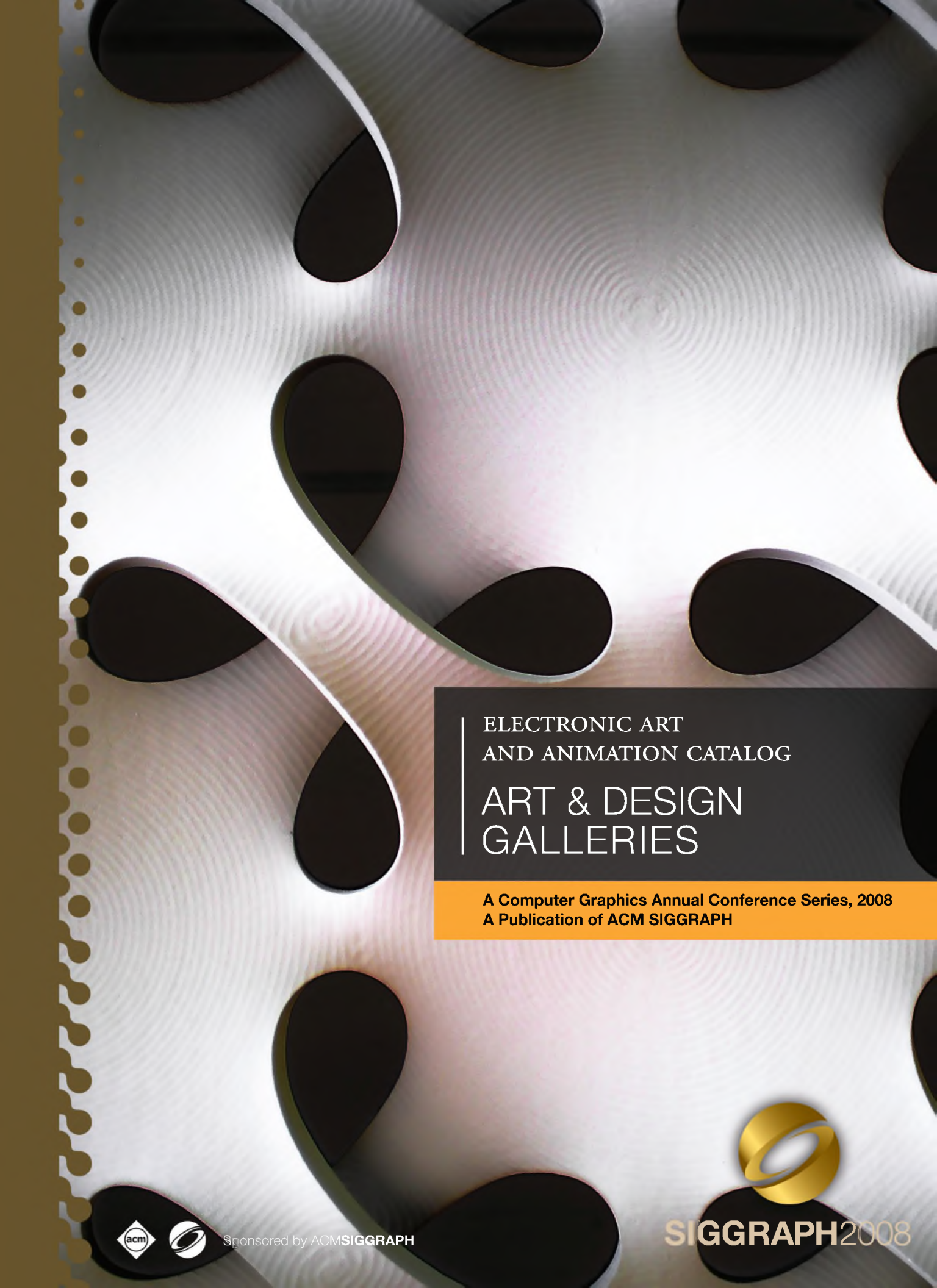

ELECTRONIC ART
AND ANIMATION CATALOG

# ART & DESIGN GALLERIES

A Computer Graphics Annual Conference Series, 2008
A Publication of ACM SIGGRAPH

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SIGGRAPH2008

# SIGGRAPH 2008
# Art & Design Galleries

**JURIED ART CHAIR**

Lina Yamaguchi
*Stanford University*

**CURATED ART CHAIR**

Lira Nikolovska
*Autodesk, Inc.*

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# TABLE OF CONTENTS

# TABLE OF CONTENTS (CONT.)





# SIGGRAPH 2008 ART & DESIGN GALLERIES
## JURY & ACKNOWLEDGEMENTS

# SIGGRAPH 2008
# Art & Design Galleries | Design & Computation

**CURATED ART CHAIR**
Lira Nikolovska
*Autodesk, Inc.*



## INTRODUCTION

We are witnessing a shift in how designers conceptualize, detail, and fabricate their work. Architects increasingly talk about scripting or writing an architectural façade rather than drawing it. Buildings and everyday objects are conceptualized and fabricated via lines of code in addition to being drawn by hand or with CAD software. Tools for manipulating digital information have provided designers new means for expression as well as new "materials" with radically different properties.

Digital methods and tools used by architects and designers have co-evolved with computer graphics and interactive technologies in leaps and bounds. The SIGGRAPH 2008 Design & Computation exhibit weaves together analog and digital, past and present, theory and artifact to give visitors a taste of an exploding field. The work has been selected to invite multiple layers of engagement and address the SIGGRAPH community's wide range of interests.

Contemporary developments, however, are not without precedent. Long before advanced computer graphics, designers reshaped their tools. For example, the work of Joseph Marie Jacquard was not only significant for the textile industry, but also laid the foundation for contemporary computational design processes. On the one hand, his invention revolutionized the way in which silk-weavers from his hometown, Lyon, wove elaborate and varied figures. On the other hand, Jacquard's work embodied the ability to control a sequence of operations and fabricate an end result in a single process.

Two Design & Computation discussion panels complement the exhibit, raising questions on complexity and craftsmanship. In the Complexity panel, architects and designers ask how tools and methods used by architects, artists, and designers contribute to the complexity of built forms. What are the problems and opportunities that increased complexity engenders both for built forms and for people's experience of these forms? The Craftsmanship panel examines the relationship among creator, tool, and final creation. Artists and designers reflect on how they conceive their work, discussing whether mediation through a digital fabrication processes alters their relationship with materials and their creations.

The exhibit would have not been possible without the intensive involvement of the gallery committee, advisors, contractors, sponsors, and the contributors themselves. I would like to thank all of these people for their hard work, generosity, support, inspiration, and endless patience. We are also indebted to our teachers of design and architecture: Edith Ackermann, John Biln, Terry Knight, Irene McWilliam, and Bill Mitchell. This exhibit is dedicated to them.

Lira Nikolovska
Autodesk, Inc.

# Imagine the Algorithm

William J. Mitchell
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**Robot Craft**

Among the things we admire about craftspeople are their fundamental skill sets: their abilities to execute certain operations beautifully, swiftly, and reliably. When I was a beginning architecture student, for example (before the days of CAD), I learned to execute a perfectly graduated wash with lamp black watercolor on Whatman's hot-press paper to make an evenly ruled India ink line on vellum with crisp ends and no smearing, and (with an HB clutch pencil) to letter like an architect. This required close knowledge of the relevant tools and materials, hand-eye coordination, and lots of practice. Acquiring these and other skills was a large part of mastering my craft.

The digitally controlled machines used to produce the objects on display in the Design & Computation gallery are robot craftspeople with very narrow skill sets. Each one does a few things really well – and tirelessly. Laser cutters cut out shapes from sheet material. Routers and milling machines precisely position milling heads to remove material from solid blocks. Deposition printers place tiny pellets of polymer exactly where you specify.

Furthermore, these machines are not set up to perform operations repetitively. They are programmable. They accept sequences of instructions to perform operations in their skill sets. These instructions are parameterized. To tell a laser cutter to cut along a straight line, for example, you provide the end-point coordinates of that particular line.

Programmability means that the familiar logic of mass production – of achieving economies of scale through repetition – no longer applies. It is no more costly to cut lines that arbitrarily vary from one to the next than it is to cut lines that are all alike.

It is possible to program instruction sequences directly, and in the early days of numerically controlled fabrication (beginning in the 1940s) this was exactly how it was done. Code specifying the types of operations to be performed, together with the coordinates, was fed into machines on paper tape or punch cards.

**Computer-Aided Design**

But designers generally don't think in these terms. Instead of working directly with process descriptions that specify how to make something, they prefer to explore possibilities by constructing and transforming state descriptions: graphic representations of the potential outcomes of fabrication processes.

This preference is very understandable. It is easy to sketch, say, a milled stone column capital, but much more difficult to code the milling instructions, to understand that code when it is complete, and to explore variations on the theme by directly editing the code. Furthermore, a state description provides a convenient basis for analysis, visualization, and critical discussion.

The preference of designers for working with state descriptions provided the original motivation for development of computer-aided design systems. In the 1950s, engineers at MIT and elsewhere began to imagine ways of constructing and editing three-dimensional shapes on computer screens, automatically generating fabrication instructions from that geometric information, and eventually executing those instructions on programmable machines to produce the required physical objects. How do designers construct these shapes on their screens? By inputting sequences of parameterized commands, of course. (They may do so by typing commands, or through gestures to a graphical user interface, but it comes to the same thing.) Generally, CAD systems preserve these input command sequences as undo trails.

These are also process descriptions, but of a different kind from those that drive fabrication devices. They are expressed in terms of geometric entities, and transformations and combinations of those entities, that are meaningful to designers rather than to machines that apply tools to materials. Designers, for example, describe artifacts in terms of Euclidean geometric constructions, or NURBS surfaces, or Boolean operations on solids, whereas milling machines need descriptions in terms of tool paths for removing material from solid blocks, and three-dimensional printers need descriptions in terms of layers of polymer pellets. In other words, computer-aided design and fabrication requires translating a designer's process description into a stored state description that can support analysis, visualization, and discussion, and then re-translating that state description into a fabrication device's process description.

**Complexity**

The ratio of the length of the designer's process description to the length of the fabrication device's process description provides a useful measure of the complexity of the resulting fabricated artifact. (We can express this statement rigorously by carefully hedging it, but the intuitive idea will suffice here.) Simple artifacts are generated by CAD-system input sequences that are short relative to the output sequence of fabrication-device instructions. But with complex artifacts, the length of the designer's input sequence approximates that of the resulting sequence of fabrication-device instructions.

How do designers create elegantly economical input sequences? By exploiting principles of order. A repetitive design, for example, can be specified very economically by first describing the repeating element, and then giving a "repeat" command with appropriate parameters. This does not take much work on the designer's part, but it creates a lot of commands for the fabrication device to execute. However, if a design is composed of arbitrarily located random shapes – with no evident order – then the designer's only option is to specify each shape and location explicitly. This may not result in any more instructions for the fabrication device to execute, but it requires a lot more input from the designer.

**Insight**

In general though, there is no recipe for creating elegantly simple input to generate extensive and varied fabricated forms, just as there is no recipe for deriving elegantly simple scientific laws that describe widely varied phenomena. In both cases, it takes creative insight into underlying structure.

Here, then, is a way of critically examining and understanding the artifacts on display in this show. For each one, try to imagine the shortest algorithm that would generate it. Then generalize, and imagine an algorithm that would produce variations on the theme. If you can come up with something clever and cogent, you have achieved a deep understanding of the piece.

