundary curve. The surface, like the knotted boundary itself, has 322 symmetry, meaning three-fold and two-fold rotational symmetry but no mirrors. The mathematical surface is thickened into a three-dimensional sculpture by simulating the process of blowing a bit of air in between two parallel sheets of soap film. To create a more pleasing result, the surfaces are actually modeled in 3D hyperbolic space. This sculpture is an homage to Brent Collins, whose "Atomic Flower II" has the same topology.

## MINIMAL FLOWER 4

*(above) Sculpture (3D FDM print). 3" x 5" x 5". 2010.*

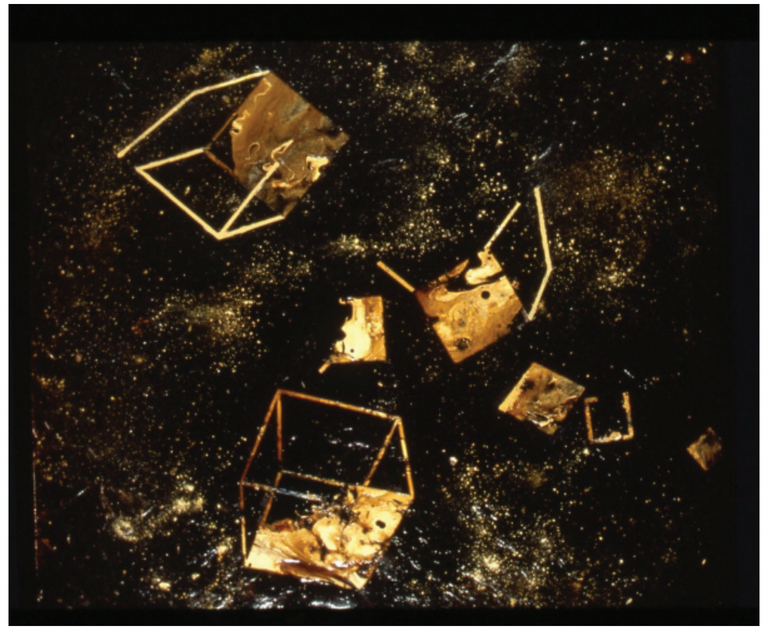
"Minimal Flower 4" shows a nonorientable minimal surface spanning (like a soap film) a certain knotted boundary curve. The surface, like the knotted boundary itself, has 422 symmetry, meaning four-fold and two-fold rotational symmetry axes but no mirrors. The mathematical surface is thickened into a three-dimensional sculpture by simulating the process of blowing a bit of air in between two parallel sheets of soap film. To create a more pleasing result, the surfaces are actually modeled in 3D hyperbolic space.

# JOEL VARLAND

Savannah College of Art and Design
Savannah, Georgia, USA
jnvarlan@scad.edu

## STATEMENT

I work in a wide range of media and dimensions which includes painting, sculpture and installations. Usually, I work in series with associated works, but beyond that the subject matter of my work varies significantly. The two works I am show in this show come from two very divergent series. 'Cubed 18' is a paintings that corresponds to four installations. 'Untitled 107' is part of a large series of paintings which deal with myths about frogs. Within the content, both paintings have underlying structure and imagery of mathematical themes which are expressed though visual metaphors.



## CUBED 18

*Oil paint. 22"x24". 2010.*

Oil painting which is part of a series about the life of cubes.

## UNTITLED: 107

*Oil paint. 24"x 36". 2006.*

Both frogs and Gothic architecture share the unique attribute of an extended linear structure. Gothic arches are an extension, both mathematically and aesthetically, of Roman arches. They where created to test the limits of physics and the potential of beauty, spaces and light. In a poetic fashion, a frogs structure amplifies this same dynamic—an extreme embellishment of common structure. In this painting I have correlated these structures and forms.



# JOHN HIIGLI

Le Jardin a l'Ouest/Jardin Galerie
New York City, New York, USA
john@jardingalerie.org
johnahiigli.com

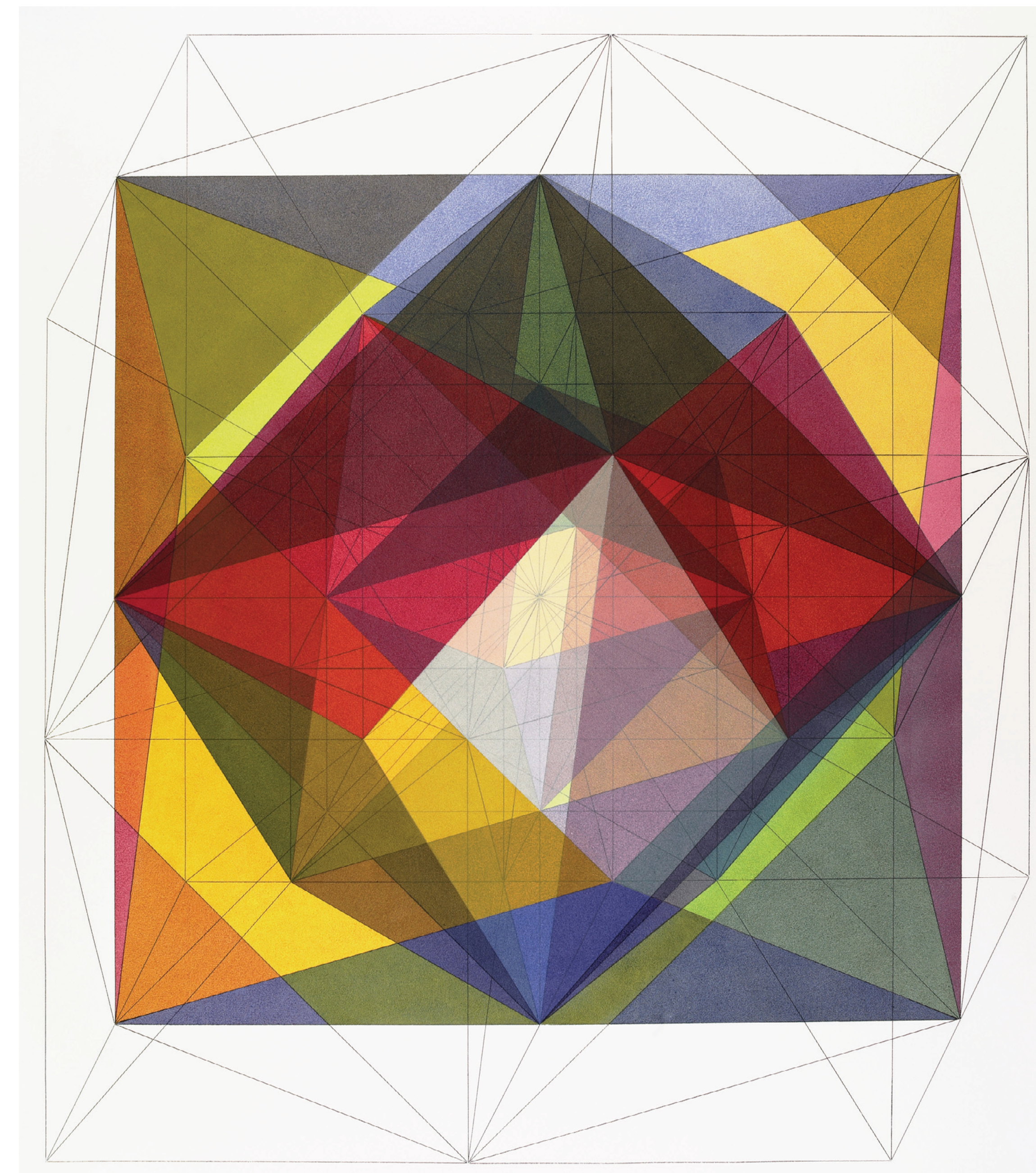
## STATEMENT

I am a geometric painter; I paint with transparent paint. I am interested in promoting the study of geometric art as I believe it has broad significance as we move from a culture where much of our energy and most of our natural resources are wasted to one in which our energy and our resources are conserved. In my paintings I am trying to express the "light of the heavens" !

## CHROME 163

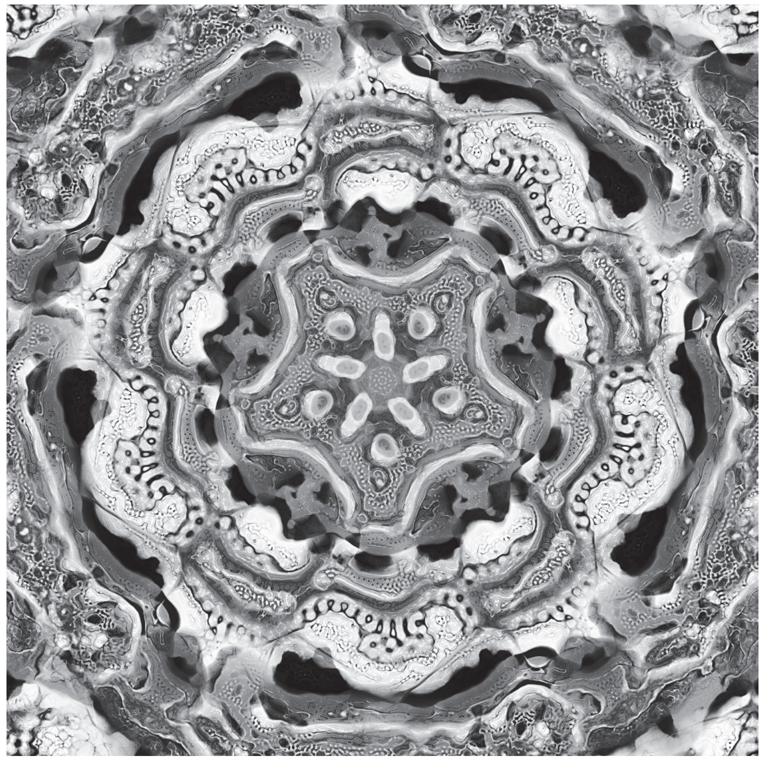
*Digital Print on Canvas. Approximately 24" X 24". 2005.*

Digital Print of the original painting: Cr 163 CUBOCTAHEDRON, RHOMBIC DODECAHEDRON, OCTAHEDRON II TETRAHEDRON, > > OCTAHEDRON: TOP VIEW TETRANET SERIES. 2002-05. Transparent Oil on Canvas, 56 X 64 in (142 X 183 cm)



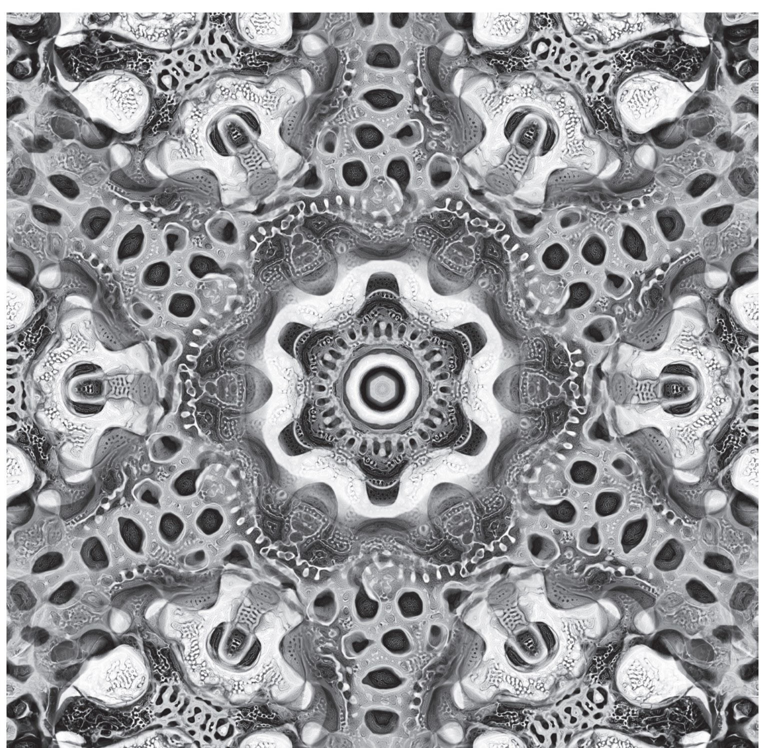
# JONATHAN MCCABE

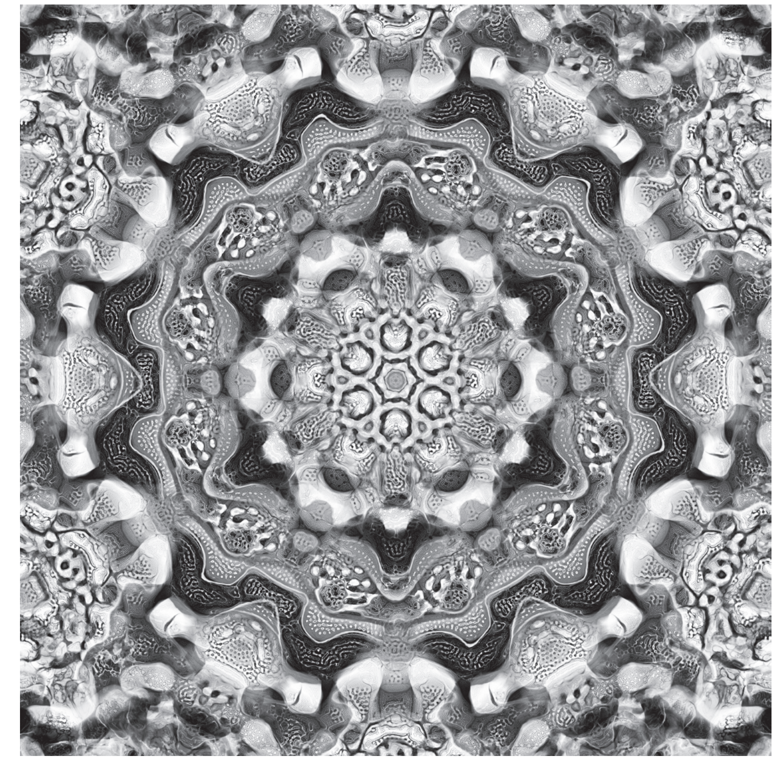
Faculty of Arts and Design, University of Canberra
Canberra A.C.T. Australia
Jonathan.McCabe@canberra.edu.au
www.jonathanmccabe.com



## STATEMENT

I am interested in spontaneous pattern formation in the natural world, and the application of its "algorithms" to generative mathematical computer art. At the moment I am investigating the Turing Instability as a process to produce bio-mimetic images and animations, which look somewhat like electron microscope images of diatoms. I am attempting to understand by imitation the mathematical processes which produce the world.

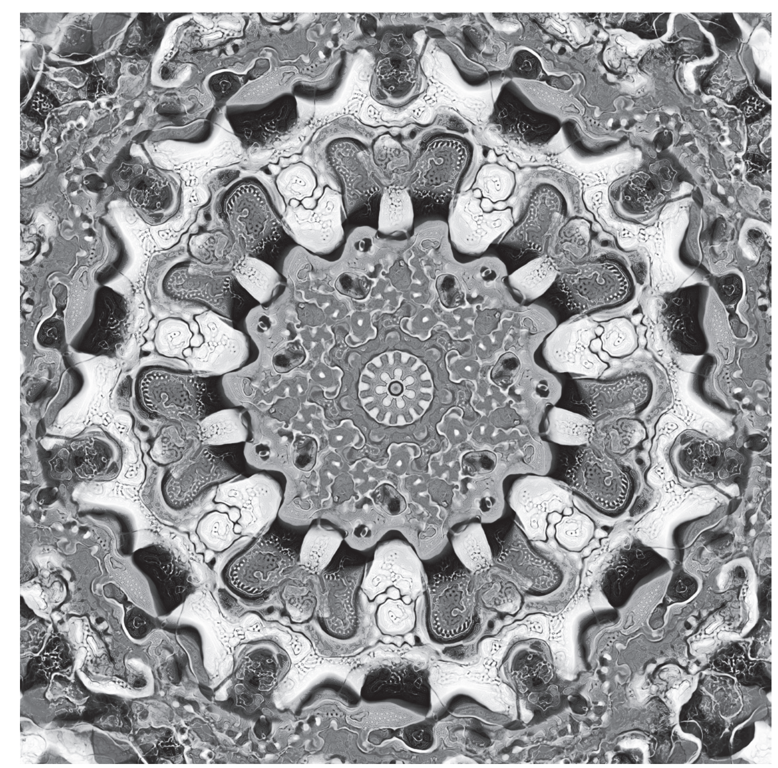




## DIATOMACEOUS ONE, TWO, THREE, AND FOUR

*Archival Inkjet Prints. 20" x 20". 2010.*

Multiple Turing Instabilities of differing scale with cyclical symmetry are combined, to produce images somewhat reminiscent of a diatom under the electron microscope.

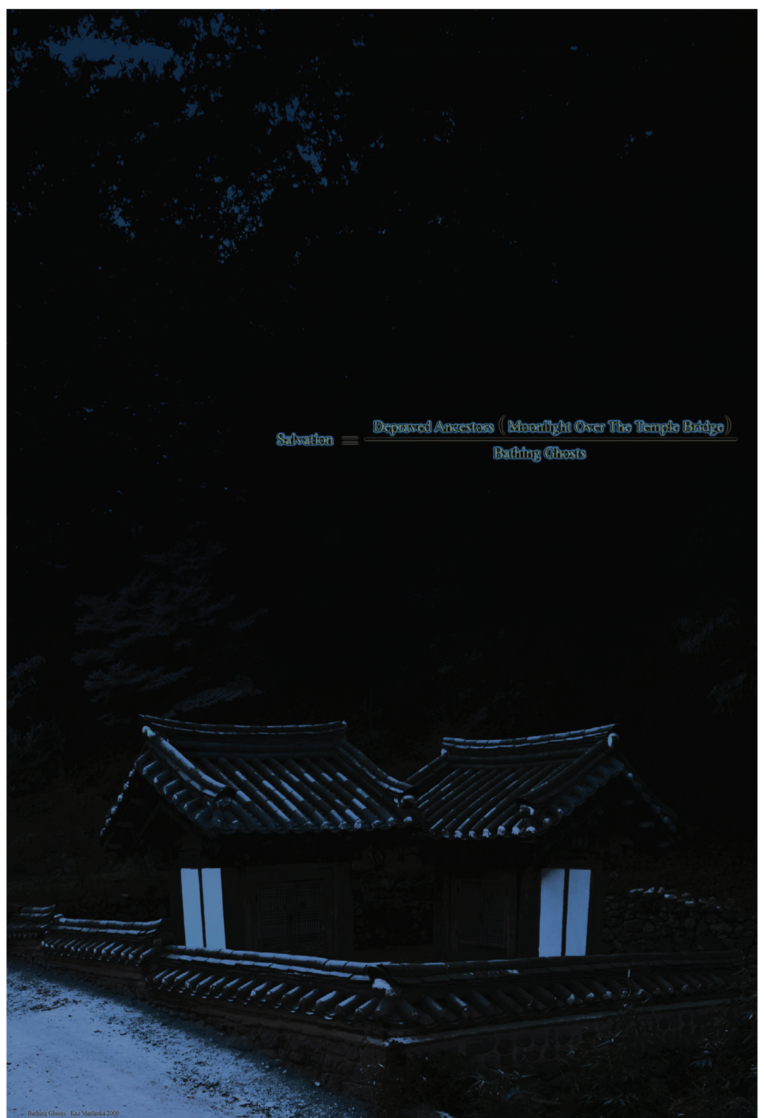


# KAZ MASLANKA

San Diego, California, USA
kazmandu@aol.com
www.kazmaslanka.com

## STATEMENT

"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. This freedom transforms equations for uses other than scientific by freeing equations from the boundaries of denotation and opens up a new world in the realms 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."