## Origins and Ends: Craftsmanship in the Work of Hauer and Rosado

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*Lecturer in Practice*
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I drove out into the Connecticut countryside to visit Professor Erwin Hauer of Yale, who rents a non-descript red barn from the local water company as his studio in Bethany, outside New Haven. I studied with him in the 1970s, with many of my fellow architecture majors, in a class known as "The Bone Course," where we examined the underlying structures of nature and attempted to create a few of our own. It was a precise discipline, and one not particularly suited to my adolescent brain. I remember well the struggles to complete tension assemblies of string and struts, but nothing of the results themselves. I lacked both the geometric acuity to create provocative results and the technical skills to build even my simple ideas.

On my recent visit, as I walked through Professor Hauer's studio and examined the results of years of his much more enabled investigations, I found myself wishing I had taken his course in middle age. While the objects still seemed inaccessible (how does he imagine this stuff?), at least the logic was much more clear some 30 years later.

Hauer's fascination with continuous surfaces and infinity are the heart of his work. He has labored for decades to perfect a series of fundamental geometries that extend, when repeated, in an infinite grid. They are comprised of formally simple but remarkably subtle weavings of continuous surface elements that appear, in their finished form, to be quite straightforward. But the clear, elegant forms have emerged from many years of experimentation and refinement in both process (casting concrete in carefully built, modular forms) and outcome (the elemental forms themselves).

It is that intersection that led the curators of SIGGRAPH 2008's Design & Computation exhibit to include Professor Hauer's work. In partnership with Rick Rosado, he has begun to produce a new set of screens not with hand castings but through digital fabrication. In his introduction to the exhibit, Bill Mitchell describes the digital process as comprised of "state descriptions," the originating digital geometry of a form, and "parameterized commands," by which robots fabricate the resulting outcome. Hauer and Rosado are now exploring how to replace wooden design models and casting molds with three-dimensional computer models and the resulting tool paths necessary to manifest them. Where once enormous manual dexterity with tools combined with knowledge of materials was the technical platform (the underlying craft) of Hauer's process, software dexterity and intimate knowledge of the limitations of both

modeling technology and fabrication machines have become the new "craft" of the digital age. Hauer and Rosado hope that redefining both the state descriptions and the parameterized commands to fabricate them will, in combination, reinvigorate the work.

Those of us in the design-technology industry confidently presume that the tools that we produce are capable, essentially, of representing anything conceivable by a sculptor, architect, automobile designer, or even movie director. Since geometry is essentially computational, and today's tools are so powerful, where is the inherent challenge? And since software will translate that intent from form to realization so easily, is not an infinite number of formal possibilities apparent? My visit with Hauer and Rosado proved that these assumptions are, at best, completely wrong.

In a recent symposium on the nature of design labor in the digital age, Columbia's Scott Marble explored the relationship between craft (the making of a desired artifact) and risk[1] (the challenge of being able to execute a sustained process without error until the outcome is reached). He posited that digital tools might remove the risk that is in craft itself, since so much of the "making process" is predetermined not by analog tool actions but easily perfected software commands. Surely geometries perfected only by Hauer's intellect and skill in the mid-20th century are easily understood by the powerful technologies of the early 21st, where the "risk" is now gone?

But alas, it isn't so, as their attempts to fabricate entire screens (including the pieces that you see in the show) have revealed. Risk has transferred from the refinement of the casting process to cajoling recalcitrant software and robots to get to the right results.

It turns out that modeling and fabricating Hauer's infinite surfaces is "devilishly complex"[2] as he and Rosado look for the right combination of software that can represent the original geometries, generate the correct tool paths, and meet the exacting standards that decades of refinement demand. It seems that computational conclusions about surface continuity and tension derived from fabrication software simply do not achieve these goals, and years will be invested in resolving approaches. Ironically, Hauer and Rosado have concluded that the process, which has recently resulted in an installation in a residential building in New York, is incredibly expensive," and they may indeed return to more traditional means of fabrication. We're fortunate that Hauer is as deft as ever in the casting studio.

Observing Hauer reinvigorate his work with computation suggests an important change in the definition of craft itself. Hauer says that "a three-dimensional idea … is wonderful. But it is not any more important than the means to bring it into physical existence." For him, assembling parametric models and tuning fabrication tool paths might replace exploring via wood models and casting shapes with molds, but only if the results meet the exacting standards of his vision for the result.

In the screens in the show, we rediscover the seductive nature of complex geometric form that he has understood all along. Digital tools now make the potential of those forms more accessible to all, but they will not provide the craft, what Bill Mitchell calls "the creative insight into the underlying structure." Right now, for Hauer, that insight exceeds the ability of the tools to accomplish it, calling for a redefinition of craft itself.

Professor Hauer and I exchanged email messages a few days after our visit, and he wrote: "Now, in the digital age, you are way ahead of me in some ways, but we still have plenty of things to look at and to talk about and to explore. Isn't it wonderful?" I'm not so sure my digital colleagues and I are so far ahead, but I had to agree that, indeed, there is much left to accomplish, and that in itself is wonderful.

1. See David Pye, 1968, *The Nature of Art and Craftsmanship,* page 20.
2. From *Metropolis,* "Sculpting Infinity" October 2006, page 120.

# Kolam

*This entry was made possible with the generous support of Professor Ketki Dhanesha and her students Shashikala Sathyamurthy, Pallavi Naik and Samir Bellare from the Indian National Institute of Design in Bangalore.*
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*Special thanks to Sudha (artist)*

Kolam is a traditional Indian art form, executed by women, in which drawings are made at the entrances of the home. Known as Kolam in the south and Rangoli in the north, the drawings can be associated with the beginning of a celebration, an honor to a deity or other religious event, or simply to commemorate the beginning of a new day.

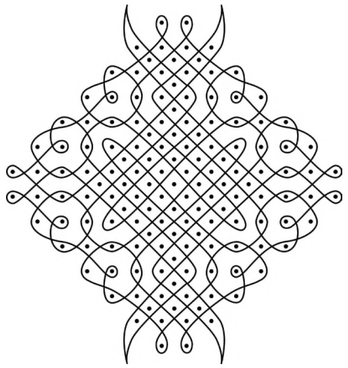
Kolams are symmetric geometric patterns. Drawing them implies following precise procedures. Dots (pulli) are drawn first, and then straight lines or continuous curves (neli) are drawn around the dots to make the desired patterns. Different designs could be drawn with the same set of dots.

The tradition and craft for drawing these algorithmic patterns is passed from mothers to daughters and has been for centuries. In South India, Kolams are created with rice flour. Colored powder is used in North India to draw Rangoli. Beyond being a way for women to display their drawing skills, this daily ritual is a representation of the women's agency and gender role in Indian society, in addition to being a means for personal expression.

Through these ephemeral yet cyclical drawings, it is the women who invite and "communicate" with the outside world and the deities. Kolams, in essence, are a sort of painted prayer. Many women dedicate their Kolams to Lakshmi, the pan-Indian goddess of prosperity, fertility, and protection of the home. These drawings are also signs of invitation to the women's homes and symbols to prevent evil spirits from entering. Besides functioning as decoration, Kolams also serve as food source for ants and other insects thus inculcating a habit of caring for other lives.

The month of Margazhi (15 December – 15 January) is considered special for those interested in the art of Kolams. Early in the morning during Margazhi, the ground in front of the houses is cleaned and neighbors compete to draw the largest and most beautiful Kolam. It is common in India to hold these competitions throughout the year.

Kolam designs have found their way into contemporary art and design forms such as clothing and jewelry, and they continue to be an integral part of the Indian culture. The generative aspect of Kolam creation has been researched by architects, computer scientists, and others.



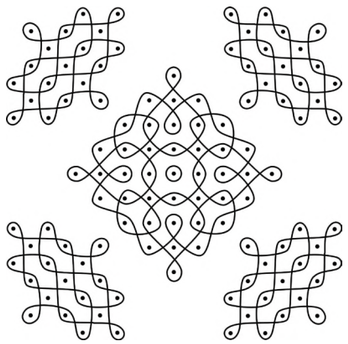


*Photo from a Rangoli workshop led by Sudha in March 2008 at the Indian National Institute of Design in Bangalore.*



# Fourier Carpet and Body Blanket

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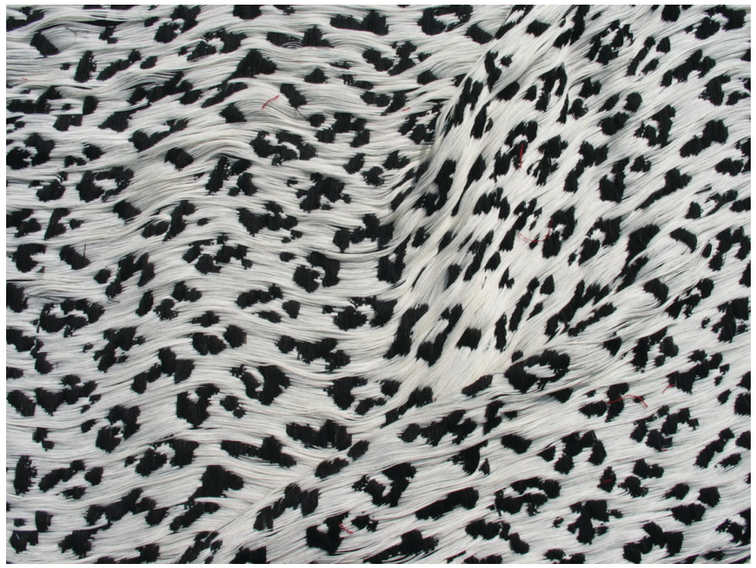

As one traces the technological and cultural history of weaving, a link is revealed between the punch-card technologies used to automate the Jacquard looms of the mechanical age and the early binary systems used for computation in the first computers. This link is rooted in the coded binary patterning system of warp and weft; its configuration is the weave. Because weaving exists within the space of zero and one, it is possible to weave computational designs that are rooted in a binary structure of data points.

Fourier Carpet and Body Blanket involve computational models that describe data as fields of woven points. These digital algorithms reveal a spectrum of scalar possibilities found in the point, the field, and the woven skin. The extension of this space is immanently vast in weaving. This relationship is important to architecture because it describes the geometry and matter of diverse collections of harmonic and dynamic data through woven material.

By taking advantage of an algorithmic process rooted within binary space, selected datasets may be input into the digital interface of a Jacquard loom. Through this process, one can begin to intuit spatial patterns within datasets that through study and analysis lead to multi-scalar textile tectonics. The process gives rise to questions regarding data imaging, technology, interface, and empowerment through materialized representation of information. Data are no longer represented as static images, but rather as a dynamic, woven model that is driven by the code inherent in the archetype of weaving.

These relationships were investigated in Fourier Carpet, a 36-foot by 5-foot tapestry that was generated from multiple Fourier series. In this instance, the data are transformed into a CAD file of binary block code, which is then used as input to a digitized Jacquard loom. The Fourier Carpet represents the materialization of music, color, and sound data.

Data provided by the human body may also be woven. For example, when undergoing Magnetic Resonance Imaging (MRI), the human body emits a series of frequencies that are then filtered through a transform called the Fourier transform. Once filtered, the harmonic data emitted from the body are transformed into a static image.

In the Body Blanket project, the output is more than a static image. The filter enables transformation of data along a curve into a material output. The discrete mathematics behind the Fourier series enables dynamic manipulations of material outputs. The Fourier transform is a useful tool for filtering and transforming generic data from points to waves to multiple woven waves, allowing for various representations of data. The transformation reveals a new interface between technology and the individual.

# Branching Morphogenesis

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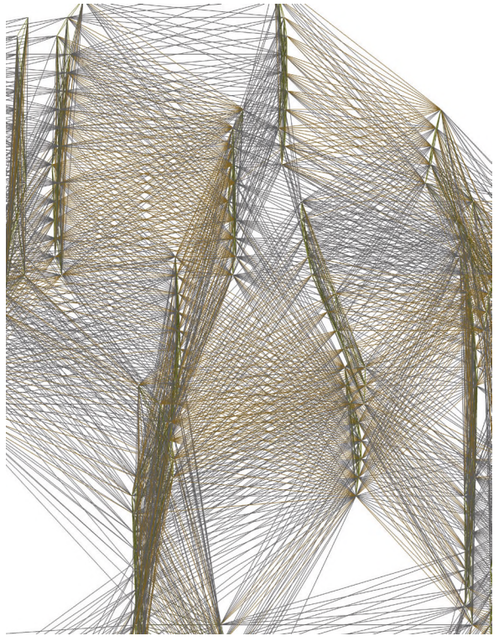

Branching Morphogenesis is an investigation of the relationship within branching structures formed by interacting vascular cells. The study and quantification of this network allows for greater understanding of how variable components give rise to structured networks in biology and architecture.

The primary function of the lung is to provide gas exchange during our post-natal life. Determining how networks of blood vessels are generated and maintained during development represents a major challenge in contemporary lung biology. The aim of this project is to model the networking process involving blood vessels and airways in vitro. The resultant digital tools and structures are abstracted for architectural application.

Using parameters that govern branching morphology, the study investigates how cell-to-cell and cell-to-underlying-extracellular matrix networking interactions develop. We have experimented with modification of parameters that prohibit networking behavior such as intercellular communication, environmental catalysts, and cellular geometry.

Biology and architecture regularly borrow from each other. Tensegrity structures and geodesic domes have led to new insights into how living systems (such as eukaryotic cells, tissues, and organisms) are assembled and function, as well as to a new understanding of how the micro-ecology of cells influences the genome. Conversely, models found in biology, particularly relating to self-organization and the emergence of complex, non-linear, global systems from simple local rules of organization, have led to discovery of new forms and structural organizations in architectural design.

The intent of this project is to jointly investigate fundamental processes in living systems and their potential application in architecture. Through investigation of cell-tissue biological models, algorithmic tools and digital models reveal the parametric logic inherent in biological and responsive systems. The result is a component-based networked surface architecture capable of responding dynamically to both environment (context) and deeper interior programmed systems.



# Tensor Shades

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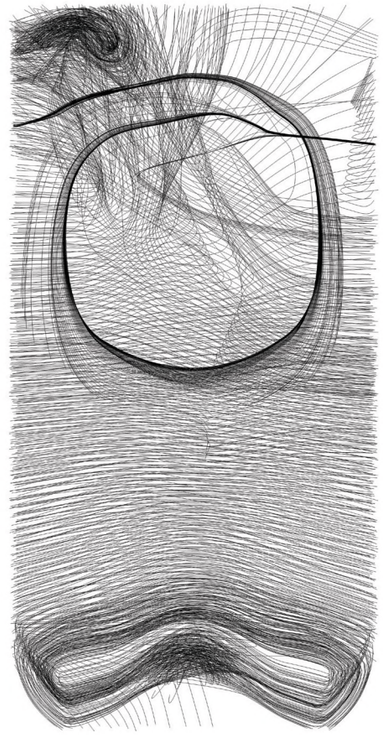

The Tensor Shades are light shades generated by the interrogation of structural information (stress tensor field) and desired lighting information (inverse illumination field). The project explores a process that preconditions the design space by combining these two types of spatial information in order to create a design that maintains structural integrity and formal consistency.

The inspiration for this project comes from our frequent professional observation of a disjunction in the relationships between design intentions, geometry, and structural considerations. This is partly a result of the division of disciplines within the design and construction industry, and reinforcement of such divisions by the employed methods and software tools. Such tools allow designers to create more complex forms than previous technologies could support, yet they treat the design space as homogeneous and isotropic Cartesian space. As a consequence, operations on a designed object tend to disregard its intrinsic properties and behavior, making integration and negotiation of concerns difficult.

To overcome this problem, we have focused on the construction and interrogation of tensor fields that endow the design space with varying properties. Before developing a parametric model, we treat the ambient space itself as a generalized parameterization whose properties will affect and enrich the embedded objects. In effect, the form is the interpretation of the field that encompasses a multitude of concerns related to the particular design.

SIGGRAPH 2008 attendees are invited to interact with a simplified version of the software tool developed for designing the Tensor Shades. The stress tensor field is extracted from the results of finite-element analysis of the volume material with given support and loading conditions. The inverse illumination field is left for the users to define. Each light shade is paired to one surface (wall, floor, or tabletop), on which users can designate their desired light intensities, which are projected back to the light through an inverse illumination process. The introduction of these fields allows for treatment of space as non-homogeneous and non-isotropic, and establishes a spatial condition that is variable and multi-dimensional. This complex spatial information is represented in various forms for the user to explore and interrogate – a process parallel to that of designers reaching a well-integrated design solution for the Tensor Shades.

# Parametric Urbanism, Procedural Complexity

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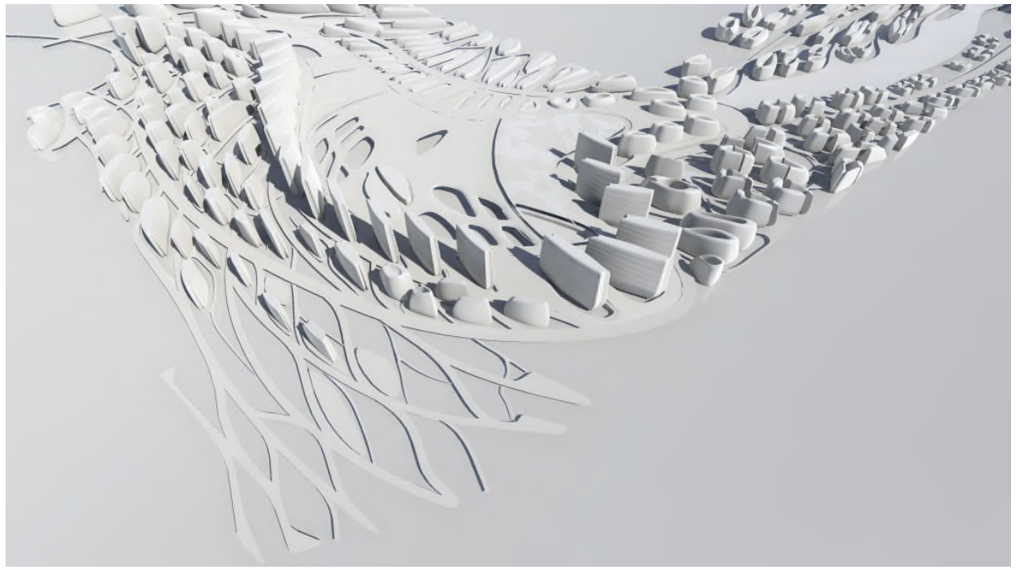

Zaha Hadid Architects (ZHA) uncovers internal correlations and recursive relationships in its design practice at multiple scales, from the detailed to the urban. ZHA is systematically searching for parameters, laws of change, and tools for generating complexity to shift how architects approach form making and space design.

**Parametric Urbanism**

This project recruits powerful digital-design techniques to produce form and make urban spaces with an architect's sensibility. The design team uses recursive Maya scripts to generate a pattern that responds to varying environmental parameters. The result is a complex field for an urban context. The first step is to reconstruct the fundamental typological catalog of architecture and urbanism in terms of field conditions: point fields of villas, line fields of towers, plane fields of slabs, and volume fields of urban blocks. The second step calls for a series of parametric variations. In the final step, the designers play a "matrix game" of recombination and interpenetration that generates the richness and complexity that makes an urban territorial strategy.

ZHA has experimented with this approach in real-world projects at the Thames Gateway in London, in Istanbul, Turkey, in Singapore, and in Appur, India.

**Procedural Complexity**

ZHA's in-house research group, the Computation and Design Group, brings designers and programmers together to develop specialized tools for generating spatial and experiential complexity in geometry. The group is experimenting with topological complexity, cellular logics, and field structures, among other domains. These explorations have resulted in new tools that are available to all the end-users at ZHA for projects at any stage of development. In other words, the tools address the entire design process from end to end and underscore the recursive nature and inner correlations that are a hallmark of ZHA's design.



# Nanjing South Station

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As a competition entry, KPF's design for Nanjing South Station was one of many stations planned as part of a major expansion of China's high-speed and regular service train lines. The station is sited in a slight valley, bisected through the center by a "green corridor" that connects the area's major parks. Inside the station, the green corridor takes the form of an inter-modal hall. The arrival hall is located around the inter-modal hall, and above it are the station's platforms and departure lounges. Above the elevated departure lounges roof is the metaphorical and physical centerpiece of the project: a large, sweeping roof that protects passengers from rain, sun, and wind.

Using parametric modeling techniques, initial designs for the station's roof were tested and then manipulated in order to optimize environmental parameters such as light, wind, rainwater collection, and natural ventilation. Structural efficiencies were tested in a similar manner. The roof pieces were designed with S-shaped sections, and the variations were derivatives of various configurations of the discrete S curves, which were parametrically controlled. The layout and organization of the S curves were defined with global rule-sets, and the final design configuration was a result of these rule-sets, rather than a "hand-crafted" geometry. The behavior and ranges of adaptation for the S curves were defined beforehand, thus the geometry was already being developed under certain constraints. In other words, the design was informed and restricted by certain limitations, so it was pre-rationalized with embedded intelligence in the parametric model.

By designing parametrically, within the constraints of the program brief (set platform widths, column locations, and roof coverage), the design team generated a form that was the absolute product of the imaging technology. Through all stages of design – from the initial site analysis to the structural detailing – parametric modeling was used to help build, test, and improve the design team's formal and programmatic decisions.

**Client**
Ministry of Railroads, People's Republic of China

**Location**
Nanjing, China

**Design Team**
Onur Gun, David Malott, Forth Bagley, Nicholas Wallin, Zhe Wang, Thomas Brown, Charlie Portelli, Jenna Fizel

The CNC milling of the massing model for this project was made possible through the generous donation from **SITU Studio** www.situstudio.com

# Phare Tower, La Défense

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While the Eiffel Tower was shaped by the interaction of wind and gravity, towers today address more complex requirements that integrate multiple systems and serve a range of functions. The Phare Tower by Morphosis, an architectural practice headed by Thom Mayne, is a 300-meter skyscraper that will be built in the Paris district of La Défense in 2012. Phare is designed as a sustainable, performance-driven building.

Scripting in software allows a design to be iteratively developed, tested, and refined to address multi-variant parameters. Rather than design each element, the architect inputs the given variables into the software; defines parameters by which to evaluate the aesthetics, cost or performance; and then selects from the multiple alternatives generated by the software. Changing a few variables can manifest in dramatic change over complex geometries.

Computational design is used to adapt the diagonal grid (diagrid) of the structure and Phare Tower's non-standard form. The architect writes software that models the diagrid components or the louver system as an interconnected matrix. This multi-directional relationship of the matrix enables automation of global changes and suficient flexibility to work with intuitive human design.

An iterative computational design process shaped the diagrid structural system in response to a number of variables. First, the geometry of the initial tower design was optimized for smoothness of the diagrid mesh, to create a seamless wrap of the tower. The smoothest form requires the maximum number of unique triangles in the mesh, so it is the most costly. The next iteration thus targeted cost, standardizing the structure by maximizing the incidence of the same triangle. Gaps between these standardized areas can still be seamlessly connected with the same smoothing optimization.