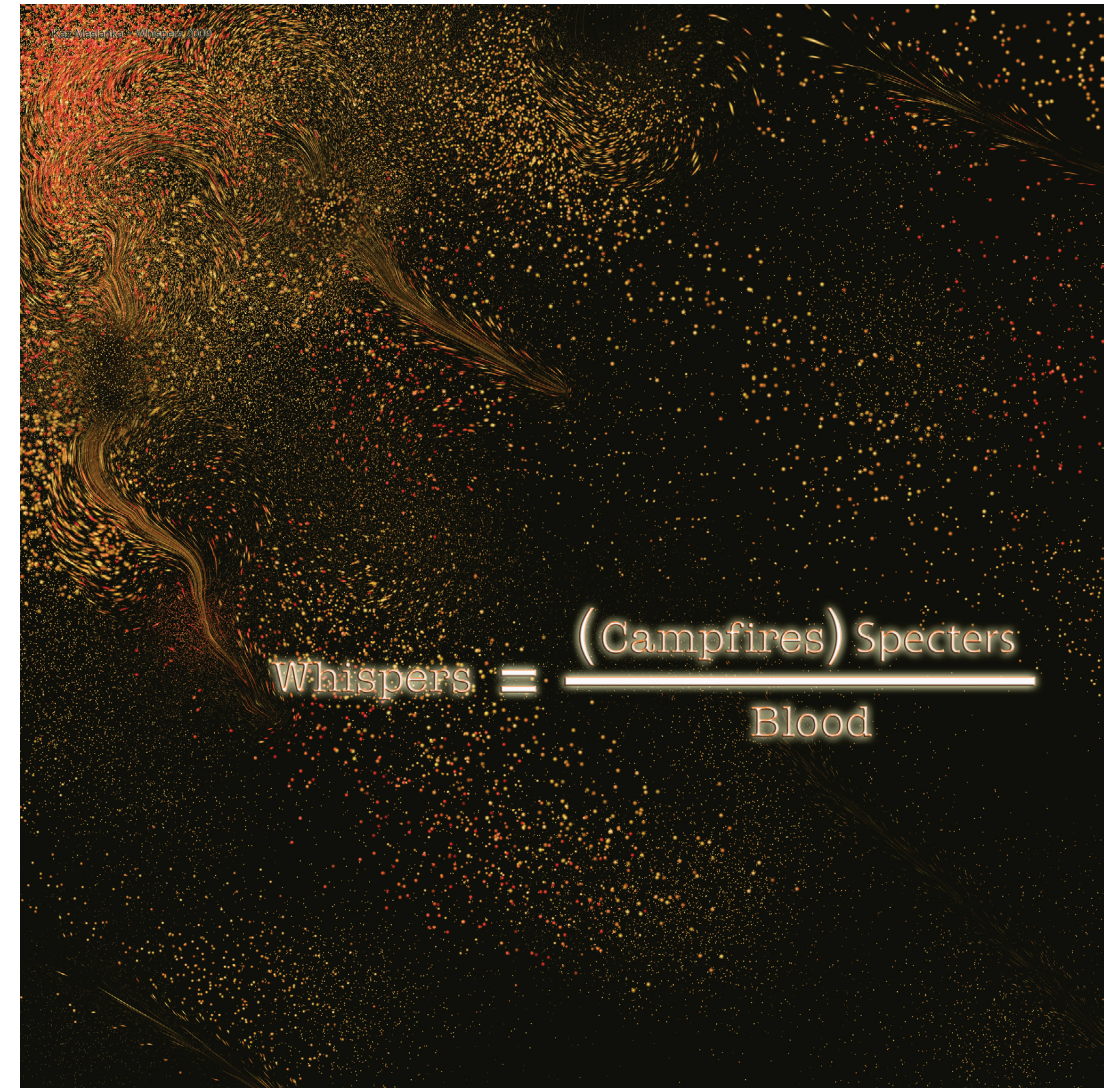



## SALVATION

*Digital print on paper. 11 x 14. 2009.*

This work is titled Salvation and is an example of what I call a "Proportional Poem". All proportional poems are in the form of "a is to b" as "d is to e". In addition, one of the variables is chosen to be solved and the poem is displayed as a result. The visual images within this polyaesthetic work serve synergistically in the conflation of the mathematical and visual aesthetic experience. The two houses you see in the image are bath houses just outside the temple bridge at Songgwangsa temple in Korea. These bath houses are used to bathe the ghosts of our ancestors as a requirement before they are allowed into the temple.





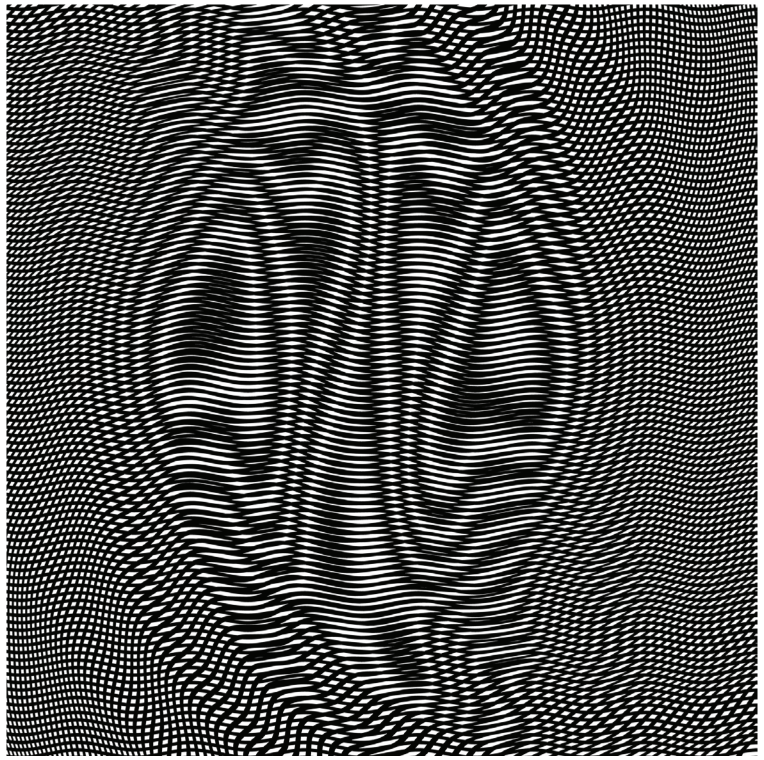

## WHISPERS

*Digital print on paper. 12 x 12. 2009.*

This work is titled "Whispers "and is an example of what I call a "Proportional Poem". All proportional poems are in the form of "a is to b" as "d is to e". In addition, one of the variables is chosen to be solved and the poem is displayed as a result. The visual images within this polyaesthetic work serve synergistically in the conflation of the mathematical and visual aesthetic experience.

# KOERT FEENSTRA

Hengelo ov The Netherlands
kfeenstra@home.nl
www.koertfeenstra.nl



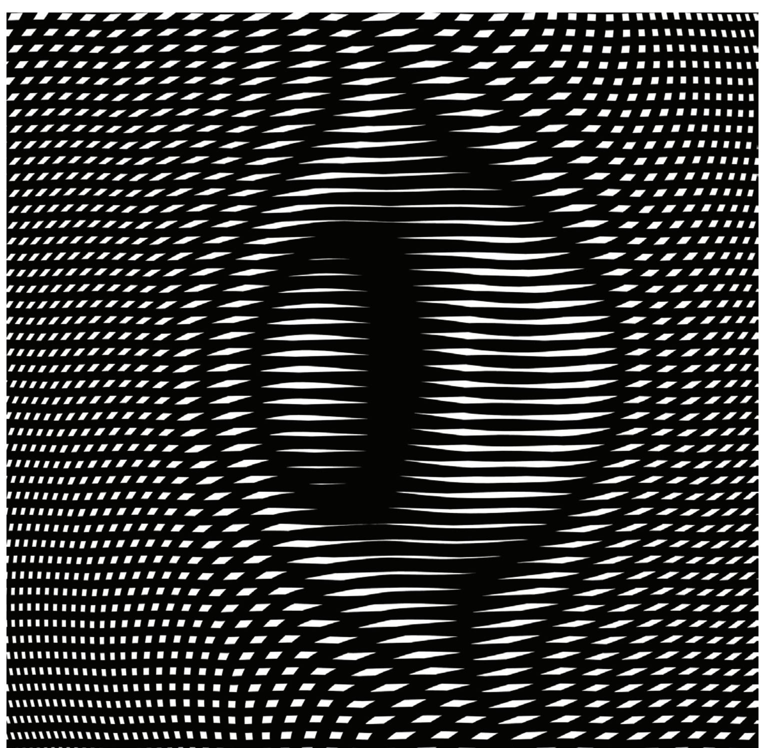
## STATEMENT

I am a 3D artist. I create images that are inspired by the optical phenomenon moiré.

## FACE 3

*Archival Inkjet Prints. 61 cm x 61 cm. 2009.*

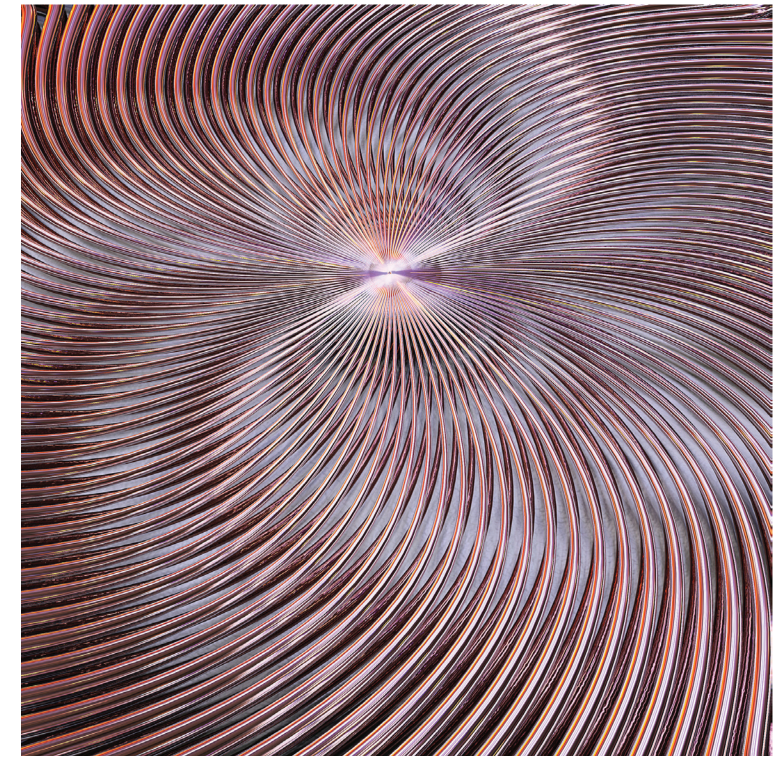
Two grids of black lines on top of each other forming a moiré.



## MOIRÉ 6

*Archival Inkjet Prints. 61 cm x 61 cm. 2009.*

Two grids of black lines creating a moiré.



## 5P

*Archival Inkjet Prints. 61 cm x 61 cm. 2010.*

Two grids of reflective tubes creating a moiré.

## 3P 1

*Archival Inkjet Prints. 61 cm x 61 cm. 2010.*

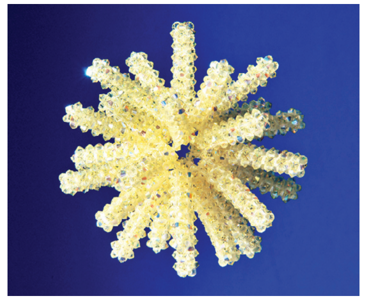
Two grids of reflective tubes creating a moiré.

# LAURA M SHEA

Parker, Colorado, USA
dancingrainbow@comcast.net
www.adancingrainbow.com

## STATEMENT

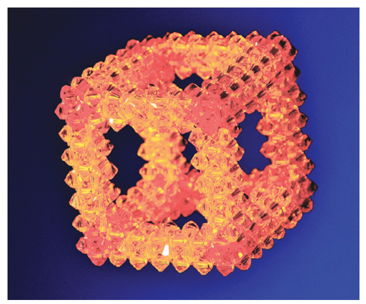
Laura Shea loves creating complex polyhedral structures from beads and thread. Her work explores classic geometric forms-whole and partial frame polyhedra, regular tilings and tessellations. She connects the component forms at contiguous polygonal faces to create chains and complex polyhedral structures. The open networks of tilings and frame polyhedra provide a magical space for light to play with glass.



### STARBURST

*Swarovski® crystal beads and monofilament. 3" in diameter. 2009.*

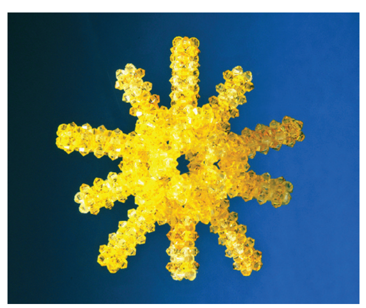
Bead frame great rhombicosadodecahedron sprouting 30 rays of cubes.



### IN OR OUT

*Swarovski® crystal beads and monofilament. 1 ⅛"x 1 ⅛"x 1 ⅛". 2010.*

Bead framework polyhedron consisting of beaded cubes.



### HIGH NOON

*Swarovski® crystal beads and monofilament. 2 ½" x 2 ½" x 1". 2009.*

Beadwork frame polyhedron—great rhombicosadodecahedron with 10 rays of alternating cube stack and 20 cubes.

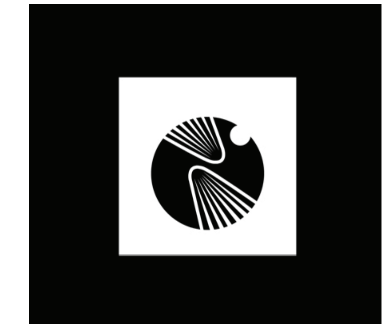


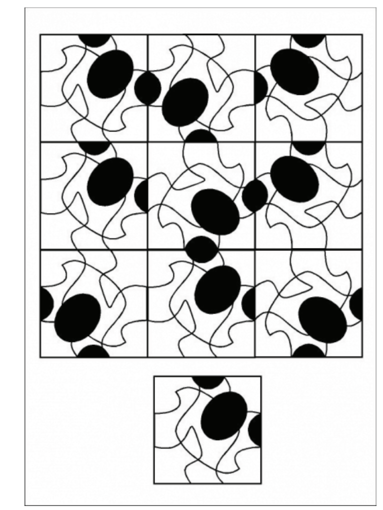
# NEDA YAVARI RAD

Sariyan University
Tehran, Iran
arts_rad@yahoo.com
www.nyavarirad.com

## STATEMENT

I am interested in circular movement and when I design a logo, I try to integrate curves and symmetry.





### SPORT PUBLICATION 1

*(top left) Print. 12cm x 12cm. 2009.*

This logo is designed for a sport publication depicting a book and an athlete. I have used simple elements, several symmetries, vertical reflection and rotation.

### SPORT PUBLICATION 2

*(top right) Print. 12cm x 12cm. 2009.*

This logo is also designed for a sport publication depicting cross section of two books and an athlete. I have used rotational symmetry to create the athlete's body from the books.

### MOSAIC 1

*(bottom left) Print. 50cm x 70cm. 2008.*

This is a mosaic design, created from a single square with non-symmetric black and white pattern which is repeated. Based on the rotation of the original square, different shapes are created.

### MOSAIC 2

*(bottom right) Tile. 50cm x 70cm. 2008.*

These are tiles made based on similar mosaic design, but actually three dimensional. Instead of black and white or different colors, different thickens and depth were used to create the shape. This is a photograph of the actual tiles.

# LOUISE MABBS

Self employed artist
Hove, Brighton, UK
louise.mabbs.textiles@btinternet.com
louisemabbs.co.uk

## STATEMENT

I'm a textile artist specialising in quilts / embroidery but increasingly making sculptural pieces consciously pushing the boundaries in my field.

I only did O"level maths at school, having lost the plot somewhere after quadratic equations, but a request in 1986 to enter a "Mathematical Magic" exhibition set me off remembering the pattern making side of the modern maths I'd learnt. I began working on a number-colouring system and got fascinated by how numbers related to one another.

I had worked through my system from square grids, to perspectives, to circular grids, when in I met John Sharp in 1999. He recognised the maths patterns in my work and has enabled me to put names to shapes and develop grids for the shapes I imagined.

I now avidly read maths books and people think I'm weird! So part of my mission in schools and women's classes is to make maths accessible to the general public. I love it how maths underpins everything and I want to pass that passion on to others!

## TRINITY/TREFOIL KNOT

*(left) Cotton fabrics and thread, polyester inner. c 12" x 12", 300 x 300mm. 2007.*

This is an elegant pointed Trinity knot drawn with a rounded Trefoil knot as a 2D image. Making it up was very complicated and I had no idea it would become a pyramid like this. The length of the tube is a bit short for the structure's needs—but this is a very difficult thing to gauge. Plain colours are made with the seams on the outside for extra interest in a very long rainbow sequence. I'd like to tackle some other double knots because it's not always easy to imagine what the finished structure will be like and I'm sure there are lots of surprises in store for me!

## BORROMEAN RINGS 3 (PUR/GRE/TUR)

*(above) Cotton fabrics and thread, polyester inner. c 12" x 12", 300 x 300mm. 2007.*

Third in a series of 3 dimensional textile sculptures, which show 2D line drawings as the objects they really represent. In the hope that non-mathematicians would understand them. Borromean Rings are three rings (zero knots) joined in such a way that each ring goes through both the others and if one was broken the whole pieces falls apart. One ring goes round the outside of another, the third ring goes outside the outer ring but inside the inner one, so they hold together. I normally work in a very graphic, solid colour way, but I challenged myself to be more creative by using my 'left over' project scraps. One ring has a straight 'seam', another a spiral and the other a waving line. The ring ratio (1:4.5) is about right for me.



## BORROMEAN RINGS 4 (RAINBOW)

*Cotton fabrics and thread, polyester inner. c 12" x 12", 300 x 300mm. 2007.*

Fourth of my Borromean Ring series, in my typical trademark rainbow colours and smooth edges. The rings are longer in this sculpture (ratio about 1: 5.25) so the rings have ended up being more oval in shape and less pleasing to the eye. Originally a pagan symbol, early Christians appropriated Borromean Rings as a sign of the Trinity—Father, Son and Holy Spirit. It is about the best image I have found for representing 1 deity in 3 personalities. This is normally seen as a 2D shape where three circles appear to sit on top of each other spaced in a triangular fashion, frequently used on business logos by people who have no idea what they represent!

## CHAIN LINK 1 (YEL/GRE/PUR)

*Cotton fabrics and thread, polyester inner. c 20"x 8" x 4", 510 x 200 x 100mm. 2007.*

I was wondering if there were other ways of joining 3 rings than in a Borromean format. This piece has two links joined to one another to form a chain, while the third goes through the centre of both rings, hence the 'link' in the title. What I hadn't realised is that whichever coloured ring you hold at the top, the other two rings slip into the same positions. Made in my shaggy style with deliberately contrasting snippets.

# MAGNUS WENNINGER

Saint John's Abbey
Collegeville, Minnesota, USA
mwenninger@csbsju.edu
www.saintjohnsabbey.org/wenninger/

## STATEMENT

More information about the techniques I use to produce my artistic patterns on a spherical surface can be found in the Dover publication of my book Spherical Models (1999), originally the Cambridge University Press publication of Spherical Models (1979). Robert Webb's Stella program is now my computer program par excellence: http://www.software3d.com/PolyNav/PolyNavigator.php

## SCHOOL OF FISH GEODESIC

*Paper. 8" in diameter. 2008.*

Geodesic domes are well known, especially in connection with the architectural structures designed by Buckminster Fuller. My main interest, however, has been in having geometric patterns projected onto a spherical surface. I call this geometric pattern a "School of Fish", because it has indeed the artistic appearance of 3 fish 'kissing' at the center point of each icosahedron triangle, while 5 fish have their tails conjoined to form a pentagrammic star at the vertex point of each icosahedron triangle. The 5 colors also are symmetrically arranged, adding greatly to the beauty of the whole ensemble.