Both the form and the orientation of the building respond to the path of the sun, to maximize energy efficiency. Traditionally, for optimal sun shading, louvers are angled perpendicular to the direction of the sun's path as calculated on the summer solstice. Yet the complexity of the tower's curving form and the louvers' diagonal axis required that each louver be rotated at a unique angle and adjusted for a different time of day to achieve optimal sun shading. The power of the digital script is its ability to calculate the ideal rotation for each of the 5,000 louvers. To create a secondary scale, randomly selected louvers were slightly rotated, at an angle calculated for the winter solstice, creating a pattern of striations that sweep across the surface of the building. The result is a dynamic, high-performance skin that lives up to the name Phare, or lighthouse.

*Program: Commercial office tower with office space, employee restaurants, public cafe, trading floors, public amenities, and parking for 450 cars.*

**Client**
Unibail

**Site Size**
0.8 acres

**Project Size**
1,996,705 gross square feet

**Design Director**
Thom Mayne

**Project Principal**
Tim Christ

**Project Director**
Charles Lamy

**Project Architect**
Chandler Ahrens

**IT Director**
Marty Doscher with Satoru Sugihara

**Project Team**
Irena Bedenikovic, Anna Crittenden, Patrick Dunn-Baker, Graham Ferrier, Matt Grady, Kerenza Harris, Brock Hinze, Yasushi Ishida, Hunter Knight, Debbie Lin, Andrea Manning, Richard McNamara, Sunnie Lau, Aaron Ragan, David Rindlaub, Scott Severson, Benjamin J. Smith, Martin Summers, Aleksander Tamm-Seitz, Suzanne Tanascaux, Ben Toam, Shanna Yates

**Model Production**
Patrick Dunn-Baker and Hugo Martinez with Kyle Coburn, Guiomar Contreras, Mauricio Gomez, Brock Hinze, Joe Justice, Duly Lee, Michelle Lee, Hugo Martinez, Barbra Moss, Greg Neudorf, Nutthawut Piriyaprakob, Mike Sargent, Christin To, Jose Vargas Dana Viquez

**Consulting Architect**
SRA Architectes

**Mechanical, Electrical, Plumbing Engineer**
Setec Batiment / IBE Consulting Engineers

**Structural Engineer**
Setec TPI / TESS

**Façade Consultant**
RFR Facades

**Energy Modeling**
RFR Elements

**Vertical Transportation**
Lerch Bates

**Acoustical Engineering**
AVLS

**Restaurant**
Arte Charpentier

**Code Consultant and Inspector**
Cabinet Casso

**Security Consultant**
SOCOTEC

**Cost Estimator**
Sterling Quest Associates/ Davis Langdon

**Construction Manager**
Oger International

**Etablissement Public pour l'Amenagment**
EPAD

# A Landscape of 3D-Printed Skyscrapers

During a recent visit to an architecture studio, an architect remarked that she was "writing the façade" of the skyscraper she was designing. When asked what she meant by "writing," she corrected herself and said that she was "scripting" it. The comment signified a shift in the ways designers conceptualize and detail a design. In addition to drawing by hand or modeling in CAD, she conceptualized the building with lines of code.

The studio was packed with scale models of buildings, a common practice among architects. Some of these models were generated using digital fabrication methods. The availability and application of new fabrication methods coupled with the emergence of new software tools and the growing number of architects and designers who are familiar with computer programming have expanded possibilities for designs that are generative and parametric. It has also enhanced the ability to rapidly produce process models of these buildings.

As part of the SIGGRAPH 2008 Design & Computation gallery, we invited several architectural offices to contribute 3D-printed models of skyscrapers. These models vary in format, from completed projects to projects in progress, competition submissions, or concept work. Most of the designs were conceived using parametric and/or generative tools and scripting, both during form exploration and when the designers were evaluating structural, lighting, material, or other conditions relevant to the design and fabrication of the building.

These towers represent a glimpse into the designers' process, during which they created numerous iterations and variations of the design, and its overall form and façade articulation. Aesthetics, structural requirements, and environmental concerns are increasingly handled with sophisticated computational tools.

Lira Nikolovska, S2008 Chair of Curated Art
Lorna Goulden, S2008 Design Gallery Committee member

This SIGGRAPH 2008 curated project was made possible through the generous 3D printing donations from the following companies:

**York Technical College / 3D Systems**
Contact: Michael Gayk
mgayk@yorktech.com

**RedEye ARC**
Contact: Ryan Sybrant
ryan.sybrant@redeyearc.com

**EOS of North America, Inc.**
Contact: Shane Collins
shane.collins@eos.info



# Architecture Research Office/ Della Valle Bernheimer

**Stephen Cassell and Scott Geiger**
515 West 35th Street
New York, New York USA
s.geiger@aro.net
www.aro.net



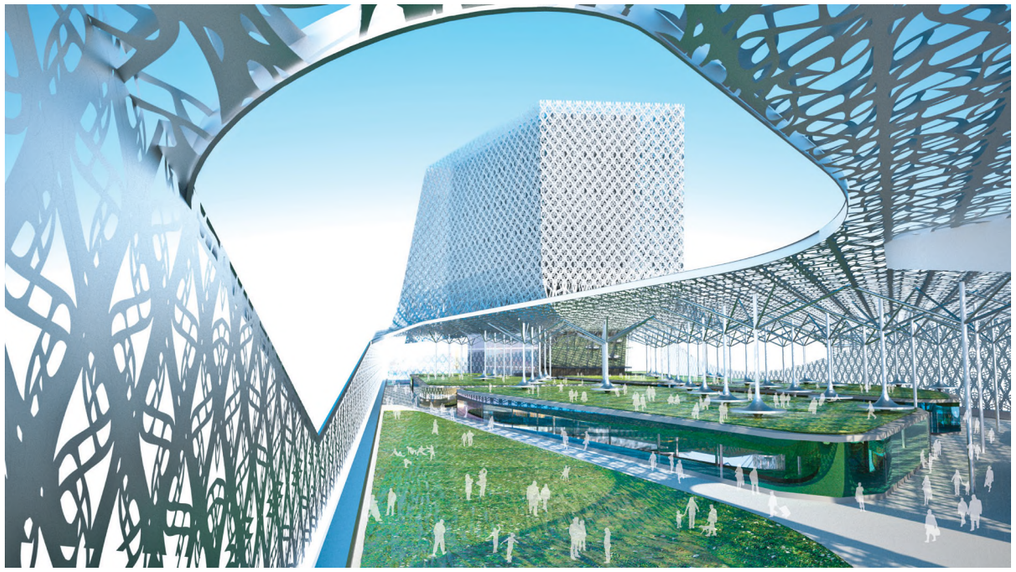
At 650-feet, this idiosyncratic tall building engages Manhattan on its two most important scales: the skyline and the street. The façade is a gesture to the city's frenzied activity and skyline. Varying mass articulation on 35th and 36th Streets, with a 50-foot-wide slot connecting the two, is a surprise appropriate for luxury hotel and signature residential property.

3D printing of ARO / DVB models was made possible through a donation from **York Technical College / 3D Systems.**

## Evan Douglis Studio

**Contact: Richard Sarrach**
1205 Manhattan Avenue Unit 1-2-14
Brooklyn, New York 11222, USA
info@evandouglis.com
www.evandouglis.com





A colossal open-air rooftop retail and hotel complex in New York, the el // Tower represents a new urban typology for the 21st century. Utilizing a single surface as a branded wrapper, the structural diagrid transforms from a horizontal trellis to a vertical bris-soleil along a distance of three city blocks. Enclosing over 10.1 million cubic feet, the new complex envisions the future skyscraper as an (L) system in which future urban expansion is now multi-directional, as it simultaneously increases horizontally and vertically.

**Principal**
Evan Douglis

**Project Director**
Richard Sarrach

**Design Team**
Jeremy Carvalho
Tamaki Uchikawa
Che-Wei Wang
David Mans
Peter VanHage
Dan Breitner

**Engineers**
Ashok Raiji
Mahadev Raman (mechanical)
Ricardo M Pittella
Matthew Clark (structural)
ARUP

**Cost Estimator**
Ethan Burrows

**Project Manager**
Davis Langdon

**Location**
New York, New York USA

3D printing of Evan Douglis Studio models was made possible through a donation from **York Technical College / 3D Systems**



## Foster + Partners

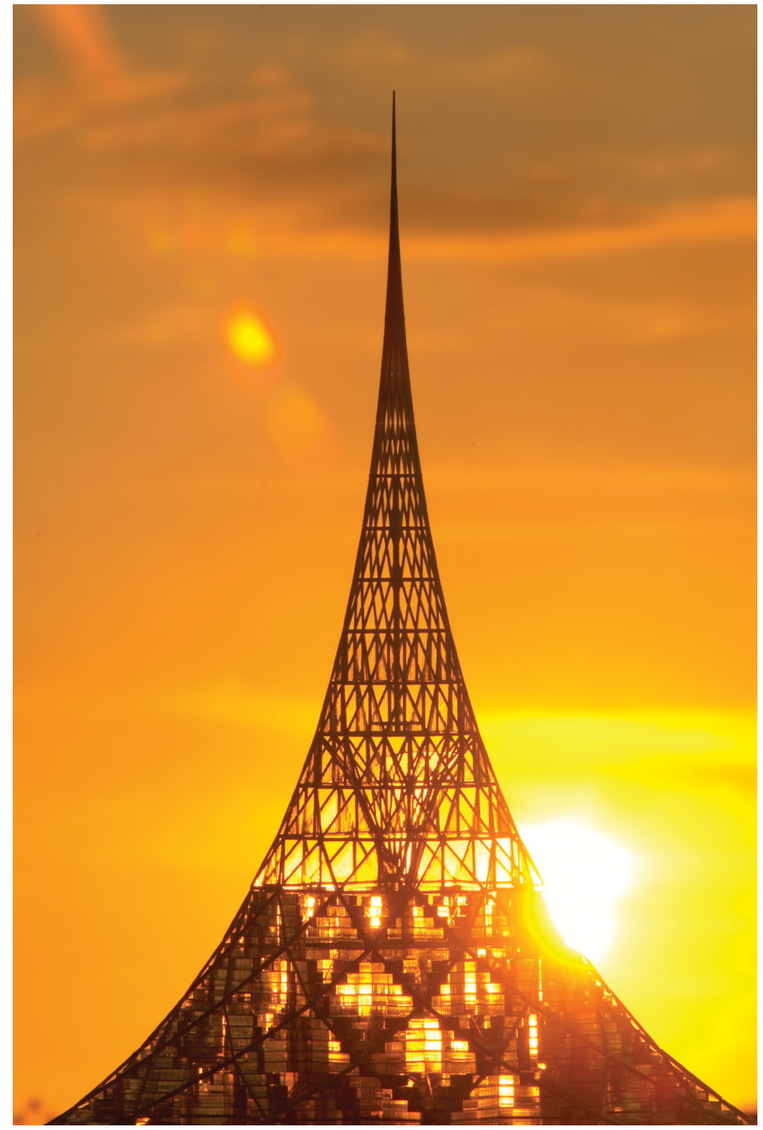
Riverside, 22 Hester Road
London SW11 4AN, England
enquiries@fosterandpartners.com
www.fosterandpartners.com



Crystal Island is a vast mega-structure covering a total floor area of 2.5 million square meters. At 450 meters, the building is one of the tallest structures enclosing the largest space on the planet. It also creates a spectacular new emblem on the Moscow skyline. Conceived as a self-contained city within a city, it contains a rich mix of buildings, including museums, theatres and cinemas, to ensure that it is a major new destination for all of Moscow. It is located on the Nagatino Peninsula, edged by the Moscow River, only 7.5 km from the Kremlin and offers panoramic views across the city.

**Location**
Moscow, Russia

**Client**
STT Group



3D printing of Foster+Partners models was made possible through a donation from **EOS**

## Foster + Partners

Riverside, 22 Hester Road
London SW11 4AN, England
enquiries@fosterandpartners.com
www.fosterandpartners.com

**Millennium Tower**

Tokyo is among the megacities forecast to exceed populations of 15 million by 2020. The Millennium Tower presents a timely solution to the social challenges of urban expansion on this scale and to the particular problems of Tokyo, with its acute land shortages. Commissioned by the Obayashi Corporation, the building rises out of Tokyo Bay. The tower is capable of housing up to 60,000 people, generating its own energy, and processing its own waste. Developed in response to the hurricane-strength wind forces and earthquakes for which the region is notorious, the tower's conical structure, with its helical steel cage, is inherently stable. It provides decreasing wind resistance toward the top, where it is completely open, and increasing width and strength toward the base to provide earthquake resistance.

**Location**
Tokyo, Japan

**Design**
1989



## Foster + Partners

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www.fosterandpartners.com

**Russia Tower**

Russia Tower is the tallest building in Europe. It is a striking new addition to the dynamic high-rise skyline of Moscow. The 600-meter building continues the firm's investigation into the nature of the tower, taking structural, functional, environmental and urban logic to a new dimension. The mixed-use project incorporates apartments, hotel, office, and leisure space, and it will have an "energy cycle" that pioneers sustainable architecture and reinforces the economic and social vitality of Moscow.

**Location**
Moscow, Russia

**Client**
STT Group

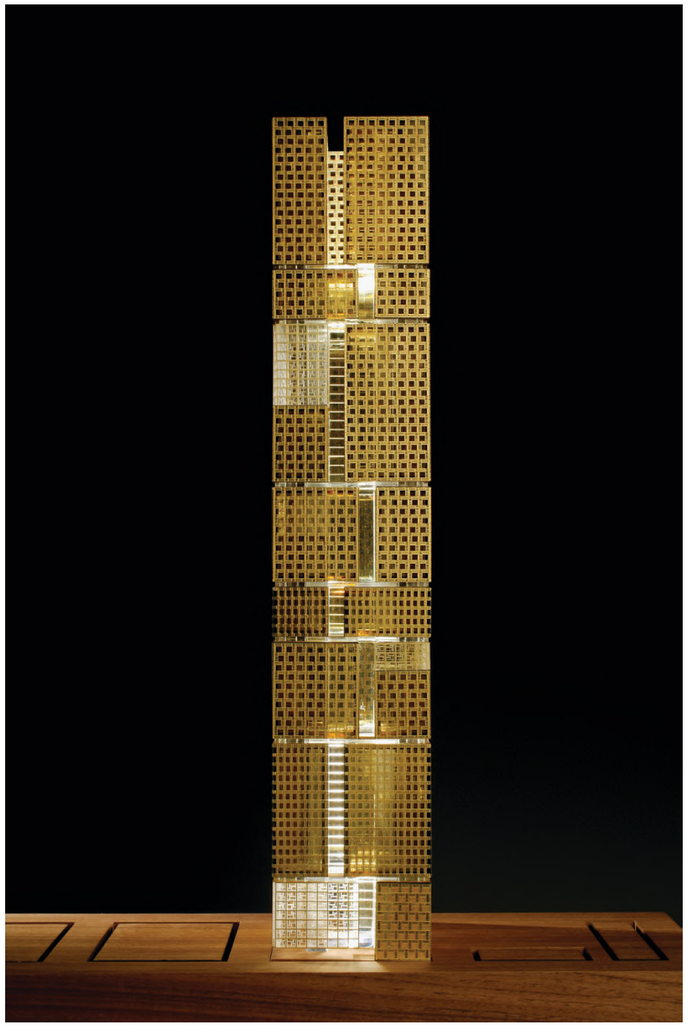
**Concept Structure**
Halvorson and Partners

# Grimshaw Architects

**Contact: Shane Burger**
100 Reade Street
New York, New York 10013 USA
shane.burger@grimshaw-architects.com
www.grimshaw-architects.com

Tower Concept A

The design concept is a balance of three requirements: reflect the traditions of Islamic vernacular architecture, create a building with multiple functions and internal villages, and provide an intelligent response to a hot, humid climate. The layering of these factors creates the building's character. The Tower adapts the vernacular mushrabiyah screen to create comfortable internal conditions with minimal energy consumption. The resulting screen provides the proper level of light and reduction of heat gain, which is appropriate for the variety of internal program conditions, all within a vernacular textural framework that references the rich history of Islamic geometry.



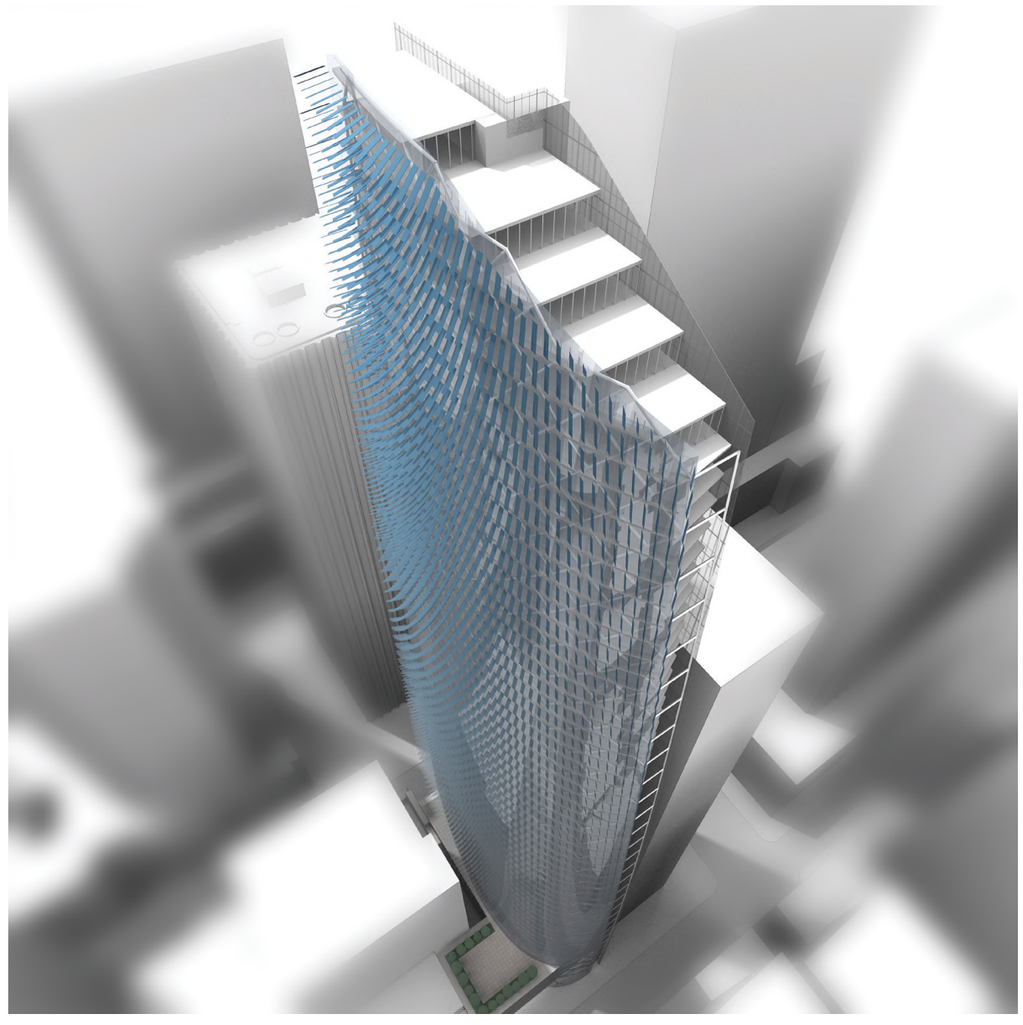
3D printing of Grimshaw Architects models was made possible through a donation from **York Technical College / 3D Systems**



# Grimshaw Architects

**Contact: Shane Burger**
100 Reade Street
New York, New York 10013 USA
shane.burger@grimshaw-architects.com
www.grimshaw-architects.com

Tower Concept B



Beginning with complex zoning and right-to-light requirements, this tower concept explores the performative development of a paired-blade, double-skin façade. The macro-scale environmental form is enhanced by micro-scale exterior-actuated louvers that track sun movement and interior heat gain, and provide a naturally comfortable interior year-round while preserving the prevailing views.

## HOK International

**Contact: Miles Walker**
216 Oxford Street
London W1C 1DB United Kingdom
miles.walker@hok.com
www.hok.com

**VAO**
**HOK México**

VAO is a mixed-use development in Monterrey, as major city in northern México. This development includes office space, 350 apartments, retail, and hotel. The tower itself has 45 floors and extends 240 meters above street level.

**Location**
Monterrey, México

**Client**
Internacional de Inversiones

**Completion**
2010 (tentative)

3D printing of HOK models
was made possible through a donation
from **York Technical College /**
**3D Systems**



## HOK International

**Contact: Miles Walker**
216 Oxford Street
London W1C 1DB United Kingdom
miles.walker@hok.com
www.hok.com

**New Songdo Towers**
**HOK New York**

HOK has designed seven new buildings in Incheon, South Korea (six mixed-use towers and one hotel tower) as part of New Songdo City, a $25 billion master-planned international business district.

**Location**
Incheon, South Korea

**Client**
Gale International

**Completion**
2009

## HOK International

Office Tower Design

**Contact: Miles Walker**
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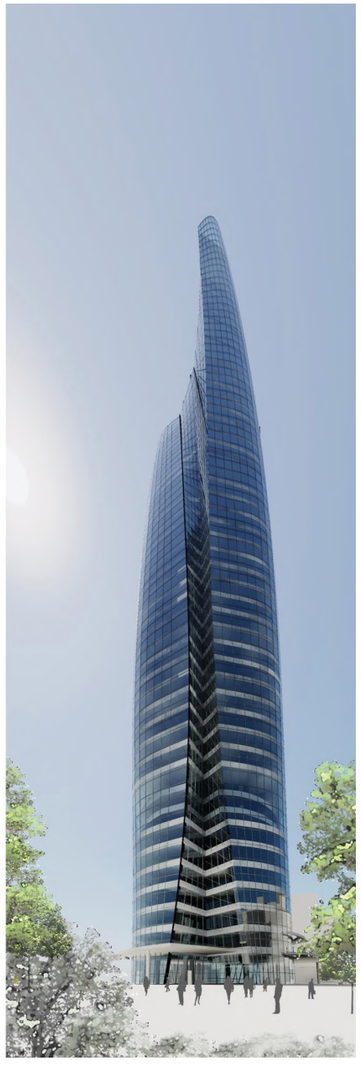
London W1C 1DB United Kingdom
miles.walker@hok.com
www.hok.com