# MARCEL TÜNNISSEN

Hörby, Sweden
www.tunnissen.eu/polyh/

## STATEMENT

Lately I started building models of polychora. By using transparent material I try to show all faces. This is different from what I have seen before and it comes with some new challenges.

First of all the inside of a model, with all the imperfections, can be seen. The tabs to glue the faces together can now be seen and they need to be as small as possible, as a result however the relative errors become bigger. Several layers of cells will lead to the fact that outer layers won't fit anymore. This requires much more craftsmanship than building polyhedra.

Using transparent colours influences how faces in lower layers are experienced. If you use layers of analogous colours, it is hard to distinguish them, if you use layers of complementary colours, lower layers will loose their effect. One has to balance the colours carefully. Sometimes one has to break a mathematically correct colouring scheme to get a far more aesthetic result.

## PROJECTION OF A RECTIFIED 24-CELL

*Chromolux paper and coloured transparent overhead sheets. 118 mm x 118 mm x 118 mm. 2009.*

This is a model of the (4 dimensional) uniform polychoron called rectified 24-cell. It consists of 24 cubes and 24 cuboctahedra. All cubes are transparent and 8 are light pink, 8 light yellow and 8 colourless. Bright white light is needed to be able to distinguish these colours. The cubes on the inside are a bit darker. The colours pink, blue and green are evenly divided over the triangles. The colouring scheme of both the cubes and the triangles is such that a rotation around a symmetry axis transforms one set of colours into another. For the triangles this symmetry is partly broken by using transparent material for the triangles on the outside, while all the others are opaque. This makes the model visibly more attractive.

# MARIEN METZ

Schagerbrug, the Netherlands
atelier@handweverij-metzwier.nl
www.handweverij-metzwier.nl

## STATEMENT

Let me present myself: I am a weaver, interested in weaving repetitive patterns. For me weaving is characterized by patterns in lines, blocks and repeating forms which are composed by the use of (different) colors and special weaving-techniques.

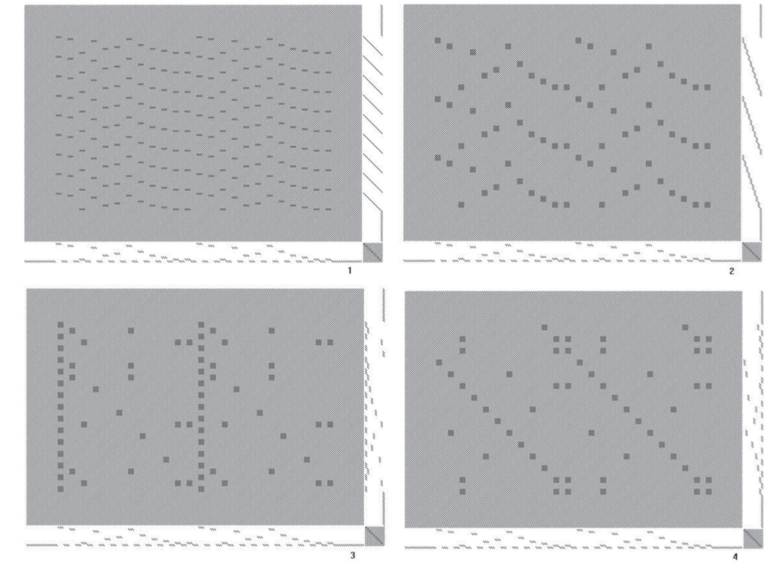
I like to compose and than discover how the composition works out (material, technique, color). Furthermore I am a teacher and I work in commission. I always thought my woven products must enable everyone to use in and around the house. Than a good friend, Roland de Jong Orlando, told me my work has a real connection to art and especially to mathematical art. To work with that idea for me is a very fascinating challenge!

## RUHR METROPOLE 2010,4

*Textile handwoven. 300 x 400 mm. 2010.*

My artwork on the loom: I used several colours in blue shades in the warp, inspired by the art of Victor Vasarely. Material: mercerized cotton 34/2 (Venne Colcoton) 16 threads/cm

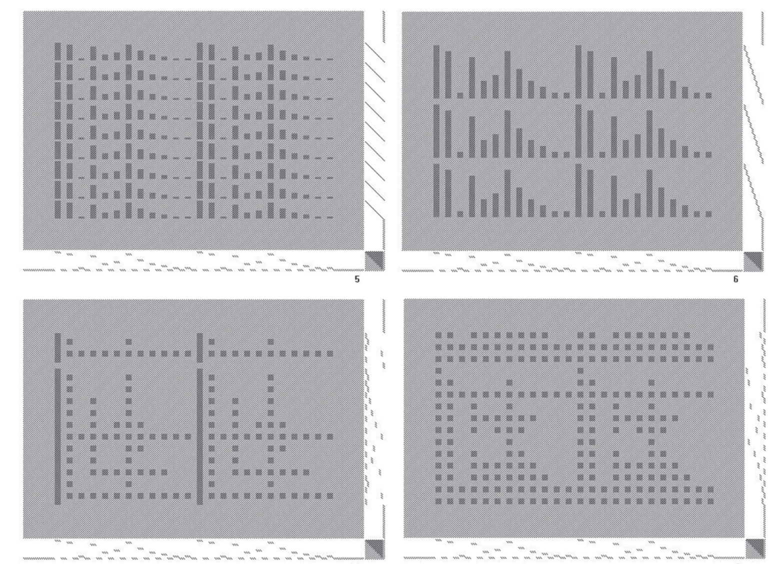




## RUHR METROPOLE 2010, 1

*Textile handwoven, design 1,2,3,4. 300 x 400 mm. 2010.*

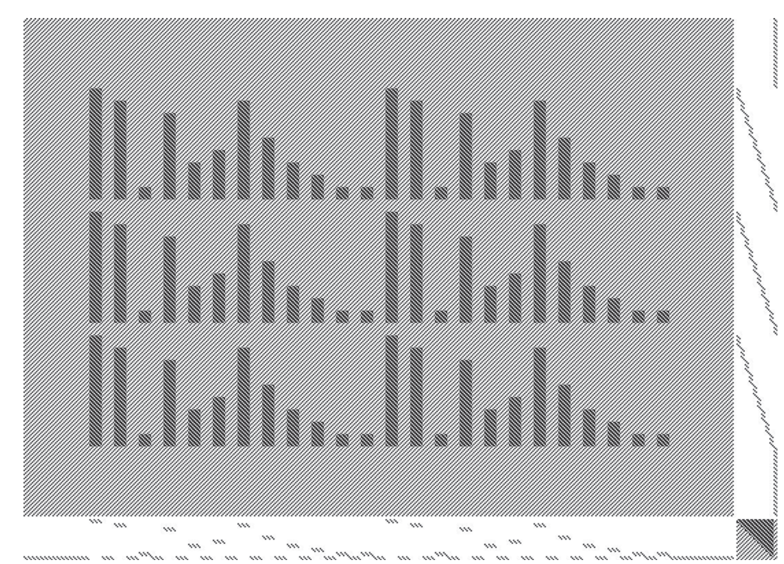
The technique I use in this artwork is a block twill (2/1) woven on 30 shafts. I' am fascinated by the work of Fibonacci which is to be noticed in my artwork. This for me is the link with mathematics. In the examples the warp-threads are all threaded in the same way, built on the numbers of Fibonacci. I repeated the numbers to get two rapports. I made 8 examples (numbered 1 – 8): Four pairs of the examples are each treadled in the same way 1 and 5, 2 and 6, 3 and 7, 4 and 8. An other difference is made between the examples 1, 2, 3, 4 and 5, 6, 7, 8 . The difference lies in the fact how the shafts are tied up.



## RUHR METROPOLE 2010, 2

*Textile handwoven, design 5,6,7,8. 300 x 400 mm. 2010.*

In the several examples made with help of a PC program the warp-threads are all threaded in the same way, built on the numbers of Fibonacci. So I used the numbers 0,1,1,2,3,5,8 and the sum of the following numbers, (13) 4, (21) 3, (34) 7, (55=10) 1, (89=17) 8, (144) 9 ; then I repeated all this numbers to get two rapports. The reason of threading in this way is because I have 30 shafts and for a 2/1 twill I need 3 shafts for each number. So my highest number is 9 (0 – 9). I made 8 examples (numbered 1 – 8).



## RUHR METROPOLE 2010, 3

*Textile handwoven, design 6. 300 x 400 mm. 2010.*

This is the design to be woven for the exhibition

# MANUEL DIAZ REGUEIRO

IES Xoán Montes
Lugo (Galiza- Spain)
www.allegue.com/artigos

## STATEMENT

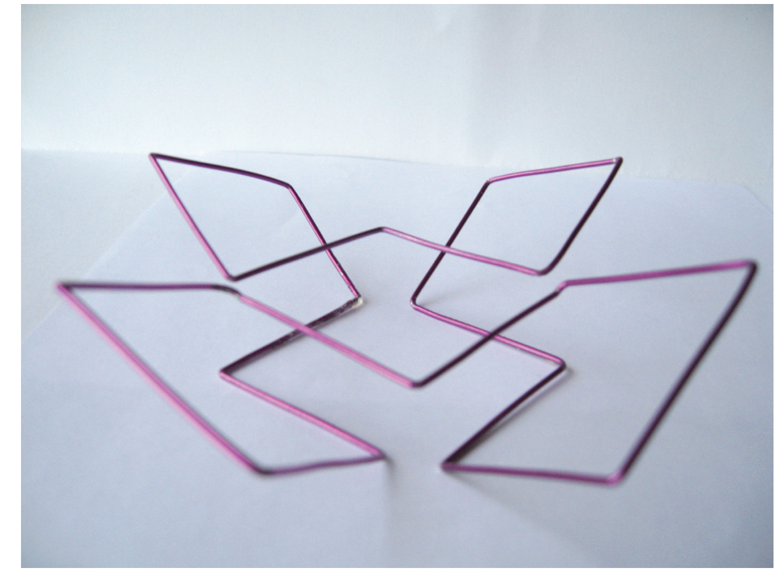
I call my art 'Galician sculptures'. It's a very particular and special kind of three dimensional l-system, created with my own programs. At present I have a set of several hundred figures, most of them "wire sculptures" with axial symmetry like tables, exotic dishes or jars. Some of them have a geometric profile with Islamic flavor, and others are purely 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.

## WIND

*Wood. 10"x10"x10". 2010.*

A woodwork. A figure with a joint system that allows the figure to make a constant twist while maintaining its structure giving it its own character. However, the figure conceals its generation system as an L-system, a simple formula that with constants angles combined into a graceful figure.

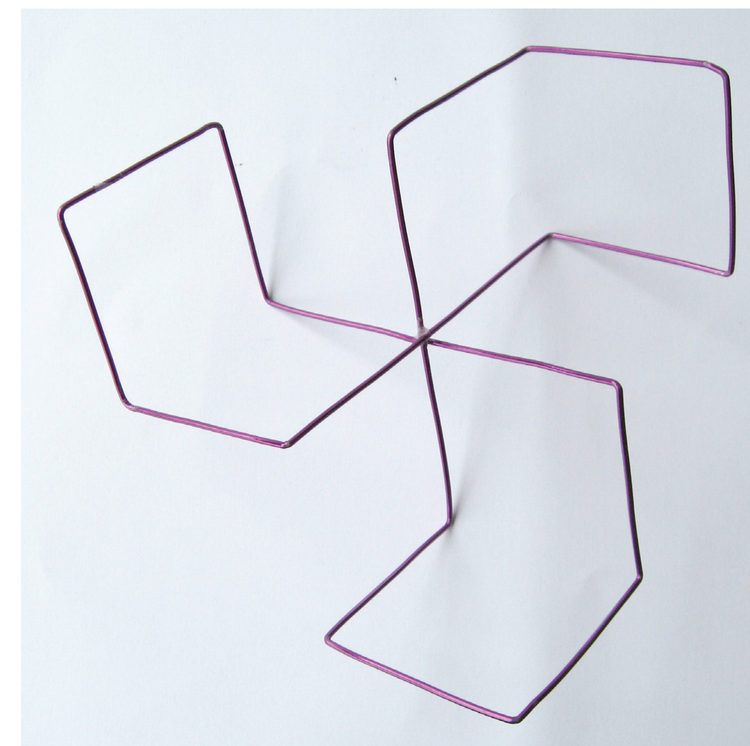




## SIX SQUARES

*Wire. 5x11x11 cm. 2010.*

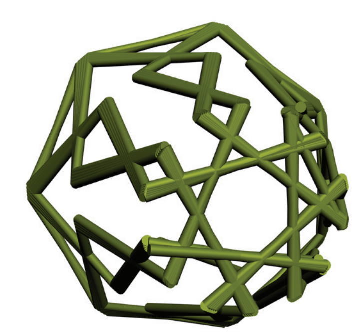
The work shows how a simple set of five squares in 3D can show several hidden symmetries. Indeed, there's not squares at all, only squares that aspire to make a 3d figure. A 3d L-system in which the 90º angle predominates.



## SQUARED TRISKEL

*Wire. 10x10x10 cm. 2010.*

A triskel is an ancient Galician symbol (500 BC) that is based on a division in six parts of the circle, i.e, it's based on a hexagon. Now, here is a simple particular view of a 3D figure with six squares. This, again, is an L-system that is away from the traditional idea of an L-system as a tree.



## ISLAMIC GLASS

*Rendered image with extrusion.*
*10x10x10 cm. 2010.*

A 3D wire object representing a glass with Islamic and geometric profile. A traditional and usual object that also can be studied as an L-system.

# MEHRDAD GAROUSI

Hamadan, Iran
mehrdad_fractal@yahoo.com
mehrdadart.deviantart.com

## STATEMENT

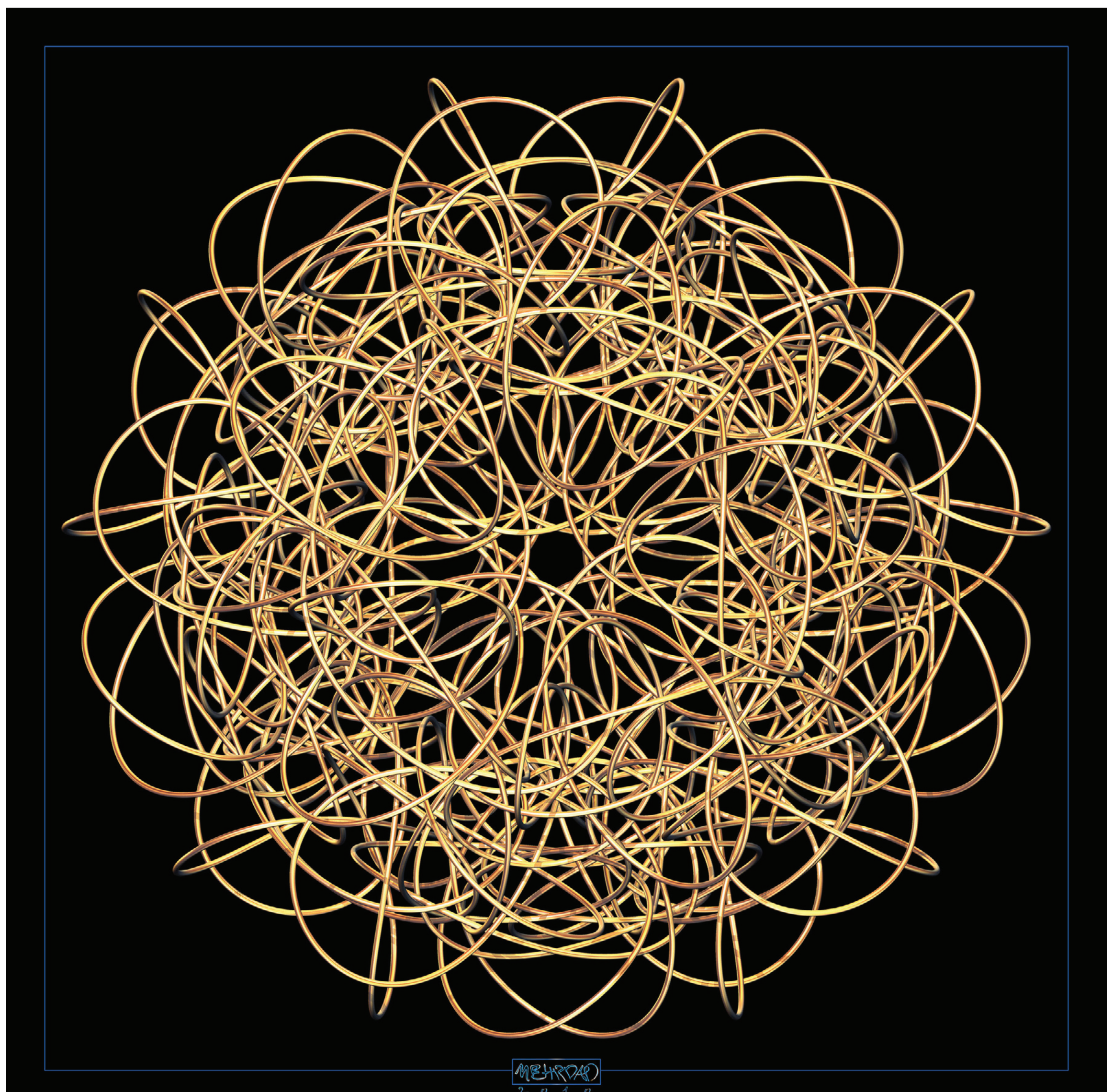
There are diverse types of knots and various ways of knotting in constructing complex and eye catching works of art. I found my own way of working with them. Basically, I provide a polyhedron and a simple pattern of a few interwoven knots. Then, I put same groups of knots similarly on the vertices or faces of the polyhedron. All of the knots on different vertices or faces must be moved and adjusted altogether so that they intertwine with their neighbors and provide a big chain of knots in the form of an apparent sphere. Afterwards, we must find our desirable point of view through which an appropriate symmetry appears.

Here, in following works, I have exploited icosahedrons and trefoil knots of which different groups are placed on the vertices of the icosahedra. Although, my initial 3D polyhedrons in all following works are icosahedra, due to the pentagonal arrangement of trefoil knots, they look icosidodecahedra and even dodecahedra.

## KNOTS 2

*Digital art print. 24" x 24". 2010.*

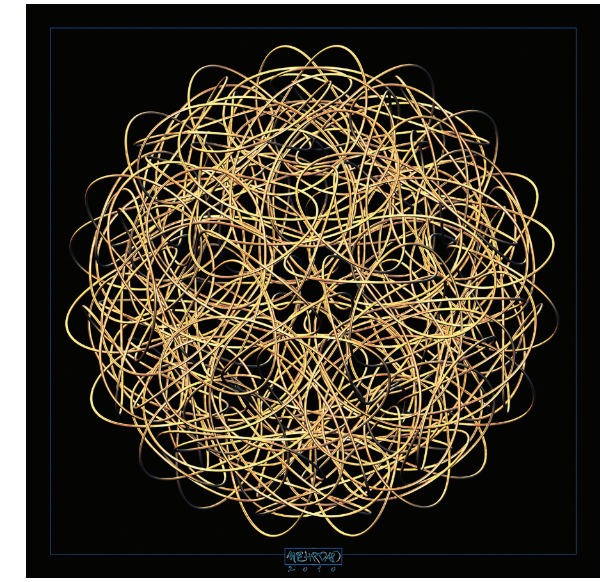
By staring at this five-fold rotational symmetric work, one can find different pentagons composed of ambient and particular parts of trefoil knots. The big central circle surrounding the internal pentagons is the special property of this piece. It must be paid attention that the underlying knots, usually with darker colors, contributing in the symmetry, actually belong to the backside of the icosahedron and their distance to the foreside ones is equal to the diameter of the big flat-looking medallion we





*Continued from left...*

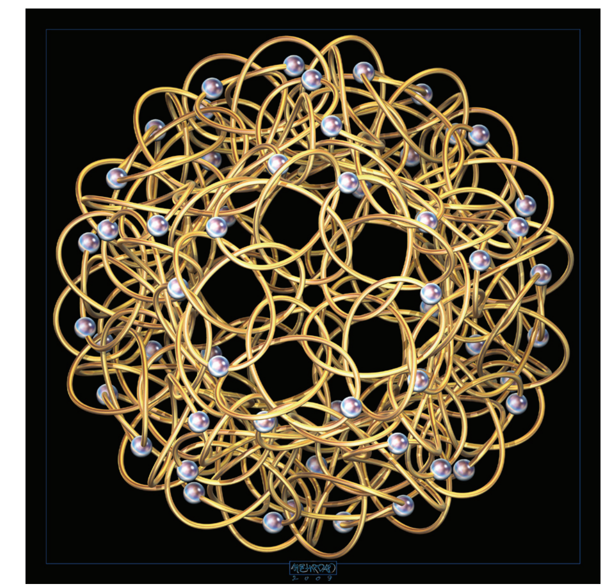
are looking at. The bizarre symmetry yielded through the curves, the type of lighting, and our perpendicular eyesight are the main reasons of destroying perspective in the eyes of the viewer as if he would face a completely flattened disc. In this work and following ones, none of the knots touch each other. They do act like chains.



## KNOTS 3

*Digital art print. 24" x 24". 2010.*

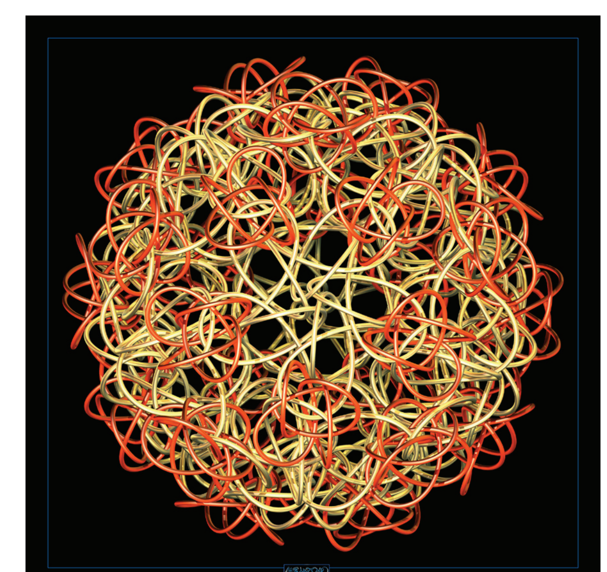
Another five-fold rotational symmetric and flat-looking icosahedron of which significant property is the big five-point lotus is displayed on the basis of the central pentagon. This work comprises corps of a larger number of trefoil knots which do not touch each other at any point.



## KNITTED PEARLS

*Digital art print. 24" x 24". 2009.*

Apart from the different pattern and the perfect central lotus, the further distinction of this work from others is the existence of strung pearls. These pearls being placed similarly at certain points of every knot have created a new symmetry with a different pattern.



## KNOTS AND KNOTS

*Digital art print. 24" x 24". 2009.*

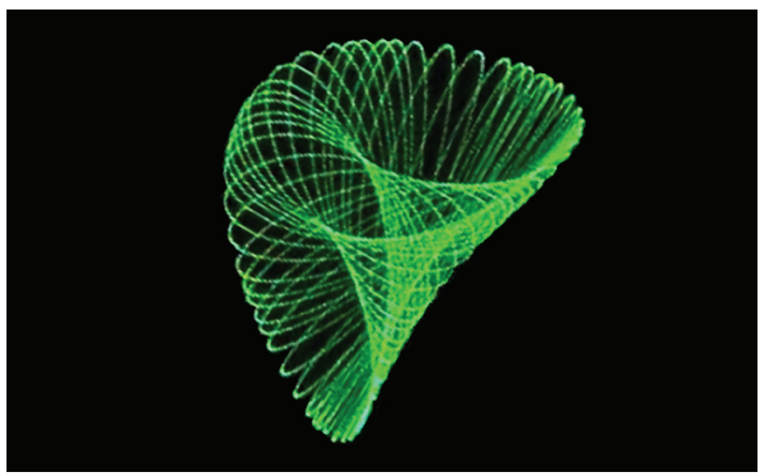
This work consists of two separated corps of red and golden knots. The golden knots similar to previous works display a pentagonal pattern on the front vertex of our icosahedron, but groups of dual red knots are used to tie all the pentagons, placed at basic icosahedron's vertices.

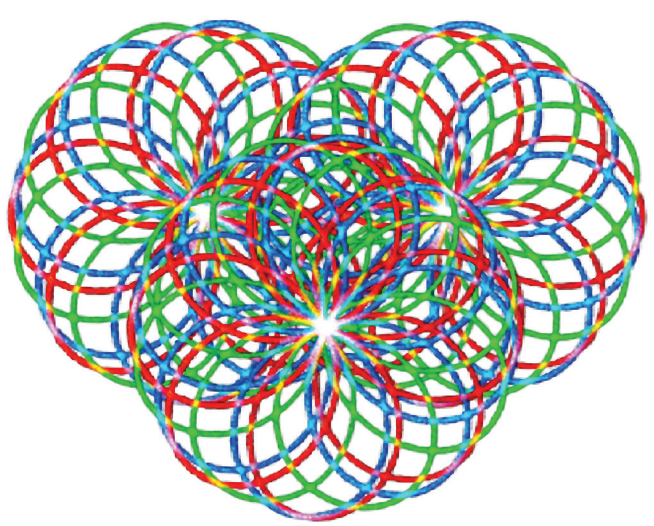
# MERRILL LESSLEY AND PAUL BEALE

University of Colorado at Boulder, Department of Theatre and Dance, and Department of Physics
Boulder, Colorado, USA
lesslev@colorado.edu
spot.colorado.edu/~lessley

## STATEMENT

In our interdisciplinary research and creative work, we create laser images in motion that represent specific mathematical curves (epicycloids, hypocycloids, roses, epitrochoids, hypotrochoids, and other special sine/cosine cases). We create these images by using a computer-controlled laser projection system that we have designed and built. Graphing such curves in multiple laser colors produces a wide variety of images that are really quite beautiful. Unlike drawing them on paper, however, projecting such curves with a laser, or several lasers, poses a particularly challenging problem: while a laser is often referred to as a kind of "pencil" in light, it can only be used to generate a complete picture by moving its projected "dot" rapidly and repeatedly over a reflective surface. The images we create must be scanned at rates between 15 and 2000 times per second. Our primary goal is to create computerized tools that can be utilized by laser artists throughout the world.





## LASER CORNUCOPIA

*Digital print of high resolution video frame. 12" x 9.6". 2010.*

"Laser Cornucopia" was constructed by applying mixtures of sine and cosine signals to a green laser programmed to scan rapidly and repeatedly in "X" and "Y" directions. Creating this art required a mathematical approach similar to the traditional graphing of hypotrochoid curves. However, since we use base and trace oscillators to form our images, traditional parametric equations are modified to accommodate the "dynamic" scanning process. Revised equations, therefore, consider the elements of both base and trace frequencies: x = (a-b) cos(ωt) + h cos(((a-b)/b) ωt); y = (a-b) sin(ωt) + h sin(((a-b)/b) ωt). Also, ω = 2πf, where the base frequency f is the number of times per second that the base oscillator completes a cycle. With this particular image, the fundamental hypotrochoid scan was modulated by a third cosine signal, which formed a pseudo "Z" axis, thus generating the three-dimensional quality of the image.

## LASER HEART

*Digital print of high resolution video frame. 12"x9". 2010.*

"Laser Heart" was constructed by applying mixtures of sine and cosine signals to three lasers programmed to scan rapidly on "X" and "Y" axis lines moving rapidly and repeatedly in various directions. An image was extracted from a video and made transparent in Photoshop. Three copies were overlaid to gain the montage effect. Creating the art started with a mathematical approach similar to the graphing of any hypotrochoid curve. However, since we use base and trace oscillators to form images, traditional parametric equations were modified to accommodate the "dynamic" scanning process. Revised equations considered both base and trace frequencies: x = (a-b) cos(ωt) + h cos(((a-b)/b) ωt); y = (a-b) sin(ωt) + h sin(((a-b)/b) ωt). Also, ω = 2πf, where the base frequency f is the number of times per second that the base oscillator completes a cycle. Since the Rose curve is a special case of the hypotrochoid function, a = (2n) h/(n+1), b = (n-1)/(n+1) h, where n is the number of petals.



# JAVIER BARRALLO

The University of the Basque Country
San Sebastián, Spain
javier@barrallo.com

## STATEMENT

I studied Computer Engineering at the University of Deusto, Bilbao (Spain) and made my PhD on Applied Mathematics. I am currently working in the University of the Basque Country at the School of Architecture in San Sebastián. The union of Computer Graphics, Applied Mathematics and Architecture in my work soon stimulated my love for digital art. I have experimented with interactive video, geometric computer models, architectural simulations but I feel specially comfortable creating innovative fractal images. During the last five years I have been working with Benoit Mandelbrot in the arrangement of Fractal Art contests and exhibits, as well as courses on Art and Mathematics all over the world.

## CTHULHU MYTHOS

*Digital Print. 400x400 mm. 2009.*

The name Cthulhu Mythos is taken from a fantastic universe created in the 1920s by American horror writer Howard Phillips Lovecraft. This image is inspired in the gothic terror and science fiction aesthetic that flood his novels. From a technical point of view, the image is an attempt to create a Mandelbrot Set fractal by expanding its formula into 3D. After proved to be impossible to make that expansion, several programmers developed some tweaks in a non-strictly mathematical way. This is a variation of the Mandelbrot set formula raised to the eighth degree instead of being quadratic (z->z^8+c). The final geometry and coloring techniques were carefully shaped to keep the gloomy and scary atmosphere described in Lovecraft's books.

# MICKEY SHAW

Le Roy, Kansas, USA
fullunac@yahoo.com
FullLunaCreations.etsy.com

## STATEMENT

My inspirations are drawn from nature, mathematics and science. These inspirations are combined with my own experiences and emotions, creating a union between what is seen, what is known and what is felt internally. As an artist, my goal is to create for the viewer, visually, the concept that art, mathematics and science display a fundamental connection conveying the idea that all three encompass more than what can just be seen. I believe that art is an intrinsic aspect of all visual experiences and mathematics can provide a basis for understanding and recreating those same experiences.

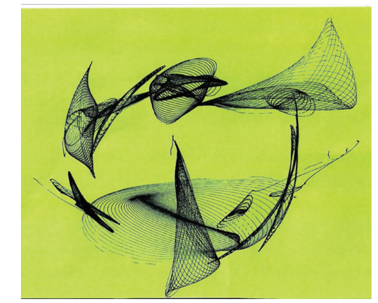
## HYPERBOLIC TWISTSLUG

*Crocheted Fiber Soft Sculpture*
*9" x 22" x 13"*
*2009*

This crocheted fiber soft sculpture is based on non-Euclidean geometry. It represents a variation of the hyperbolic plane ruffle effect. The piece was created using basic crochet stitches which were increased at a rate great enough to create exponential growth. Attention was given to pushing the construction into a form of varying volume, irregular shape and an integration of pattern and color. The end result is simultaneously geometric in its basic nature and organic in its form. This creation used over two pounds of fibers. The structure is malleable, allowing the form to morph into numerous shapes. The hyperbolic soft sculpture is a further exploration of what forms can evolve in combining hard-edged geometric concepts with the fluid, textural aspects of fiber and stitches. This combination creates a three-dimensional visual and mental juxtaposition of the interconnection of the two elements.



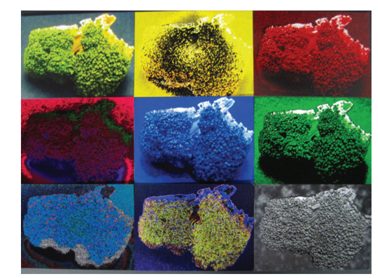
## SPIRAL GENESIS



*Original Ink Pen Drawing*
*8.5" x 11"*
*2009*

Spirals are curves emanating from central points, progressively growing further away as they revolve around the point. This drawing is a unique, one of a kind rendition of spirals, but created in reverse direction from outer edges into a central point. Some variations resembling Sinusoidal, Archimedean and Hyperbolic spirals and even an occasional pseudosphere are created. The drawings are created on a drawing board suspended from a pole with an attached arm holding a pen. The board is set in motion by hand. Drawings are manipulated by changing the motion of the drawing board. This particular drawing resulted from creating a circular cycle of spiraling forms. The spiral design drawing conveys a two-dimensional visualization and exploration of the connections between art, mathematics, and science combining drawing, spiral and pendulum theories.

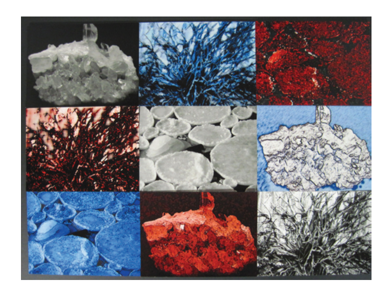
## A NATURAL FRACTAL SERVED NINE WAYS



*Altered Reality Photographic Prints*
*22" x 28"*
*2010*

As my inclusion of mathematical and scientific elements and concepts into my artwork grows, my interest in exploring more connections of all three also expands. Out of a fascination with fractals came a desire to explore the artistic nature of natural fractals, the beautiful naturally mathematical creations of nature. My goal, with this project, was to introduce an altering of the subject's surface. I didn't wish to totally disguise the object, but rather examine it from new perspectives, new perimeters of what the surface structure might look like, as well as combining it with color shifts. I wanted to make the viewer really take a look at the fractal object—shape, volume, line, surface and the repeating fractal patterns. My color shifts and surface alterations invite and guide the eye to rethink what it is seeing, not just broccoli florets, but actual living examples of the mathematical concept of fractals.

## FRACTAL LATIN SQUARE



*Altered Reality Photographic Prints*
*22" x 28"*
*2010*

Using natural fractals as the subject, I chose to use three different examples: a cluster of quartz crystals, cedar tree roots and ice platters. I decided to portray the examples in three forms, natural state plus two altered styles: a cartoon-style outline form and a more solid painterly form. Three different color paths were also chosen: black and white, blue, and red. My goal was to explore, visually, each of these natural fractals in each altered state form and color path. I wanted to display the alterations in a mathematical manner, and the Graeco-Latin Square suited this purpose perfectly. Each fractal was assigned a capital letter, then each altered style/color path was assigned a lower case letter. I then followed the simple Graeco-Latin Square layout as follows: Aa Bb Cc, Bc Ca Ab, Cb Ac Ba This arrangement allowed for an orderly manner in which to display the fractals and their alterations as well as highlight the artistic interaction of the alterations.

# NICK SAYERS

Brighton & Hove, England, UK
mail@nicksayers.com
www.nicksayers.com

## STATEMENT

I make geodesic sculptures, lighting and shelters from recycled, reused and repurposed materials. My work explores the beauty of maths and plays with how everyday, mass-produced items can be tessellated. The pieces also make a statement about sustainability and the reuse of waste.

Unlike much mathematical art, which is often purely abstract and quite cold, I use recognisable household objects to make work that is accessible, real and fun. I hope by extension to make maths and geometry similarly accessible to a lay audience.

The largest of my Spheres to date is To Live, a 2.4 metre diameter geodesic shelter made from estate agent 'to let' boards. I've also made a smaller version, entitled To Play, as a playhouse for children. I'm developing a larger one as an inhabitable shelter.

I've been inspired by Magnus Wenninger, Stewart Coffin, Buckminster Fuller and George Hart. Artistically, I draw inspiration from land artists Andy Goldsworthy, Richard Long and Jan Dibbets.

## COKE BOTTLES SPHERE

*60 plastic Coke bottles. 48cm spherical diameter. 2010.*

Sphere of 60 plastic Coke bottles, slotted and held together without glue by 180 hand-cut elliptical locking slots. The piece is intended to be lit from within as a pendant lampshade. The tops of the bottles form the vertices of a truncated icosahedron. The interlocking slots are cut along the line of intersection between each pair of cylinders, with a zigzag cut to lock the pieces together. You can see more of my Spheres project at http://flickr.com/nicksayers/sets/72157609022531531/detail



## BRITISH RAIL TRAIN TICKETS SPHERE

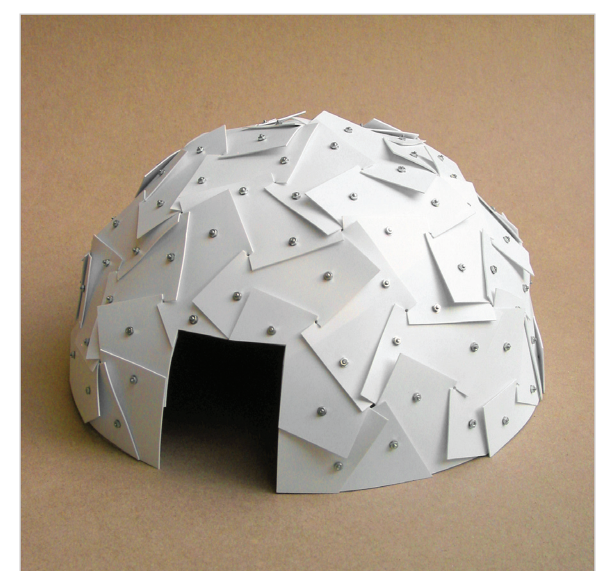
*120 self-service British Rail train tickets. 29cm spherical diameter. 2010.*

Sphere of 120 British Rail train tickets slotted together and held in place by their own tension. The structure is adapted from the IQ Light system by Holger Strøm. The basis for each module in this system is the rhombic face of a triacontahedron, scaled more in one direction to cause distortion and thus increase constructive tension. Whereas the IQ Light embellishes this with a pretty curved surrounding shape, my train ticket sphere takes things back to basics – just a train ticket with four slits cut by hand! You can see more of my Spheres project at http://flickr.com/nicksayers/sets/72157609022531531/detail

## BICYCLE WHEEL REFLECTORS SPHERE / CHANDELIER

*Plastic bicycle wheel reflectors, cable ties. 33cm spherical diameter. 2008.*

I developed this as a low-cost alternative to a crystal glass chandelier. It's made from 60 bicycle wheel reflectors sourced from a local bike shop. The parts were drilled and joined together with 120 clear nylon cable ties. The reflectors, and the holes between them, respectively form the faces and edges of a distorted rhombicosidodecahedron. You can see more of my Spheres project at http://flickr.com/nicksayers/sets/72157609022531531/detail



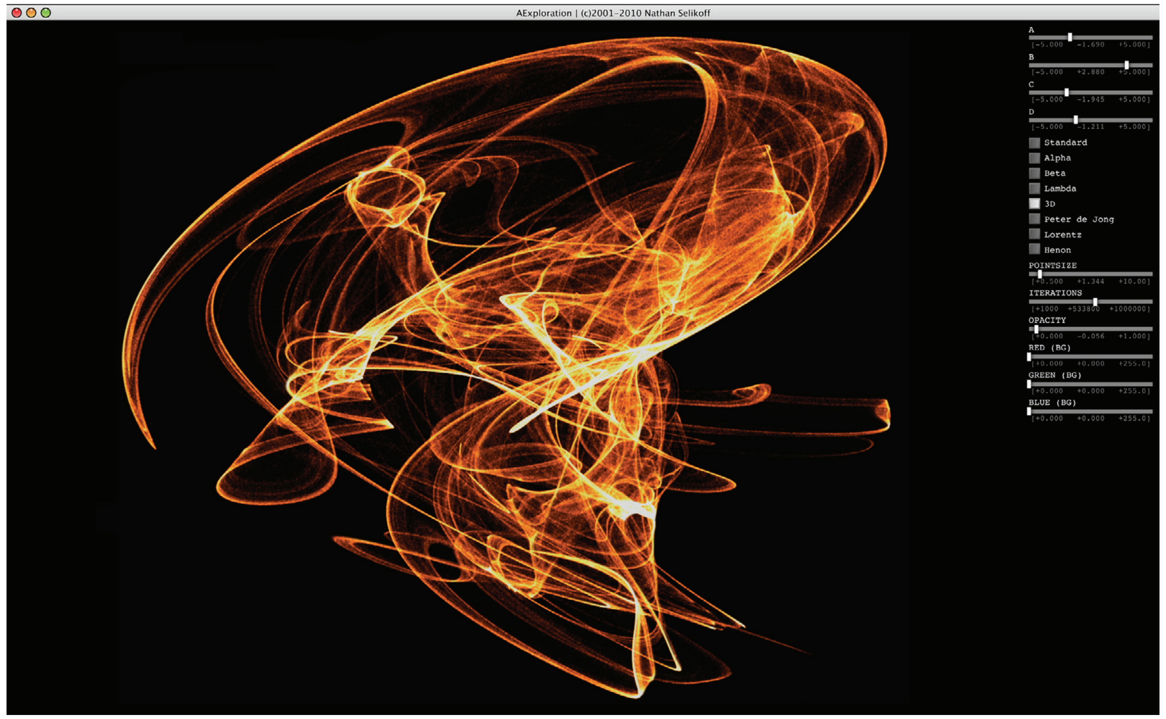
## 'LIVING IT LARGE' MAQUETTE

*Plasticard, mini nuts, bolts and washers. 31cm diameter x 16cm high. 2009.*

Maquette for a shelter dome to be constructed from 60 estate agent (realtor) 'to let' or 'for sale' sign boards. It's a development of a previous design, entitled 'To Live', also made from 60 boards in a more spherical configuration. To Live has been exhibited as an art installation but has the potential to be used as a disaster relief shelter or event kiosk. The structure is based on a truncated icosahedron, triangulated to form a diamond pattern in which the standard board size is angled to fit. You can see more of my Spheres project at http://flickr.com/nicksayers/sets/72157609022531531/detail

# NATHAN SELIKOFF

Digital Awakening Studios
Orlando, Florida, USA
nselikoff@gmail.com
www.nathanselikoff.com




## STATEMENT

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.