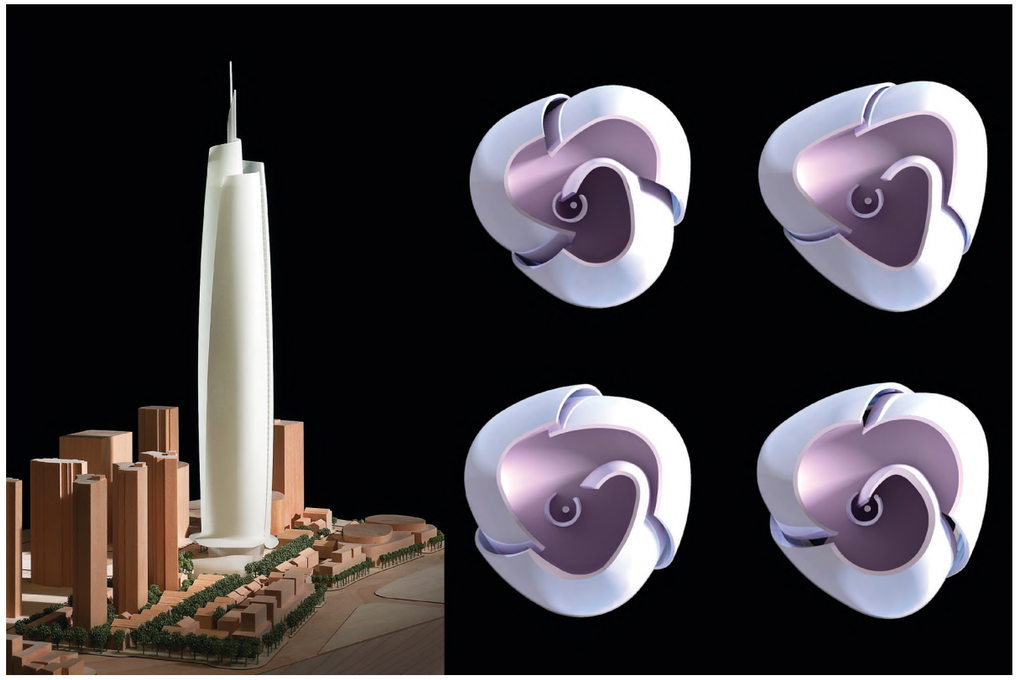
The images are conceptual explorations of office tower designs by Alistair Lillystone. The experiments were made using Autodesk Revit.



## Kohn Pedersen Fox Associates

White Magnolia Tower

**Contact: Onur Yuce Gun**
111 West 57th Street
New York, New York 10019 USA
ogun@kpf.com
www.kpf.com



With its distinctive design and name based on the idea of the white magnolia (the city flower of Shanghai), this tower aims to stand as the iconic piece in its area of the city. Its organic form twists, focusing on views and optimizing solar orientation.

**Design Team**
Onur Yuce Gun
Robert Whitlock
Aman Krishan

**Location**
Shanghai, China

**Client**
Shui On Land Ltd.

3D printing of KPF models was made possible through a donation from **York Technical College / 3D Systems**

# Kohn Pedersen Fox Associates

**Contact: Onur Yuce Gun**
111 West 57th Street
New York, New York 10019 USA
ogun@kpf.com
www.kpf.com

## The Pinnacle

The Pinnacle will become one of the most significant new buildings in the City of London, with a design that strengthens the overall character and identity of the emerging cluster of tall buildings.

**Design Team**
Jon Neville-Jones, Karen Cook, Paul Voysey, Renos Charitou, Robert Peebles, Daniel Moore, Karthikeyan Ramamoorthy, Efrat Cohen, Tim Yu, Gustav Fagerstrom, Renate Ott, Wayne Mckiernan, Stylianos Dritsas, Etain Fitzpatrick, Clara Doty, Alanna Zie.

**Location**
London, United Kingdom

**Client**
The Pinnacle Limited



# SHoP Architects

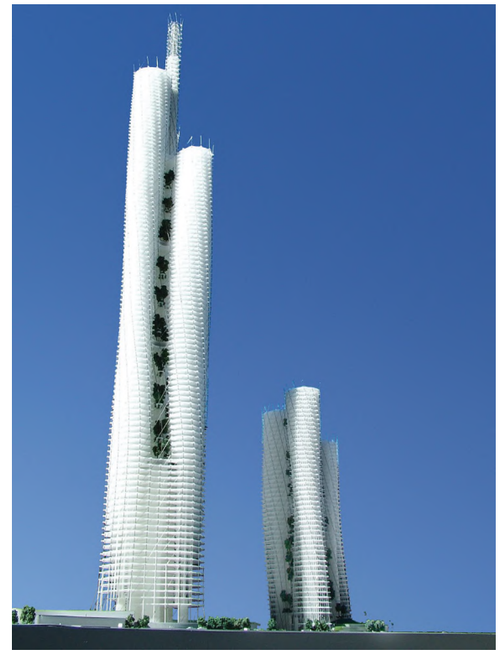
11 Park Place, Penthouse
New York, New York 10007 USA
studio@shoparc.com
www.shoparc.com

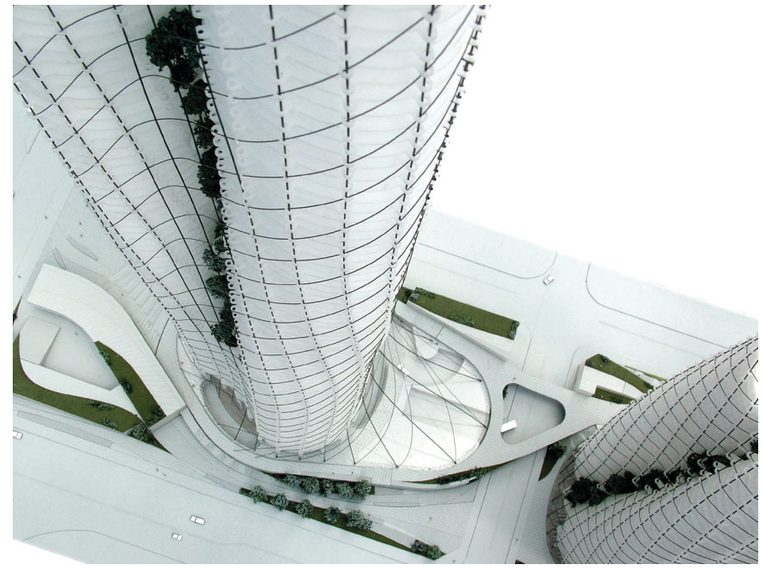
## World Business Center Busan

SHoP's design proposal for the World Business Center Busan (WBCB) complex combines the traditional Korean courtyard type ("Madang") with contemporary high-rise living to create a new urban ecology: the "vertical garden".

**Location**
Busan, Korea

**Client**
Busan International Architecture Culture Festival





3D printing of SHoP models was made possible through a donation from **York Technical College / 3D Systems**

# Skidmore, Owings & Merrill

**Hudson Yards Competition**

**Contact: Ajmal Aqtash**
14 Wall Street
New York, New York 10005 USA
ajmal.aqtash@som.com
www.som.com

The design of One and Two Hudson Place is informed by the unique challenges and opportunities of the site. The curving footprints of the towers align with the train shed below, while monumental steel buttresses bridge the active rails. This fluid massing is combined through the height of the tower, projecting the site's unique role in the Manhattan skyline. The building envelopes are transparent scrims of glass etched with graduated densities of ceramic frit, further accentuating the transforming geometry of the towers. The pattern and density of the layered frit glass maximizes natural daylighting and energy efficiency, while minimizing glare and reflecting the shimmering colors of New York City.

**Design Partner**
Gary Haney

**Architectural Associate Design Director**
Jeffrey Holmes

**Technical Partner**
Carl Galioto

**Structural Partner**
William Baker

**Structures Director**
Charles Besjak

**Management Partner**
TJ Gottesdiener

**Project Manager Director**
Kenneth A. Lewis

**Rendering**
Archimation

3D printing of SOM models was made possible through a donation from **York Technical College / 3D Systems**



# Skidmore, Owings & Merrill

**Lotte Supertower**

**Contact: Ajmal Aqtash**
14 Wall Street
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ajmal.aqtash@som.com
www.som.com

Lotte Super Tower is a super-tall, mixed-use building including retail, offices, hotel, and an observation deck in southeastern Seoul. The tower's design, in which the building transforms smoothly from a square base to a circle at 1,640 feet (555 meters), is inspired by an organizational strategy based on an ancient Korean observatory.

**Design Partner**
Mustafa Abadan

**Architectural Associate Design Director**
Chris Cooper

**Technical Partner**
Carl Galioto

**Architectural Associate Technical Director**
Nicholas Holt

**Structural Partner**
William Baker

**Structures Director**
Charles Besjak

**Project Manager Associate Director**
Brant Coletta

**Rendering**
Swim by 7th Art

# Skidmore, Owings & Merrill

**Contact: Ajmal Aqtash**
14 Wall Street
New York, New York 10005 USA
ajmal.aqtash@som.com
www.som.com

**Yongsan Tower**

In the largest historic transfer of land from public to private ownership, the city of Seoul has established a master plan for a new International Business District in the heart of the city. The centerpiece of the district will be a new landmark tower that will become the symbolic figure of Korea's place in the global economy today and in the future.

**Design Partner**
Mustafa Abadan

**Architectural Associate**
**Design Director**
Chris Cooper

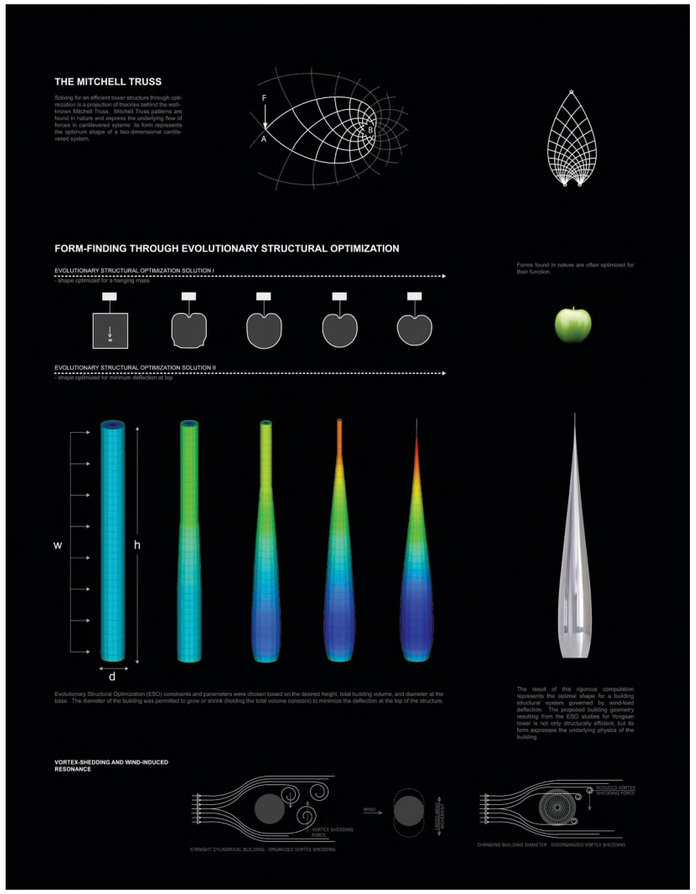
**Structural Partner**
William Baker

**Structures Director**
Charles Besjak

**Architectural Associate**
**Technical Director**
Nicholas Holt

**Project Manager**
**Associate Director**
Brant Coletta

**Rendering**
Skidmore Owings & Merryll






# Zaha Hadid Architects

**Contact: Nils Fischer and Shajay Bhooshan**
10 Bowling Green Lane
London EC1R 0BQ United Kingdom
nils.fischer@zaha-hadid.com
shajay.bhooshan@zaha-hadid.com
www.zaha-hadid.com

**Dubai Business Bay**
**Signature Towers**

The Signature Towers, 375-meter skyscrapers in the Dubai Business Bay, include offices, hotel, residential, retail, bridges, a waterfront park, and a promenade. The architectural concept takes a "choreographed" movement that combines the three towers in one overall gesture and "weaves" a series of public spaces through them: the podium, the bridges, and the landscape beyond.