## ÆXPLORATION (AESTHETIC EXPLORATION)

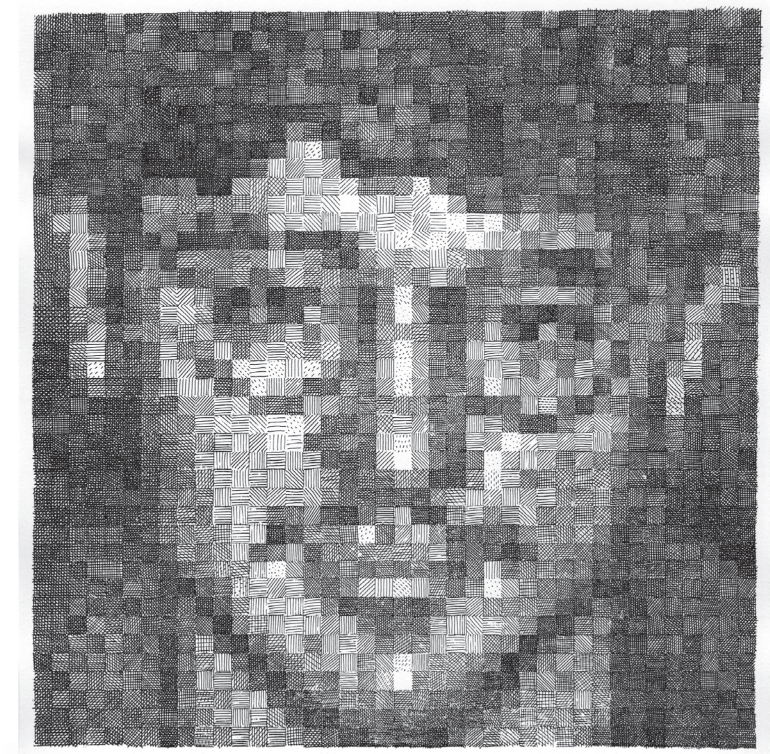
*Real-time Video Projection. Variable. 2009.*

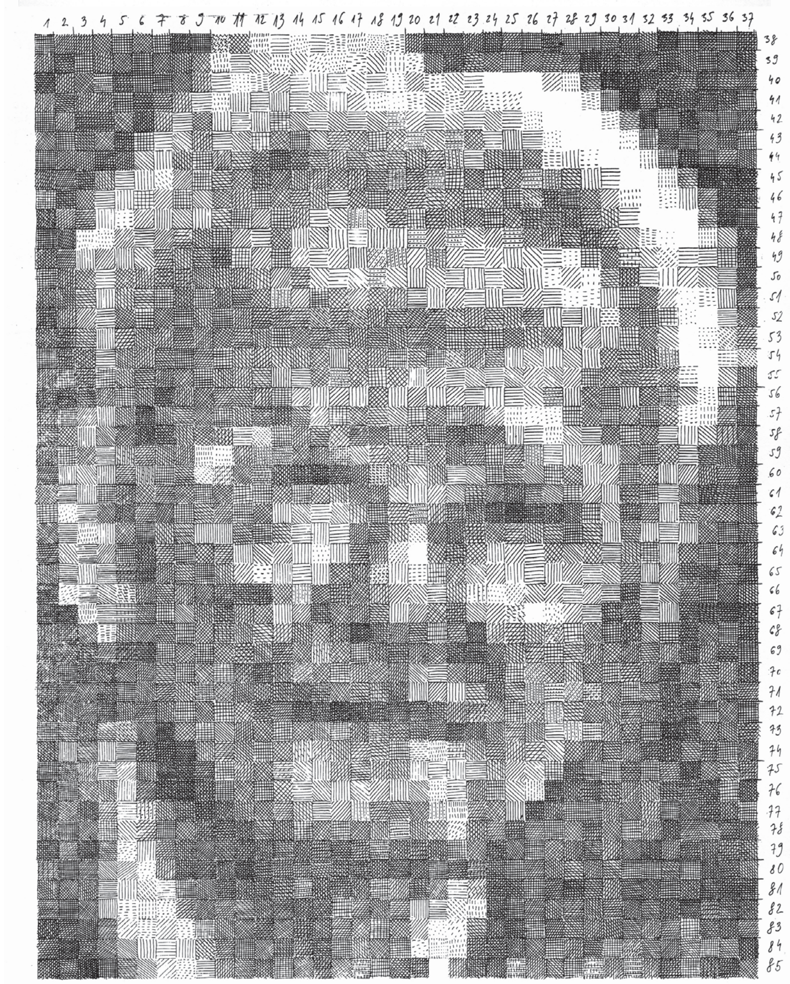
Æxploration (Aesthetic Exploration) is a real-time, interactive video projection. This custom software visualizes a variety of two and three dimensional strange attractors, allowing the viewer to control the coefficients, color, and translation of the attractor. Until recently, my goal has been to generate high quality still images of strange attractors, and my interactive software has been geared towards that purpose alone—an artist's tool that is a by-product of the process, viewable only by myself. But recently, in the course of a single day, I made some changes to my code that completely revolutionized what I was seeing on the screen while using my software, and I am excited to share the results. The image above is a screen capture. Video is available at http://nathanselikoff.com/251/strange-attractors/aesthetic-exploration



# ISTVÁN OROSZ

Sopron University (West Hungarian University)
Budakeszi, Hungary
utisz@t-online.hu
web.axelero.hu/utisz/page.htm





## STATEMENT

Themes of the natural sciences, especially of geometry and optics appear in most of my works. They are often related to postmodernism by archaic forms, art historical references, stylistic quotations and playful self-reflection. I like to experiment with the extremes, paradoxes of the representation of the perspective to create the illusion of space. I also experiment to renew the techniques of anamorphosis when I distort the pictures in such a way that it can only be seen from a particular aspect or in such a way that its new layer of meaning only reveals by the interposition of reflective surfaces.

## O.M.

*(top) Etching. 300 x 300 mm. 2009.*

Handmade etching portrait of my son created from 1600 squares.

## O.L.

*(left) Etching. 300 x 400 mm. 2010.*

Handmade etching portrait of my father created from 1776 squares.

# ANNA ILDIKÓ PETŐ

Moholy-Nagy University of Art and Design Budapest
Budapest, Hungary
hello@petoanna.com
www.petoanna.com

## STATEMENT

In most of my works I use video and photography. I like the strong and intense relation between sound and moving images in video as well as the precise composition's mathematical stillness in photography. I combine perceptions from science and music and intend to experiment with the medium itself to create a vivid but well-organized world.

## STRUCTURES OF TWO NO. 1

*Photograph (inkjet pigment print). 433 x 600 mm. 2009.*

In the series "Structures of Two" my aim is to create a mathematical structure based on symmetry and tessellation, which can express the relation between the figures. Each pair of image shows two different versions of a relation. The structures of the images are built up by opposites and parallels in which the movements of the figures and the space are strongly related. István Orosz Hungarian graphic artist's mathematically inspired works with forced perspectives and optical illusions gave me the idea to transplant this kind of graphic world into photography. M. C. Escher's similar works to that of István Orosz and the fitting of the figures on the face-card had also effects on this visual world. My aim is to create a world similar to the graphical inspirations mentioned above, which is also an experiment of how these artificial perspectives act in photography.

## STRUCTURES OF TWO NO. 2

*Photograph (inkjet pigment print). 433 x 600 mm. 2009.*

In the series "Structures of Two" my aim is to create a mathematical structure based on symmetry and rotation, which can express the relation between the figures. Each pair of image shows two different versions of a relation. The structures of the images are built up by opposites and parallels in which the movements of the figures and the space are strongly related. István Orosz Hungarian graphic artist's mathematically inspired works with forced perspectives and optical illusions gave me the idea to transplant this kind of graphic world into photography. M. C. Escher's similar works to that of István Orosz and the fitting of the figures on the face-card had also effects on this visual world. My aim is to create a world similar to the graphical inspirations mentioned above, which is also an experiment of how these artificial perspectives act in photography.

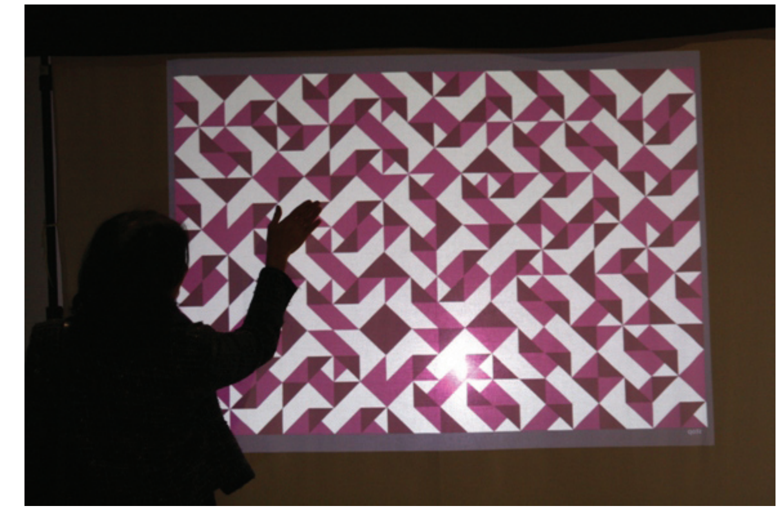


# ZSÓFIA RUTTKAY

Moholy-Nagy University of Art and Design
Budapest, Hungary
ruttkay@mome.hu
create.mome.hu/ruttkay

## STATEMENT

I am interested in interactive structures: visual patterns that change as response to external stimuli. This general definition allows changes with time (evolving images, animations), changes to urban stimuli (sound level, weather or pollution conditions, traffic parameters) and unintentional or intentional, but natural action of people in front of the (projected) image, by making sounds, walking around, gesturing or touching. Such interactive tasks are challenging in educational situations, especially to invite art students to study underlying mathematical principles (L-systems, symmetry transformations) and to acquire skills in computer graphics and programming. Interactive applications simulated on a computer screen can serve on large-scale displays or projections as urban decorations, novel data visualization or serious games to make citizens move, connect and smile.



## INTERACTIVE WALL

*Interactive installation, touch-sensitive computer generated image. ca 2m x 0.8m x 3m (3m behind the screen). 2009.*

The Interactive Wall is an installation to explore different tessellation, both considering the ornament on the square tiles and the patterns of transformation of tiles. The initial display is defined by choosing a tile design from a set prepared by art students, and arranging examples in one of 6 patterns, or in a random way. The surface is sensitive for touches by the visitors. Each touch results in a transformation (rotation or mirroring) on the affected tile. The display reflects the exploratory or goal-directed action of the visitors, who may also get intrigued to find out the underlying mathematical principles. Equipment: canvas, with computer, camera and projector behind (1-4 m). The Interactive Wall could be displayed in an alley or cut-off corner of some public space at Bridges, or in a door (to an unused room). The size of the canvas may be as big as the max size of 2d exhibits, but a wall-like measure would do better for interaction.

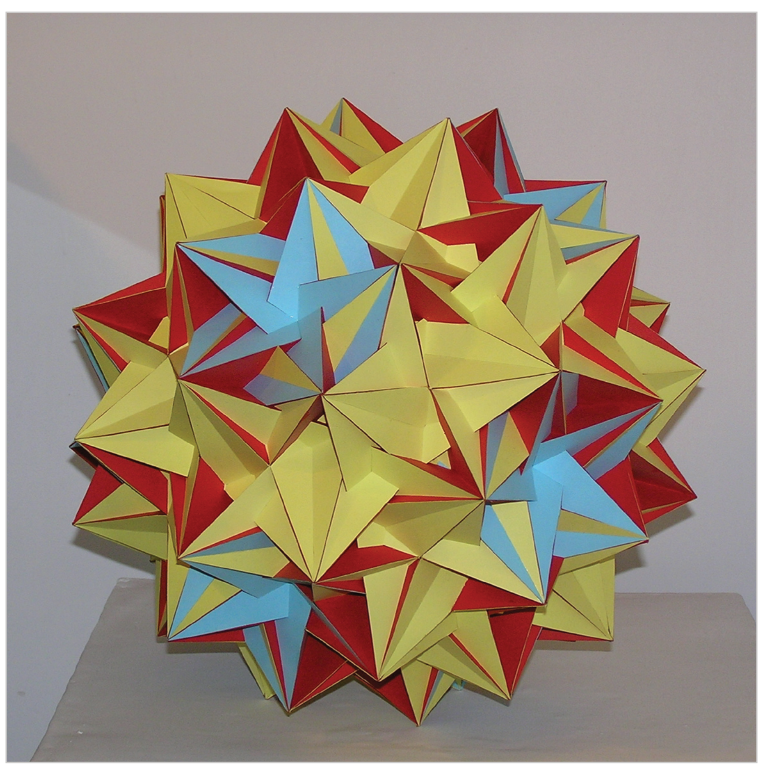
# PIOTR PAWLIKOWSKI

Adam Mickiewicz Secondary School, Kluczbork
Kluczbork, Poland
piotr.pawlikowski@inetia.pl

## STATEMENT

For many years I have been making polyhedron models. I use different techniques, but the best results I get in cardboard and glue. For a few years I have been using computer software (mainly Great Stella) for creating nets. At first, I did not recognize my hobby as an art. I was just adding new models to my collection. Once a manager of our local museum encouraged me to organize an exhibition of my models in Kluczbork's museum. It attracted many visitors and it was a moment when I started to think about my activity as some kind of mathematical art. In polyhedra (especially in their compounds) simple shapes – triangles, squares, pentagons etc. form highly complex and tricky structures. In my models one can see the harmony and the beauty of mathematics. Looking at them one can also feel some tension between simplicity and complexity. Both turn out to be the two sides of the same coin.

## TRIANGLES AND SQUARES



80 triangles and 60 squares form this highly complex and beautiful structure. From the mathematical point of view this is a uniform compound of 20 tetrahemixahedra (THH). Its constituent is interesting because it is the simplest non-convex uniform polyhedron and the only uniform polyhedron with an odd number of faces (7 – 4 triangles and 3 squares). Compound of 20 THH is intriguing because it is the only uniform compound of uniform polyhedra which cannot be obtained by adding symmetry to a group in which the basic polyhedron is uniform. The faces of each THH are so intricately facetted that the whole model consists of 1620 facelets. Nets for the model were derived from the Great Stella software.

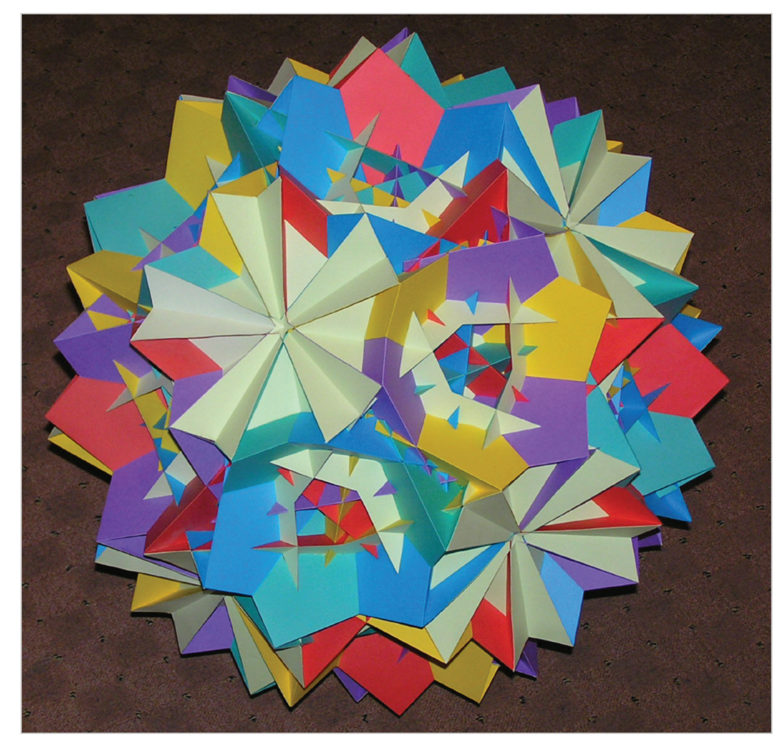
*Glued cardboard (160g/m2). 14 x 14 x 14 inches. 2003.*

## SQUARES AND TRIANGLES I

This highly symmetrical structure is built from 90 squares and 40 triangles. This is a uniform compound of 5 small rhombicuboctahedra. Its constituent is one of the Archimedean solids. It is a remarkable polyhedron because there exists a "twin brother" of it which is not uniform. The compound is interesting too. Most of the Archimedean solids do not form any uniform compounds. This one is the most complex uniform compound of not only the Archimedean solids, but also of all convex uniform polyhedra with non-prismatic symmetry (the whole model has 1080 external parts). Nets for the model were derived from the Great Stella software. A complex shape created simply with squares and triangles.

*Glued cardboard (160g/m2). 13.5 x 13.5 x 13.5 inches. 2004.*

## SQUARES AND TRIANGLES II



90 squares and 40 triangles arranged in the other way than in „Squares and Triangles I" form this wonderful shape. These polygons cut one another in so incredible way that the whole structure consists of 3540 facelets. But it is not only complex, but it is fully symmetrical too. Mathematically this is a uniform compound of 5 great rhombicuboctahedra (M. Wenninger number 85) and this is the most complex of all uniform compounds of uniform polyhedra. This is a true example of extreme connections between simplicity and complexity. Nets for the model were derived from the Great Stella software.

*Glued cardboard (160g/m2). 22 x 22 x 22 inches. 2007.*

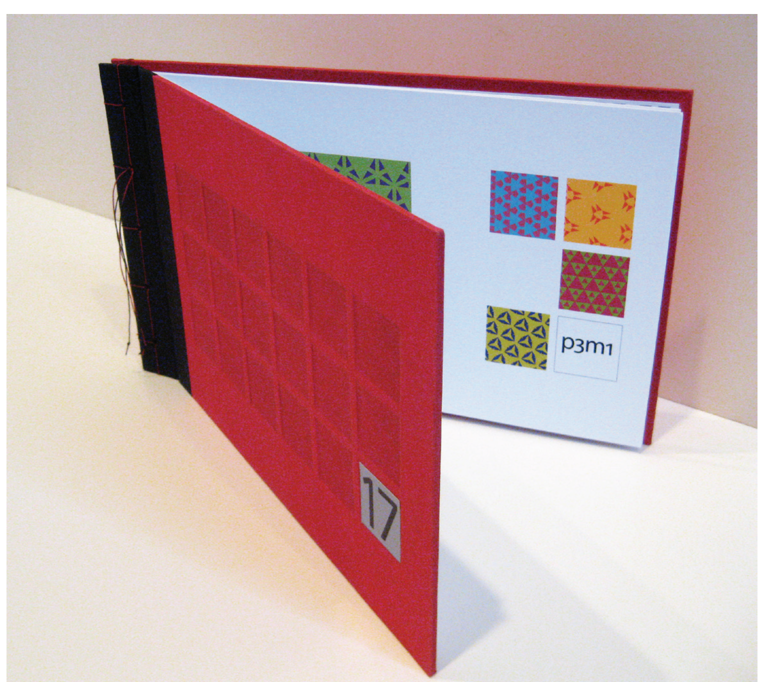
# MARGARET KEPNER

MEK Visysuals
Washington, DC, USA
renpek1010@yahoo.com

## STATEMENT

I enjoy exploring the possibilities for expressing ideas in new ways, primarily visually. I have a background in mathematics, which provides me with a wealth of subject matter. My lifelong interest in art gives me a vocabulary to utilize in my work. I particularly like to combine ideas from seemingly different areas and try to find parallels and relationships. Some years I 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. Topics that I have explored include: tesselations, symmetry patterns, combinatorics, edge-matching, group theory, dissections, magic squares, modular systems, knots, fractals, and number theory. For the most part, I use inkjet printing to produce my artwork. I have also experimented with screen printing, textile constructions, digital printing on fabric, and book making in order to produce pieces at a larger scale and/or with more physical variety.

## 17 BOOK




*Book cloth, book board, linen thread, inkjet printing on paper*
*8.75" x 13.875" x 0.5"*
*2007*

The book "17" is a visual exploration of the 2D symmetry groups—the so-called "wallpaper" groups. These 17 groups have interesting mathematical properties, and the associated patterns are widely used in the decorative arts. A symmetry pattern can be transformed by (1 or more) of the motions of translation, reflection, rotation, or glide-reflection, while still preserving the overall pattern. For this book, the same "seed" shape, a 30-60-90 triangle, is used for all patterns. There is a page for each symmetry group, with a large square containing a representative pattern for that group. Smaller squares on the page show other variations, achieved due to the effect of using different initial orientations of the seed shape, plus variations in spacing and coloring. In the lower right-hand corner, each group's name is shown according to a commonly used system: p1, pgg, p3m1, etc. Graphic index pages precede and follow the group pages. The book uses the Japanese Stab Binding method.

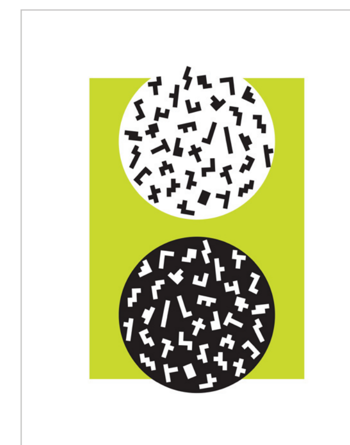


## QUILT 100 BOOK

*Folded paper, inkjet print*
*Flat: 24" x 24"; Folded: 2.4" x 2.4" x 1.6".*
*2009*

"Quilt 100" is an accordion-fold book with 100 pages. The book's subject matter is a "quilt" of 10 rows and 10 columns, composed of pairs of nested squares filled with 10 different colors. The structure and coloring of the quilt is based on a pair of Mutually Orthogonal Latin Squares of order 10. Such pairs were once thought to be impossible for all orders of the form (4k+2), based on a 1782 conjecture by Euler. Although it was proven that the order 6 case (36 Officer Puzzle) has no solution, examples of MOLS of orders 10, 14, etc. were found in 1959. They were dubbed "Euler's spoilers." In the flat quilt, due to the properties of MOLS, each color occurs in the outer squares exactly once in each row and column, and similarly for the inner squares. All 100 possible color combinations occur. To make the 2D quilt into a 3D book, a system of cuts and accordion folds is used. The two double-squares not on the quilt's main diagonal are given special "bookend" roles in the folded book.

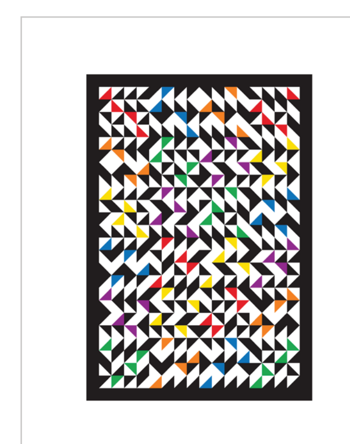
## HEX STUDY WITH CIRCLES



*Archival inkjet print*
*14" x 11"*
*2008*

"Hex Study with Circles" is derived from a shape-packing problem. The 35 small shapes in each circle are called "hexominoes." They represent all the shapes that can be formed from six squares joined along their edges, neglecting rotations and flips. Mathematicians have explored ways to pack these shapes efficiently inside various envelopes. This design is based on a tight packing of the hexominoes into a circle. The packing has been exploded slightly, creating space around the original "packed" pieces. Small random rotations have been added to loosen up the design and suggest motion. The patterns in the two circles are reflections of each other. One might imagine that the black pieces in the upper circle are expanding outward, escaping from a smaller, tightly packed circle. Perhaps the white ones in the lower circle are moving in the opposite direction, condensing inward. Tensions are created in this design between white and black, rectilinear and round, expansion and contraction.

## PERM MOD 4 EXP

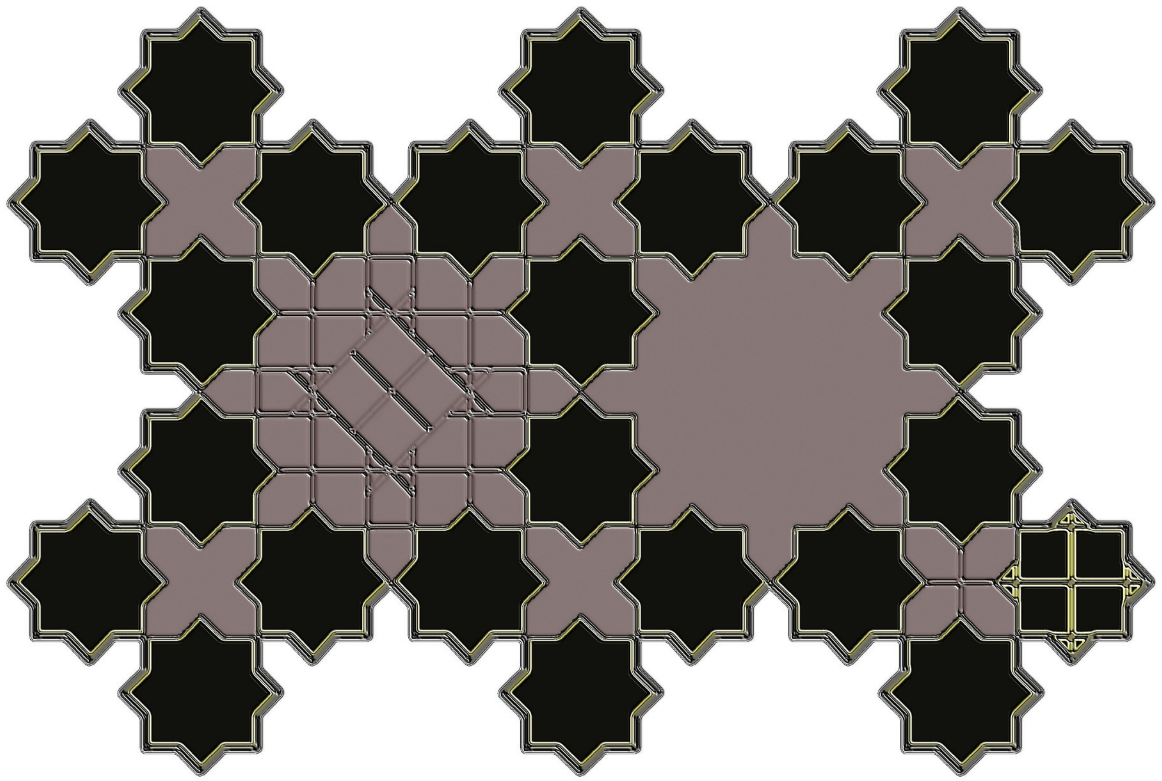


*Archival inkjet print*
*14" x 11"*
*2008*

"Perm Mod 4 Exp" is part of a series of 6 prints based on operation tables under modulus 4 arithmetic. Each print is an expression of an operation (+, -, x, etc.) using 4 symbols: the 90-degree rotations of an isosceles right triangle. The operation in this case is exponentiation. The basic operation table is a 4x4 array, where the entry in row a and col b is (a^b mod 4). A particular choice of the 4 triangle symbols to represent the numbers 1 through 4 yields a 4x4 mini-table of 16 triangles. Since there are 24 permutations of 4 symbols, 24 mini-tables are possible. These are arranged in a 6x4 grid into a larger composite table. Each mini-table is based on a particular permutation, which has an associated 4x4 permutation matrix of 0s and 1s. This matrix is "overlaid" on the mini-table to define its coloring scheme. Where the 0s fall, the triangles are black; where the 1s fall, the triangles are colored. Permutations with the same linear pattern are assigned the same primary color.

# REZA SARHANGI

Department of Mathematics, Towson University
Towson, Maryland, USA
rsarhangi@towson.edu



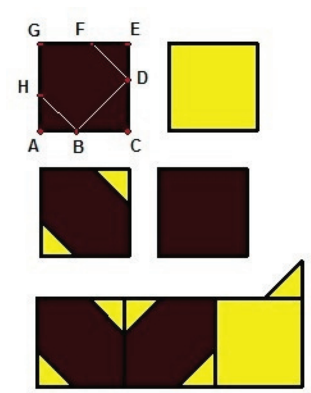
## STATEMENT

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.

## CALM

*Digital Print. 16"X20". 2008.*

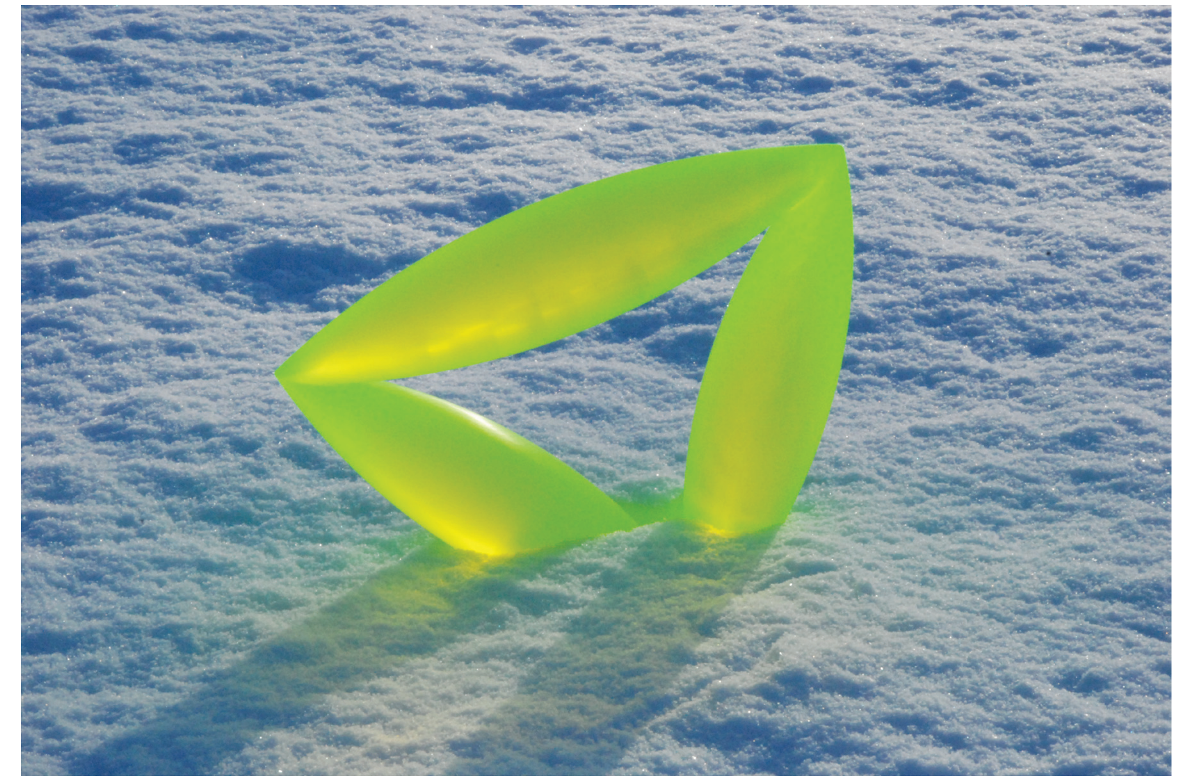
"Calm" is an artwork based on the "Modularity" concept presented in an article by Reza Sarhangi, Modules and Modularity in Mosaic Patterns, the Journal of the Symmetrion (Symmetry: Culture and Science), Volume 19, Numbers 2-3, 2008. Another article in this regard would be Sarhangi, R., S. Jablan, and R. Sazdanovic, Modularity in Medieval Persian Mosaics: Textual, Empirical, Analytical, and Theoretical Considerations, 2004 Bridges Proceedings. The set of modules with extra cuts used to create this artwork is presented in the figure to the right.






# RICHARD HOOPER

Liverpool Hope University
Liverpool, UK
hooperr@hope.ac.uk
richard-hooper.co.uk



## STATEMENT

My research interest is in the application of CAD/CAM methodologies to sculptural form.

My work is abstract, geometric and minimalist. I am interested in Platonistic Idealism and the notion of the sublime and the relationship between mathematics and art. I am also interested in the changing notion of the sculptor in (or out of) the studio and the implication for that of digital and sculptural practice.

## TRINITY

*Cast Acrylic. 75mm x 320mm x 330mm. 2010.*

The submission is a sculpture based on three conjoined forms derived from variations of the Versica Piscis lens shape. Where the classical Versica Piscis has two equal circles such that the centre of each circle lies on the circumference of the other, those in the submitted piece are spaced such that the height of the major axis of the modified Versica Piscis lens is equal to half the height of the conventional Versica Piscis (giving a smaller and slimmer lens shape). This shape is then bisected and rotated through 360 degrees to create a solid ('American Football' shaped) torpedo. The forms are then obliquely truncated at both ends by two mirrored planes set at thirty degrees to the major axis and intersecting at a point halfway along the radius (set at ninety degrees to the major axis) of a circle circumscribing the modified Versica Piscis lens shape. The truncated faces of the three forms are then mated in CAD to construct the solid three dimensional abstract form submitted.

# SAMUEL VERBIESE

Overijse, Belgium
verbiese@alum.mit.edu

## STATEMENT

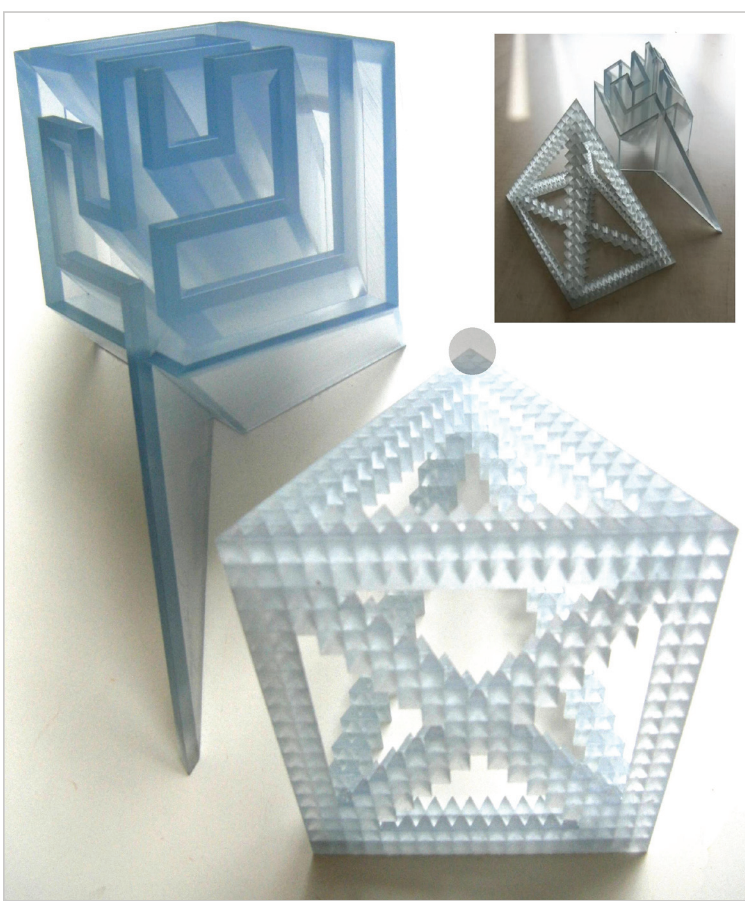
Besides expressionistic painting and sculpting of the figure and portrait, I am recurrently drawn into geometric projects, probably by previous life.

This year I present two 3-D prints by Materialise (Leuven, Belgium) of works previously shown 2-D :

- a Golden Pyramid, in echo to my paper in the present conference and to a work I was accepted to present at the Joint Mathematics Meeting in San Francisco in January 2010 (http://www.anneburns.net/jmm10/verbiese.html), and

- a microChartres labyrinth projected reverse on a cube I showed in Bridges 2009 in Banff (http://www.bridgesmathart.org/art-exhibits/bridges2009/verbiese.html)

Due to the highly educational content presented at several workshops for children, the works are again presented on a table in an "installation" setting including posters/pictures/models as explanatory material.



## 'FRACTAL' GOLDEN PYRAMID

*3-D print (stereolithography) in see-through resin. 183 x 112 x 150 mm. 2010.*

My Golden Pyramid is a truss that can project (when viewed from underneath, at a precise, quite near point, orthogonally to the back golden triangular face) into the K5 graph (pentagram inscribed in a pentagon) with remarkable proportions (two equilateral and two golden triangles on a golden rectangular base featuring its two diagonals). The model has its struts built here, kind of fractally, from 463 slightly overlapping tiny golden pyramids. The software used for modelling were Scott Vorthmann's vZome and Materialise's Magics. Thanks for their respective help.

## MICROCHARTRES LABYRINTH PROJECTED REVERSE ON A CUBE

*3-D printing (stereolithography) in see-through resin. 251 x 114 x 147 mm. 2010.*

The idea stemmed from the desire to design a labyrinth that followed the theme of the garden fair "Les Jardins d'Aywiers", devoted in the spring of 2008 to the bees. An hexagonal symmetry resulted, complete with bee cells (thanks extended to Patricia Limauge for kindly inviting me). Contemplating this, readily lead to projecting the microChartres on a cube, and this, in an 'inverted' way, i.e.: the labyrinth path on top of the domed cubic wall and the maze "wall" in the bottom of the cube. The object was further developed into a building accessible from the Ariadne thread at ground level. Four tunnels between dead-ends have been added to transform the maze into a circuit, which can be seen thanks to the see-through nature of the used material.



# SEAN R STEWART

Owen Sound, Ontario, Canada
seanstewart@rogers.com
www.seanrstewart.com

## STATEMENT

Sean obtained his Bachelor of Science degree in 1993 with a special interest in physics and mathematics. He subsequently obtained a post-graduate degree in the health sciences field in 1997.