**Location**
Dubai, United Arab Emirates

**Client**
Dubai Properties
Dubai, United Arab Emirates

**Completion**
2006 - tbc

**Architectural Design**
Zaha Hadid and
Patrik Schumacher

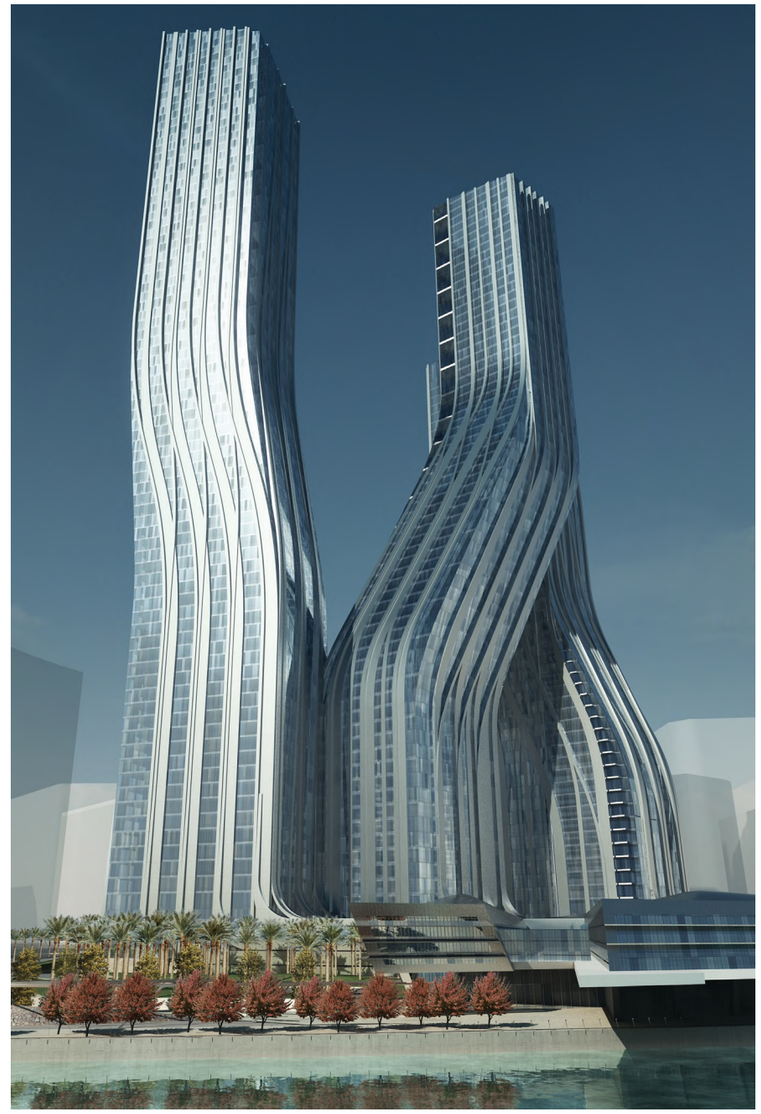
**Project Architect**
Chris Lepine

**Project Director**
Lars Teichmann

**Design Team**
Lepine, Wurster, Ciraci, Constantino, Campos, Nobakhti, Perpatidou, Noradee, Jawad, Chakouf,
Al Shiekh, Norell, Rabl, Burusphat, Ferrari, Patat, Eray, Baskin, Lemos, Hamid

**Project Architect**
[competition] Tiago Correia

**Design Team** [competition]
Cajiao, Abdel-Jalil, Le Bienvenu, Talebi, Reisigl, Rosales, Masten, Kang, Constantino, Modlen



3D printing of ZHA models was made possible through a donation from **RedEye ARC**

# Zaha Hadid Architects

**Contact: Nils Fischer and Shajay Bhooshan**
10 Bowling Green Lane
London EC1R 0BQ United Kingdom
nils.fischer@zaha-hadid.com
shajay.bhooshan@zaha-hadid.com
www.zaha-hadid.com

## The Opus Office Tower

Thse two buildings are conceived as a united mass in the form of a cube hovering off the ground. The cube is carved or eroded by a free-form void, essentially the setback space between the two tower envelopes.

**Location**
Dubai, United Arab Emirates

**Client**
Omniyat Properties, Dubai

**Architectural Design**
Zaha Hadid and
Patrik Schumacher

**Client Representative**
Graham Hallett

**Project architect**
Christos Passas

**Team Manager**
Vincent Nowak

**Competition Team**
Baerlecken, Douglas, Huang, Peyrer-Heimstaett, Jalil

**Design Team**
Peng, Lebie, Ferrari, Frings, Peyrer-Heimstaett, Skroumbelos, Sophocleous, Akritopoulous

**Consultants**
**Project Management**
Gleeds, London

**Local Architect**
Arex Consultans, Dubai

**Structural, Mechanical and Electrical Engineer**
whitbybird, London

**Façade Enginner**
whitbybird, London

**Fire Engineering**
SAFE, London

**Lift Consultant**
Roger Preston Dynamics, Maidenhead

**Traffic Consultant**
Cansult Limited - Dubai



# Zaha Hadid Architects

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London EC1R 0BQ United Kingdom
nils.fischer@zaha-hadid.com
shajay.bhooshan@zaha-hadid.com
www.zaha-hadid.com

## Cairo Tower

This tower is designed as a gracious volume that elegantly borders the Nile River in the heart of Cairo. The main structural elements of this 70-story hotel and apartment tower are concrete fin walls that rotate gently over the full height of the tower.

**Location**
Cairo, Egypt

**Architectural Design**
Zaha Hadid and
Patrik Schumacher

**Project Architect:**
Joris Pauwels

**Design Team**
Feng Xu, Paulo Flores, Sharifah Alshalfan, Tariq Khayyat

**Structure**
Adams Kara Taylor

**Hotel Consultancy / Program Development**
Eastern Quay

# The Search of Form, the Search of Order: Gaudí and the Sagrada Familia

**Carlos Barrios**
School of Architecture and Planning
The Catholic University of America
620 Michigan Avenue, NE
Washington, DC 20064 USA
barrios@cua.edu
architecture.cua.edu

The architecture of Antoni Gaudí is commonly associated with the Art Nouveau movement of late 19th-century Europe. Perhaps this association is due to the exuberance of the forms and their capricious appearance, or maybe it can be attributed to the use of picturesque and natural motifs in combination with vernacular solutions. Some experts even regard Gaudí's work as the precursor of Catalonian modernism. Nevertheless, behind the seemingly erratic appearance of complex forms and spaces, Gaudí's work epitomizes the synthesis of plain shapes and simple geometrical operations.

The interior and exterior of his buildings offer a collection of unique spatial experiences. His innovative architectural language is the result of a unique combination of geometrical operations most evident in his work on the Expiatory Temple of the Sagrada Familia in Barcelona. The Sagrada Familia, still under construction, started as a small parochial church of neo-Gothic style in 1862. The original architect resigned only a year after being commissioned and Gaudí was hired to complete the project and oversee its construction in 1863.

Gaudí, known to have been a critic of the Gothic style, took a bold, ambitious approach, changing both the style and scale of the project. The Sagrada Familia became a project that consumed Gaudí for the next 43 years until his accidental death in 1926. He spent the final 12 years of his life declining other commissions and remained exclusively devoted to the completion of the Sagrada Familia.

Most of the work was done in plaster models that still survive and provide documentation of the architect's original vision. For the columns of the Sagrada Familia, Gaudí initially proposed a single helicoidal shape. However, he became concerned that the single twist was visually inappropriate, since it produced a column that looked weak and could be squashed or deformed when loaded to compression.

The visual imperfection of the single twisted column bothered Gaudí for a number of years and inspired a search for an alternative solution. After years of experimentation, he applied two simultaneously opposite rotations. This approach, which has no known precedents in architecture, was the result of eight years of work and experimentation. Gaudí's inspiration for the helicoidal growth can be found in plants; it is believed that he studied the growth of *abelia*, a plant abundant in Barcelona. The double-twisted column was based on a single rotation of a basic shape and the corresponding counter-rotation of the same shape. When the two shapes were superimposed and intersected, the resulting shape created a new emergent form.

All the columns on the Sagrada Familia nave follow this process. The only variations can be found in the degree of rotation, the height of the columns, and the initial shape used to generate the columns. A hierarchical arrangement of the columns is present throughout the temple. The columns of the central nave use an octagonal shape; the columns of the crossing area are two pentagons forming a 10-sided polygon. The central columns on the crossing are three squares forming a 12-sided polygon and the columns of the lateral nave are made of two triangles to form a hexagon.

With today's computer-modeling systems, it is fairly easy to reproduce Gaudí's original columns and to explore possible new designs using variations of the initial shape and degree of twist, as well as the use of irregular forms and non-symmetrical shapes.

3D printing of the models for this curated project was made possible through a generous donation from **Z Corporation.** Contact: Olimpio DeMarco (odemarco@zcorp.com)

# Continua

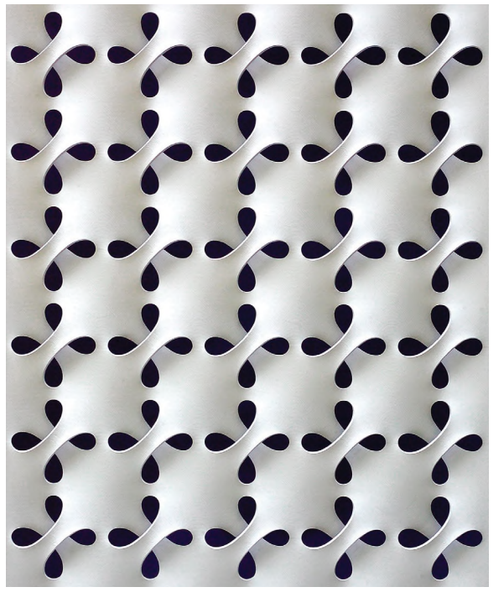
**Erwin Hauer**
**Enrique Rosado**
EHR Associates LLC
www.erwinhauer.com

The concepts of continuity and potential infinity have been central themes of Erwin Hauer's opus from very early on in his career as a sculptor. In his native Vienna, he began to explore infinite continuous surfaces that evolved into perforated modular structures that were appropriate in architectural applications. Hauer's sculptural walls are intricately woven forms that create a visual sense of infinity – a frozen poetry in motion. He patented these designs, developed the technology to produce them, and installed the modular, light-diffusing walls in buildings throughout the United States and seven other countries.

Hauer continued this work after he moved to the US, first as a Fulbright scholar and then as a faculty member in the Department of Design at Yale University, where he was invited by Josef Albers, a giant of modernism and one of the pillars of the Bauhaus.

Hauer derived the concept of continuous surface primarily from his studies of biomorphic form, an experience reinforced by his first encounters with the work of Henry Moore. He examined how Moore interlaced "… the dominant continuity of surfaces with an unprecedented cultivation of interior spaces within his sculptures." These reflections led Hauer to the awareness of the so-called saddle surface, a type of mathematical surface that looks like the peculiar shape of horse saddles that curve both up and down. These surfaces influenced his sculptures and soon evolved into a repeat pattern because, as Hauer states, "the saddle surface refuses to permit the closure of form." While Naum Gabo accepted this fact, Hauer responded to the open-endedness of the single saddle by adding replicas of it around its boundaries, in a seamless and flush manner. When this procedure is repeated for every open-ended edge, the result is in an infinite continuous surface. This characteristic is central to most of Hauer's screen designs.