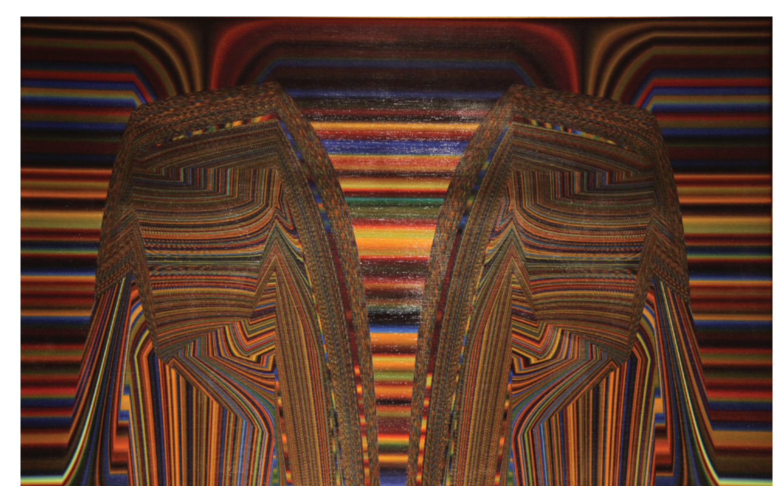
He applies his mathematical background to his photography and paintings to create 'organized randomness' in his work. Currently he is exploring x-ray photography using expired medical film and intensifying screens.

Mathematical Paintings: These images originated by first selecting a photograph which had the appropriate colour palate I was looking for. Using mathematical formulas and pushing pixels around manually with a mouse or pen tablet, the images were formed. Some still resemble the original photo, while others are only similar in their colour. Some images have thousands of formulas applied to them, taking many weeks to complete. All of the mathematical pieces were created using open source software.

## ALGEBRAIC BLISTER

*Digital print on canvas. 24x36. 2009.*

Polarizing mathematical interpretation of graffiti with manual introduction of error points to simulate 'blistering' of the image.



## COLOURFUL MYOPIA

*Digital print on canvas + board, gloss polymer. 18x27. 2010.*

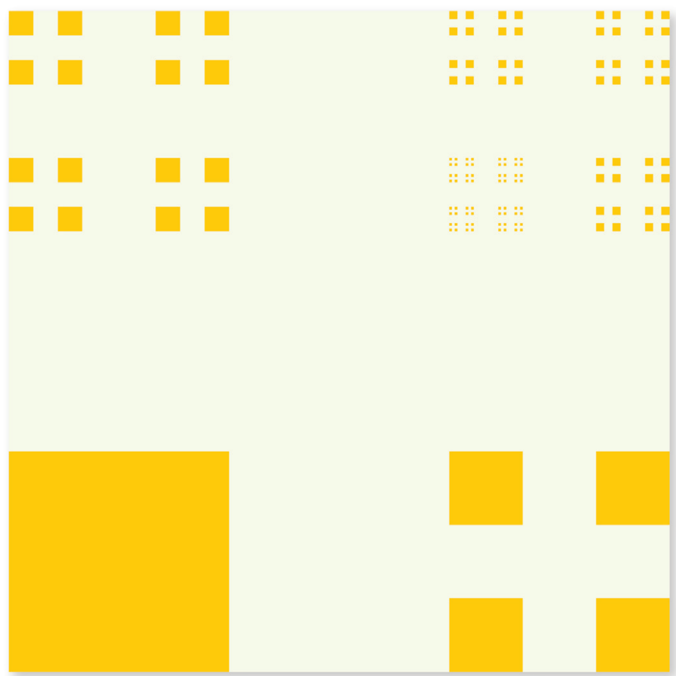
Polarizing interpretation of graffiti to simulate myopic vision problems.

# SAXON SZÁSZ JÁNOS

Mobile MADI Museum
Budapest, Hungary
saxon-szasz@invitel.hu
www.saxon-szasz.hu

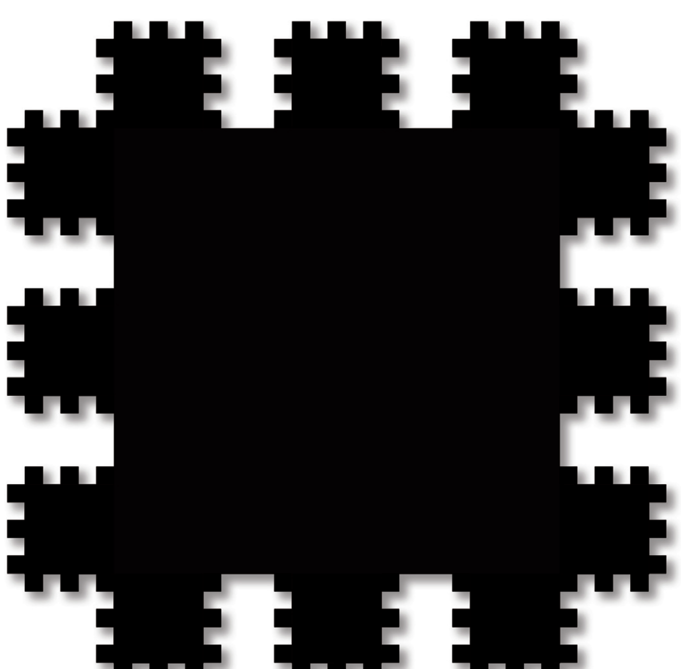
## IMMATERIAL TRANSIT

*Oil on wood. 152 × 152 cm. 1997.*



## POLY-DIMENSIONAL BLACK SQUARE

*Oil on wood. 55 × 55 cm. 2000.*



## STATEMENT

SAXON: From Immaterialisation to POLY-UNIVERSE

This complete transfiguration, this absolutely transparent state, 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 sense total depletion, or, more precisely, to set up a polydimensional net. The net that connects micro- and macroworlds, is the virtualisation of an absolute mind which, stretched in infinite dimension structures or POLY-UNIVERSE as a hyper-filter, incessantly attempts to jettison the imperfect objects of existence from its "body".

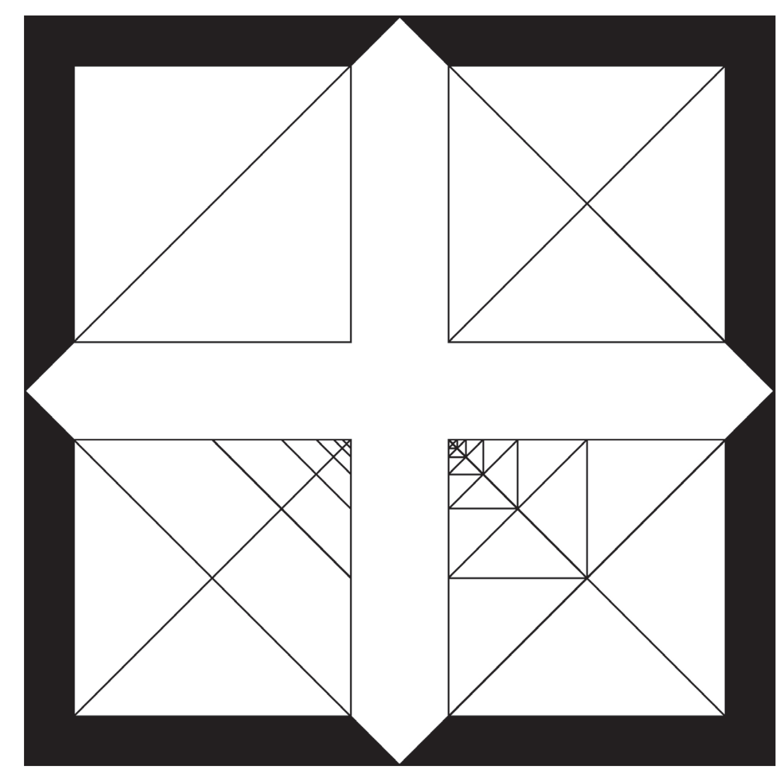
Generally it very seldom happens that a geometric form capable of iteration should be suitable as an icon on its own. If we find any, it is because it is formally related to the genre of the icon. One example can be the square, as it has the shape of the wooden board. On one occasion, studying the borderlines of the shading I had made on the shapes drawn in graphite, I did indeed take Malevich's Black Square as a starting point. The sides of this square are divided in a 1:5 proportion, and this is the scale-shift that leads to the creation of the 'fringes' surrounding the central shape. I applied this division to the picture three times. In this case let us calculate the fractal dimension of the outlines. Here we have eleven steps for a change of 5 length units; the result is hence log [11/5], that is, 1.4898… By the deliberate fusion of the black tone of the different-scale squares our eyes are stimulated to see one poly-dimensional square, in contradiction to mathematical laws.



## STAR POLY-D

*Acryl on canvas. 150 × 200 cm. 2004.*

In the '90s the square comprised my field of research almost exclusively. However, in the past ten years my attention has focused on discovering the triangle as the form of the 'Absolute'. Rearranging the triangle in a poly-dimensional way did not cause a problem, since marking the directions (interior–exterior) similarly to those in case of the square, I attached the smaller forms to the corner points, and using auxiliary planes I could create icon-like panel paintings full of gaps or empty spaces. However, I discovered an image–formation, a geometrical form of multiple concentration, the spiralling poly-dimensional Star of David, which, similarly to supreMADIsm icons, is poly-universal in the strictest sense. This mathematical synthesis, formal reduction, sacred element, icon-like work of art occupies an honoured position in my activity.



## UNIVERSE

*Tint-drawing on paper. 50 x 50 cm. 1979.*

During the past thirty years, studying the basic geometrical shapes (the square, the circle, the triangle) I have named these image structures 'poly-dimensional fields'. Now I had the analogy of my childhood observations in nature, since 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 civilization (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 realized on extreme scales. My thoughts germinating while observing nature took the object form in my first work of art very early, at the end of the 1970s when I was 15. I called it 'Universe'. The image is made up very clearly by the possible permutation of halving the diagonals of the square.

# CARLO H. SÉQUIN

EECS Computer Science, University of California, Berkeley
Berkeley, California, USA
sequin@cs.berkeley.edu
www.cs.berkeley.edu/~sequin/

## STATEMENT

My 2010 entries focus on the theme: "Math Becomes Art." Visualization models, constructed to gain an understanding of some mathematical concept, are enhanced to emphasize their aesthetic qualities. This is demonstrated with two topics; the first one concerns "Simple Knots," the second one "Regular maps."

In 2009, together with a few students, we explored "The Beauty of Knots." For a few simple knots at the beginning of the ubiquitous knot table, we looked for aesthetically pleasing and truly 3-dimensional realizations and then created small sculpture models on a rapid prototyping machine.

For the last few years I have been trying to find explicit 3D models for the embedding of regular maps on surfaces of appropriate genus. "Regular Maps" are networks of high symmetry in which all vertices, edges, and faces are indistinguishable from one another. There are 76 such regular maps on surfaces of genus-2 through genus-5. So far I have found models for about half of them.

## KNOT 5.2

*(above left) Yellow ABS plastic (FDM). 5" x 5" x 3". 2009.*

A simple knot turned into a model for a monumental sculpture.

## KNOT 6.1

*(left) White ABS plastic (FDM). 4" x 4" x 4". 2010.*

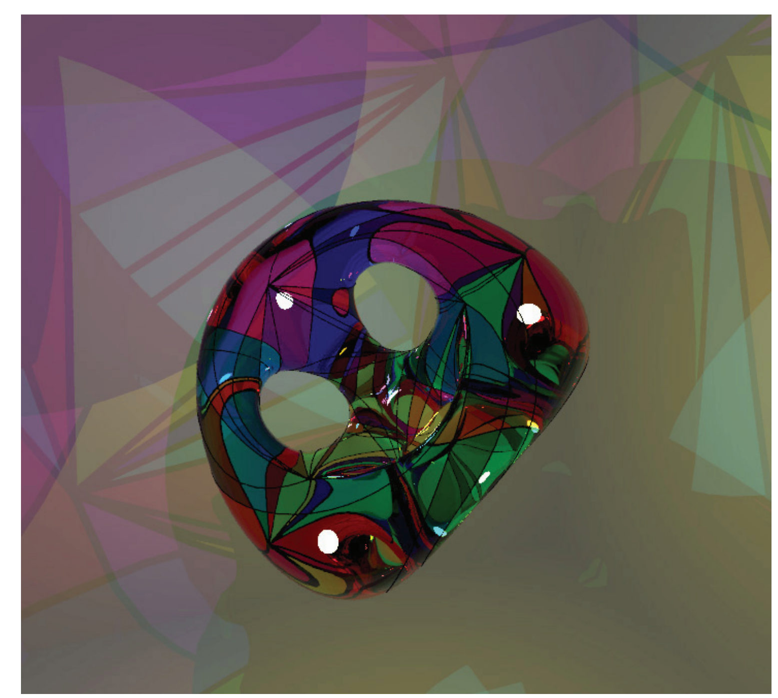
Another simple knot turned into a sculpture model.



## REGULAR MAP R3.2_{3,8} ON A TETRUS

*3D Print, hand painted. 4" x 4" x 4". 2004.*

"Regular Maps" are networks of edges and vertices embedded in closed 2-manifolds of arbitrary genus. The most familiar examples are the five Platonic solids, which represent such maps on surfaces of genus zero. There are 20 different regular maps of genus 3. They can readily be depicted in the Poincaré disk. It is a bigger challenge to find nice symmetrical embeddings on a handle-body of suitable genus. Here I have taken the regular map R3.2_{3,8}, comprising 12 vertices and 32 triangles, which always join eight to a vertex, and mapped it onto a Tetrus surface, maintaining the full 12-fold symmetry of the oriented tetrahedron.



## TIFFANY LAMP BASED ON REGULAR MAP R3.2_{3,8}

*Computer rendering. 16" x 16". 2004.*

The regular map R3.2_{3,8} embedded into the surface of a Tetrus surface, is turned into a virtual Tiffany lamp with 4 light bulbs in the corners of the tetrahedral frame. The projected pattern on the back wall is generated by ray-tracing.

# SUMAN VAZE

King George V School, English Schools Foundation
Hong Kong
sumanvaze@gmail.com
sites.google.com/site/vazeart/

## STATEMENT

I seek to depict interesting mathematical truths, curiosities and puzzles in simple, visually descriptive ways. Mathematical amusements inspire the color and form in my paintings, and I try to strike a balance between the simplicity of the concepts and their depiction in art. The logic and balance of the discipline is beautiful, and I like art that both stills and stimulates the mind – these are the qualities I strive to capture in my work.

## SACRED CUT

*Acrylic on canvas. 24" x 30". 2010.*

The Sacred Cut was perhaps historically used to find a method to double the area of a given square. For example, in order to double the altar they could not simply double the sides. The Sacred Cut gave a means to do it. It produces the Silver Rectangle with ratio of sides 1:√2 which is used in A Form paper. This work illustrates how to construct the Silver Rectangle or the Sacred Cut and also gives an impression of doubling both the rectangles and the squares.

## THE PASCAL LINE

*Acrylic on canvas. 24" x 24". 2010.*

At the age of 16, Blaise Pascal discovered and published his famous theorem entitled Essai pour les Coniques. The theorem states that if a hexagon is inscribed in a conic then the three points in which the opposite sides meet are collinear. The line is The Pascal Line. My work shows the Pascal Line in a zig-zag inscribed hexagon.



## THREE FISH ON A PLATE—COMMON CHORDS

*Acrylic on canvas. 24" x 24". 2010.*

If three circles intersect, the three common chords intersect at a point.

## PEDAL TRIANGLE II

*Acrylic on canvas. 24" x 24". 2010.*

The so called pedal triangle is also the billiard ball path (on a triangular billiards table!). It is the shortest complete repeating route that touches the three sides of the triangle. This work illustrates how you can find the pedal triangle by joining the feet of the altitudes of a triangle.

# TEJA KRASEK

Ljubljana, Slovenia
tejak@yahoo.com
tejakrasek.tripod.com

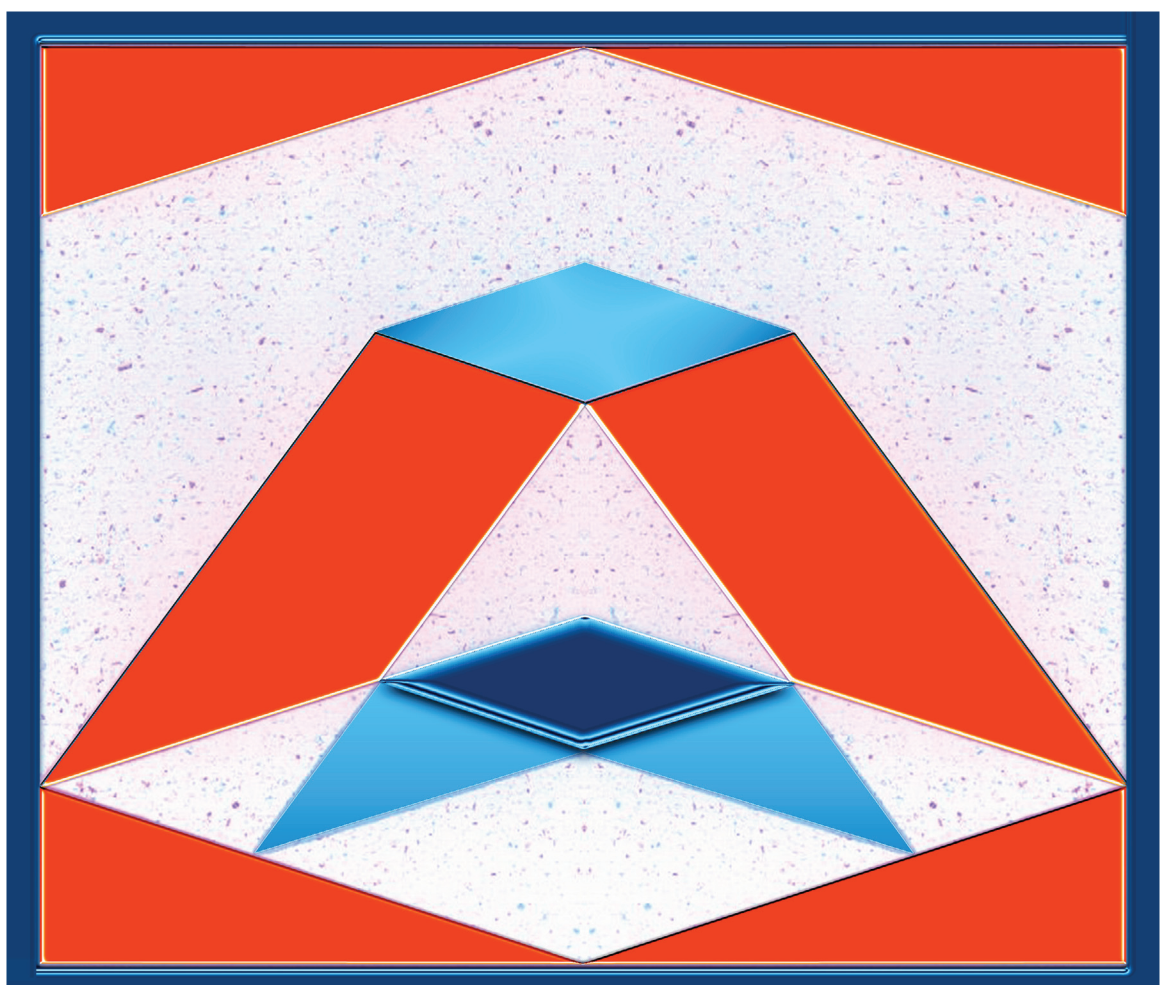
## STATEMENT

I seek to depict interesting mathematical truths, curiosities and puzzles in simple, visually descriptive ways. Mathematical amusements inspire the color and form in my paintings, and I try to strike a balance between the simplicity of the concepts and their depiction in art. The logic and balance of the discipline is beautiful, and I like art that both stills and stimulates the mind – these are the qualities I strive to capture in my work.

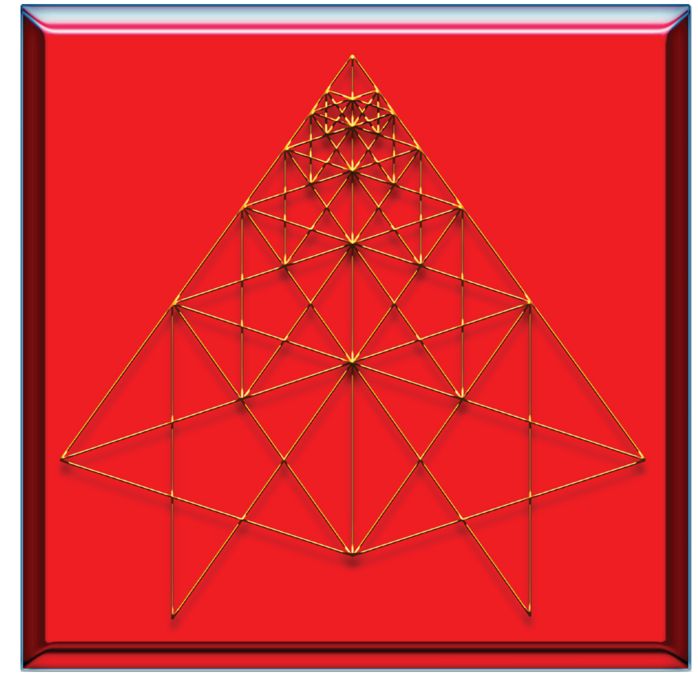
## 2 IN 1 VARIATION

*Digital print. 230 x 280 mm. 2010.*

In a quasicube shape constituted of Penrose rhombs we can observe thin Penrose rhombs on a smaller scale, Penrose darts, which are part of a P2 tiling, golden mean relations, and perceptual instability.



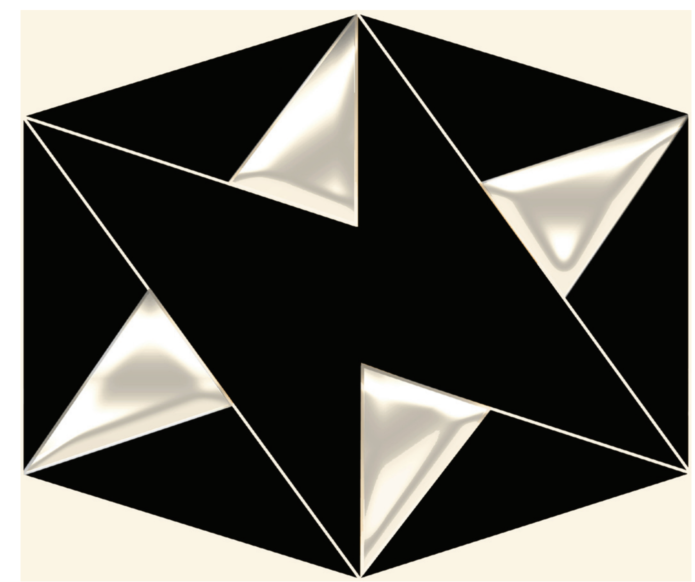




## THE PASCAL LINE

*Digital print. 257 x 259 mm. 2009.*

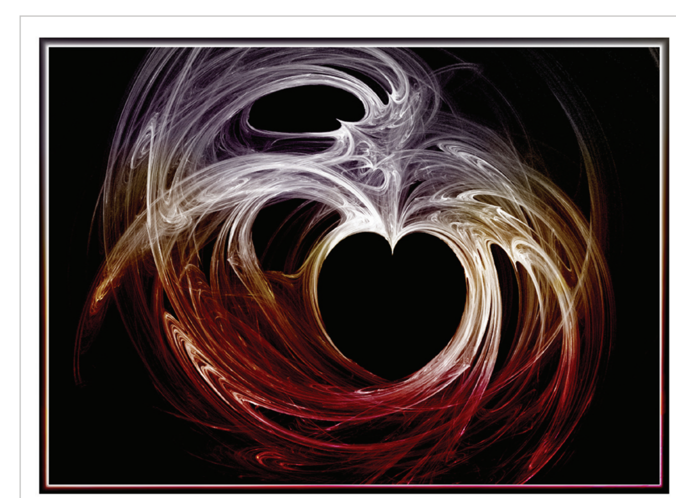
Ten interlaced pentagonal stars forming a tree-like shape are scaled by the golden mean. They are showing self-similarity and forming Penrose rhombs on different scales in the middle. We can observe the richness of golden mean relations in the lines, and in geometrical shapes.



## TWINSTAR

*Digital print. 240 X 280 mm. 2010.*

In the black quasicube constituted of thin and thick Penrose rhombs we can find two interlaced pentagons in which two interlaced pentagrams can be drawn, together forming a double- or a twin star. While observing the artwork our minds themselves complete the image in parts where the lines are intentionally absent. The image is perceived in various interpretations. A rich interplay of golden mean relationships can be observed, as well.



## HEARTWORK NO.1

*Digital print. 200 x 250 mm. 2009.*

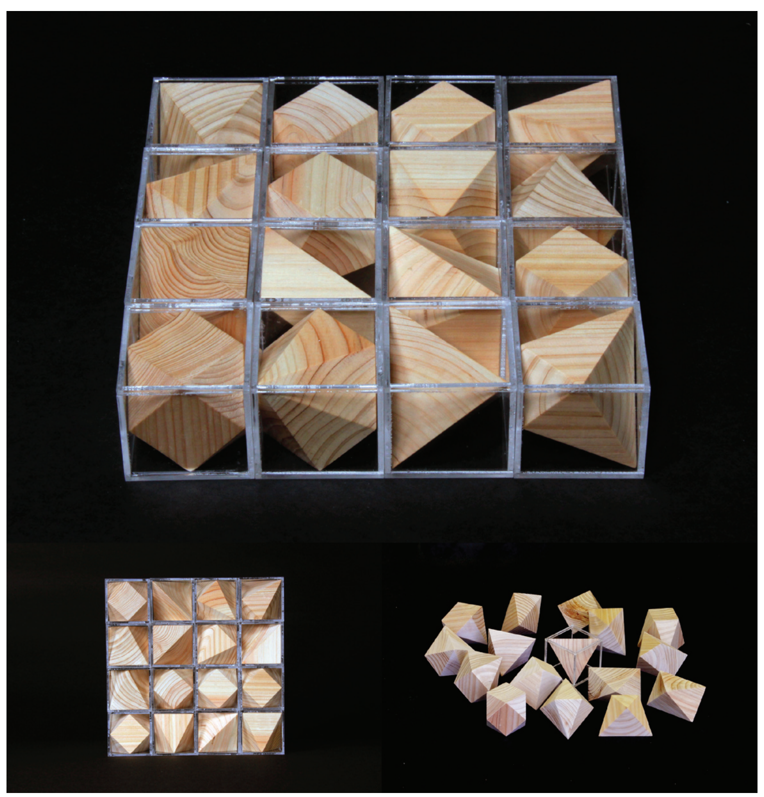
In the mysterious world of chaos and strange attractors a seeker can find very heartful things...

# HIDEKI TSUIKI

Kyoto University
Kyoto, Japan
tsuiki@i.h.kyoto-u.ac.jp
www.i.h.kyoto-u.ac.jp/~tsuiki

## STATEMENT

The “Imaginary Cube” is based on a simple geometrical idea. See the paper in the Bridges proceedings for the details. Through a mathematical study of imaginary cubes, the author arrives at an idea for an object of art. The 16 components of the sculptures all have different shapes but together they present uniform appearances when viewed from three orthogonal directions. Moreover, the 16 components are not arbitrary ones but they are exactly the representatives of all the 16 classes of minimal convex imaginary cubes. Imaginary cubes are also useful in mathematical education; the author held a lot of workshops on imaginary cubes with classes from elementary schools up to universities. Special thanks to Hiroshi Nakagawa; through his accurate woodworks, imaginary cubes become really artistic sculptures. Thanks are also due to Kei Terayama for his techniques in assembling paper models and Mako Mizobuchi for fine pictures.

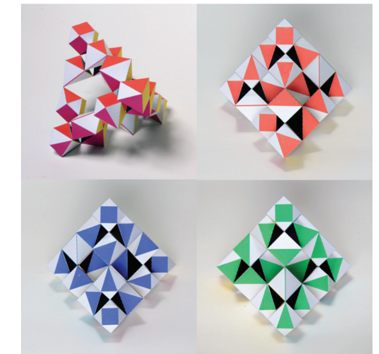


*Wood and acrylic resin*
*45 x 45 x 45 mm for each*
*2010*

## IMAGINARY CUBES

Woodworks by Hiroshi Nakagawa (Gallery of Wooden Polyhedra, http://ww6.enjoy.ne.jp/~hiro-4/woodenpolyhedra30.html ). Imagine a three-dimensional object which has square appearances in three orthogonal directions just as a cube. We call such an object an imaginary cube. Among imaginary cubes, consider convex ones, and also among convex ones, minimal ones for a fixed surrounding cube. Such minimal convex imaginary cubes are divided into 16 equivalence classes and here are the representatives of them, made of wood. It is difficult to imagine that these polyhedra have this property if they are put solely, but once each of them is put in an acrylic resin box with one side open, one can easily find that it is an imaginary cube just by looking at it from the faces of the box. It is a good mathematical puzzle to put imaginary cubes in a box.





*Paper*
*180 x 180 x 180 mm*
*2010*

## IMAGINARY CUBE SCULPTURE (SIERPINSKI TETRAHEDRON LAYOUT)

These four pictures present different appearances of one and the same object. It is composed of the 16 imaginary cubes of the above artwork, that is, all the representatives of the minimal convex imaginary cubes. The object as a whole is also an imaginary cube, as this picture shows. The imaginary cube components are arranged according to the structure of the 2nd level approximation of the Sierpinski tetrahedron, and their assignment and orientation are carefully chosen so that they are connected at vertices. They are connected by threads which are glued from the inside of the polyhedra at vertices. This object is colored with 7 colors except for white; six colors are assigned to faces and edges of the 6 directions with square appearances, and those faces which compose the holes in the four blocks are colored black. These holes have the form of a triangular antiprismoid, which is also an imaginary cube.

*Paper*
*180 x 180 x 180 mm (400 mm x 600mm x 450mm with mirror)*
*2008*

## IMAGINARY CUBE SCULPTURE (CUBOCTAHEDRON-LIKE LAYOUT)

The object is placed in the center of the picture, and the surrounding three are reflected images in mirrors. The object is also an imaginary cube composed of the 16 representatives of the minimal convex imaginary cube classes, but with a different layout of the 16 components. These two arrangements of the 16 imaginary cubes are obtained through the investigation of Latin squares of degree 4. This object has 4 holes of the shape of a triangular antiprismoid—also an imaginary cube—in the four blocks, and one hole of the shape of a regular octahedron in the middle.

*Wood*
*220 x 220 x 220 mm*
*2010*

## IMAGINARY CUBE SCULPTURE (CUBOCTAHEDRON-LIKE LAYOUT, WOOD)

Woodworks by Hiroshi Nakagawa. It has the same shape as the above sculpture, but composed of wooden imaginary cube components. As we have explained, it is an imaginary. Amazingly the empty space is decomposed into five polyhedra; the central hole has the form of a regular octahedron and the others have the form of a triangular antiprismoid. Frames for these polyhedra are constructed from brown wood. The 16 imaginary cube components are glued together through these frames to form one imaginary cube object.

# ANNA URSYN

University of Northern Colorado
Greeley, Colorado, USA
ursyn@unco.edu
Ursyn.com

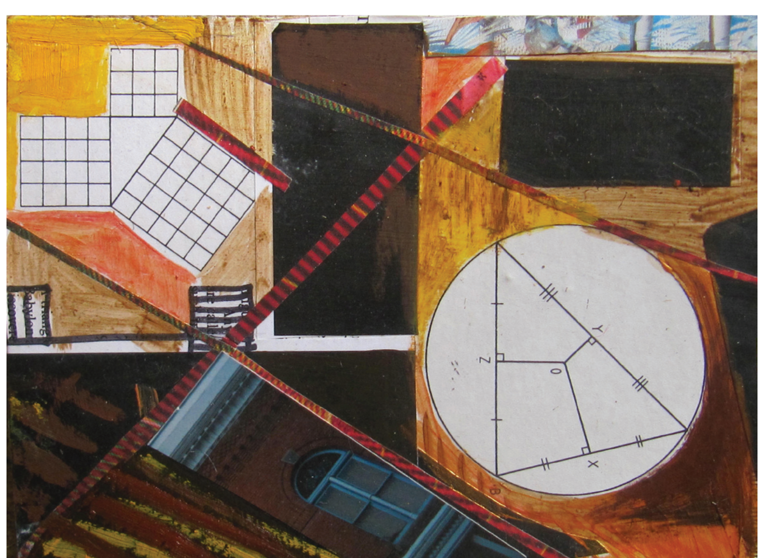
## STATEMENT

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 with the use of painterly markings.

## A SURFACE OF REVOLUTION

*(above left) Archival Print. 5x7". 2010.*

It is possible to construct $^{1}/_{5}$th of a given entity, but many believe such division may not be seen adequate.

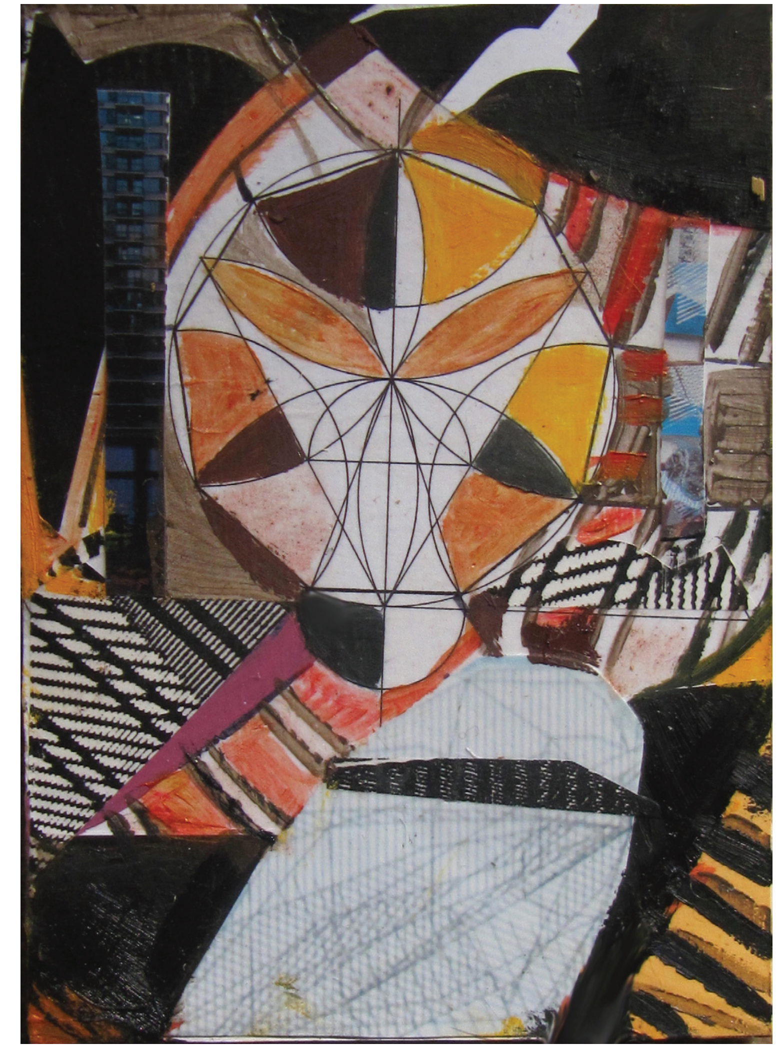


## EXPRESSIVE MATH

*(left) Print. 7x5". 2010.*

We may imagine infinitely many figures that satisfy one basic rule.





## MINIMAL SURFACES

*Archival Print. 5x7". 2010.*

In order to communicate the essence of a notion, we can abstract ideas by removing all non-crucial elements.

## RECTIFYING THE CIRCLE

*Archival Print. 7x5". 2010.*

There are so many methods that it is hard to come up with one standard solution. It makes room for shortcuts, insight, and intuition.

# XAVIER DE CLIPPELEIR

Design Academy Eindhoven, The Netherlands
Antwerp, Belgium
xdc2000@hotmail.com

## STATEMENT

KINETIC SCULPTURES

I have been inspired by the geometry of the ELLIPTIC CYLINDER. This profile can be formed with a toy spring, the one that walks down stairs . It has an ellipse as cross section and circular sections when cut under the right angle. The circular sections are joined to produce transformable forms.

The experiments led to the discovery of transformable polyhedra and design applications a.o. in the field toys ( produced by the Swiss company NAEF SPIELE AG, caterpillar Juba, flexible chain Ellipso, Rhombic cube ).

The geometry of the expanding—contracting cubic grid has an equivalent in nature as the crystal structure of minerals named "tilted perovskites".

## TRANSFORMING CUBE

*Beech wood, metal connectors. 30x30x30 cm. 1977.*

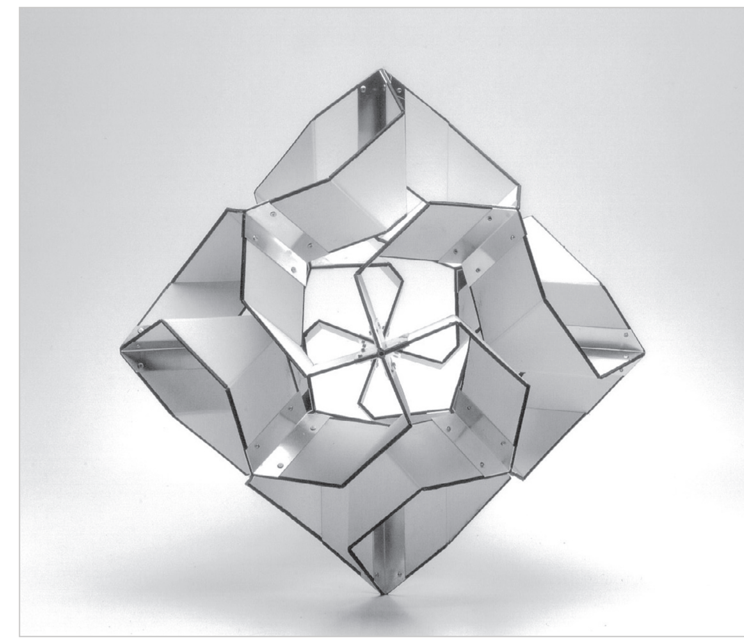
The edges of the cube are elliptic cylinders. Each edge has two circular sections with rotation axles. This allows the cube to rotate into a solid with 24 faces ( icosi tetrahedron ). The photo shows a halfway position.



## TRANSFORMING CUBIC LATTICE

*Beech Wood, metal connectors. 90 x 90 x 90 cm. 1990.*

The corners of the single cubes are cut under an angle perpendicular to the diagonals of the cube. They form circular faces. The faces are provided with rotation axles and joined. The whole cubic lattice ( grid ) is transformable. The direction of rotation of each cube can be chosen: to the right or to the left. This forms different symmetries within the lattice. The picture shows an assembly of six cubes.The grid is extendable in the x,y,z direction. The grid is rigid. Turning one part transforms the whole structure.



## TRANSFORMING RHOMBIC DODECAHEDRON

*Cardboard linen aluminium. 60 x 60 x 60 cm. 2005.*

The edges of the rhombic dodecahedron are instrumented with 2 hinges, 48 in total. The dodecahedron transforms into a cube.

## TRANSFORMING TRIACONTAHEDRON

*Plasticcardboard.80x80x80cm.2006.*

The edges of the triacontahedron are instrumented with 2 hinges, 120 in total. The triacontahedron transforms into a dodecahedron. The picture shows an in between position.