In 2003, Hauer formed a partnership, Erwin Hauer Studios, with Enrique Rosado, a former student of his at Yale who has extensive knowledge in the digital field. Their purpose is to re-issue a selection of Hauer's original screens of the 1950s, to adapt some of these classic designs to modern production methods using digital technology, and to develop new designs as well. With the same intensity and scrutiny Hauer applied to his original molds and casts, Enrique Rosado now focuses on design transformations, creation of custom tools, and CNC-milling techniques.



**Fabricators**
Digital Stone Project and others

# Weaving Public and Private: Interior Wall Studies

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This interior wall panel was designed for an SOM client from the Middle East. It is conceived as a 25-meter-long and 15-meter-tall screen that consists of solid, repeating Corian components that hang together structurally and weave public and private spaces. The resulting divider is a thickly layered and textured screen that generates the project-appropriate degree of visual transparency.

The system functions as both surface and structure thanks to the interplay between geometry and material. Corian is an artificial material that is typically used as a slab in architectural settings. Here, the designers worked with Corian fabricators to push the material's structural capabilities and to explore the potential of digital fabrication. The resulting geometries are consistent with the ways Corian can be produced and manipulated, but open new possibilities for structural applications.

Instead of cutting off public from private spaces, the wall mediates between the two. The solid component pieces are "woven" together like fabric, and link one side to the other physically and visually. The three-dimensional texture and repeating pattern of the surface allow variation when viewed from different vantage points or in motion. This dynamic experience is dramatically reinforced under different lighting conditions.

**Design**
Skidmore, Owings & Merrill LLP (SOM)

**Fabrication**
Evans & Paul Unlimited Corp



# Islamic Patterns

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The rise and spread of Islamic culture from the 7th century onward has provided us with one of history's great artistic and decorative traditions. Across Europe, Africa, and Asia, we find artistic treasures of unrivaled beauty in calligraphy, stylized floral designs, architecture, and abstract geometric star patterns. Islamic star patterns adorn buildings, particularly mosques and tombs, throughout the Islamic world.

Design methods for construction of Islamic patterns were the private domain of the artisans who practiced them. The knowledge was passed down from master to apprentice over generations and ultimately was lost as the practice declined during the 15th century. Except for a few scattered remnants of this technical knowledge, the design of Islamic star patterns is a mystery. As a guide, we have only the end product: hundreds of beguiling geometric designs found all over the world. One thing known with certainty is that star patterns are deeply mathematical in nature. The artisans were well versed in geometry; in their pursuit of mathematical knowledge, early Islamic scholars translated Euclid's Elements into Arabic. And so even though we cannot peer back through time to understand their design techniques, we can at least be confident that their constructions were firmly rooted in geometry.

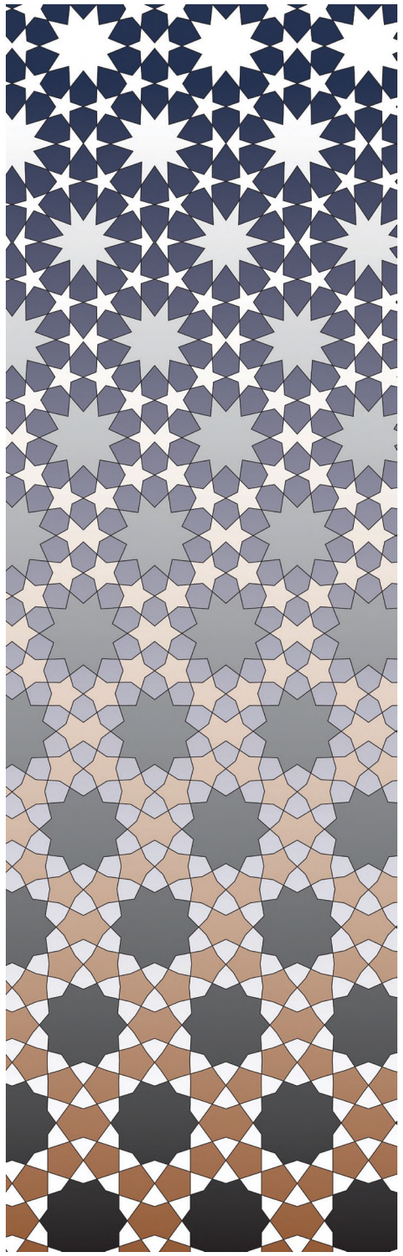
In the past 100 years or so, many mathematicians and hobbyists have studied the construction of Islamic star patterns. The result is a small set of practical techniques that can be used to generate traditional and novel star patterns, techniques that may or may not resemble those practiced historically.

Craig Kaplan develops software for design and rendering of Islamic geometric patterns. His work is inspired both by historical examples and by contemporary research into the mathematical structure of these patterns. Kaplan's software marries algorithms from computer graphics with the modern mathematical machinery of symmetry theory and tiling theory.

His work breaks the process of pattern construction into two steps. First, the designer chooses a tiling of the plane. Then the software places small geometric motifs in every tile, a process governed by a small set of parameters under the designer's control. The motifs link together to form a finished design. The computer handles the tedium of precise, repetitive drawing, thus freeing the human designer to explore the space of star patterns quickly and enjoyably.

Kaplan's work provides an opportunity to extend the range and scope of Islamic star patterns beyond the boundaries of the historical canon. Non-Euclidean geometry would have been inconceivable hundreds of years ago. Kaplan has shown how star patterns can be adapted to the hyperbolic plane and the sphere. His "Islamic parquet deformations" exhibit a slow geometric evolution in space. The mathematical technique is straightforward, but it would have been impractical to produce these designs without computers because of the lack of strict repetition.

The connection between computer graphics and computer-controlled manufacturing offers the exciting possibility of realizing computer-generated art as physical artifacts. Kaplan has experimented with sculptural, architectural, and decorative forms using a variety of manufacturing technologies and media.



# Ice-rays

**George Stiny**
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Ice-rays are a kind of traditional Chinese lattice used in ornamental window grilles (figure 1).[1] Ice-rays form irregular patterns that suggest cracking ice on still water — straight lines meet longer lines in myriad ways.

Rules for ice-rays are easy to define in a shape grammar.[2] They are in two equivalent schemas: x -> div(x) and x -> x' + x", where x, x', and x" are triangles, quadrilaterals, or pentagons, and div(x) divides x into x' and x". Sample rules are in figure 2.

Rules apply in alternative ways. Imagine a Chinese craftsman at a building site, with his tools and a trove of sticks. Shown a window opening, he starts an ice-ray. He selects a stick of the right size and inserts it between two sides of the rectangular frame to form two quadrilaterals. He continues his work by dividing one of these areas into a triangle and a pentagon. Then he divides the triangle into a triangle and a quadrilateral, and the pentagon into a quadrilateral and a pentagon. He goes on connecting sides of polygons to make others of the same kind. Everything is stable in this process, if he keeps to the rules.

It is striking how rules apply recursively, but also notice something new. Calculating in a shape grammar is visual. Rules apply directly to ice-rays. There are no hidden representations that limit what you can do — what there is, you can see, and what you see is there.

Divisions in ice-rays may vary — some require multi-axial figures and motifs (figures 3 and 4). Just put them in rules: draw what you see before you divide, and then draw what you want. Or let the schema x -> div(x) include your rules, so that polygons are divided into two areas or more.

The ice-rays in this exhibit were made using CNC milling. There is no end to the ice-rays you can get from the schema x -> div(x): both known ones, and ones that are new. Go on and try the schema — make an ice-ray of your own!

1. Daniel Sheets Dye, 1949, *A Grammar of Chinese Lattice,* Cambridge MA: Harvard University Press.
2. George Stiny, 2006, *Shape: Talking About Seeing and Doing,* Cambridge MA: The MIT Press.

The project was funded in part by a Director's Grant from the
**Council for the Arts at the Massachusetts Institute of Technology.**
The Council's generous support is greatly appreciated.

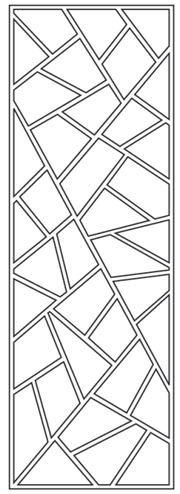

*Figure 1. S-shaped ice-ray, Chengtu, Szechwan, 1800.*

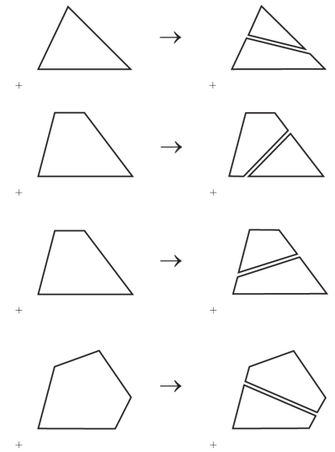

*Figure 2. Shape grammar rules for making ice-rays.*

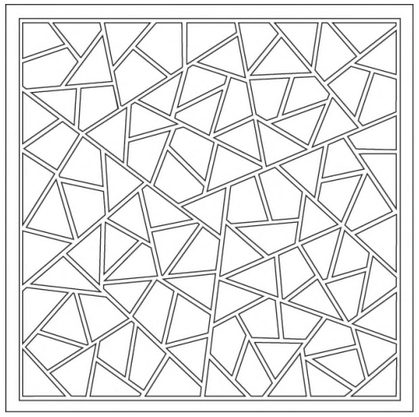

*Figure 3. Irregular ice-ray, Chengtu, Szechwan, 1880.*

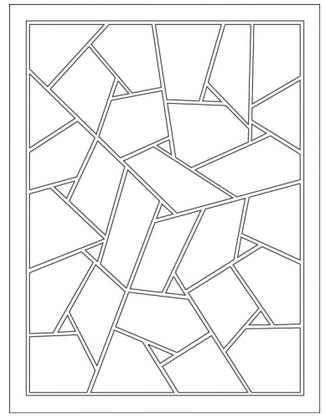

*Figure 4. Complex three-vaned windwheel ice-ray, Jungking, Szechwan, 1725.*

# African Kuba Textiles: Structural Inference and Contemporary Design Using Shape Grammars

**The Generative Design Team**
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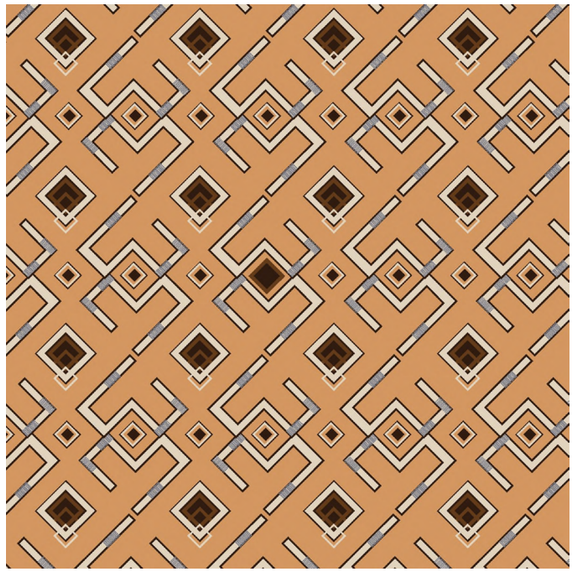
Montréal, Québec, Canada



While many cultures create designs with geometric patterns, each has distinct motifs and symmetries. The textiles by the Kuba ethnic groups in southeastern Congo are unique in their iterations and transformations of basic geometric shapes. These textiles, woven from the fiber of the raphia palm, reveal a sophisticated vocabulary of geometric patterns. This project illustrates application of a generative model to interpret the geometric structure inherent in Kuba textiles by ascribing a shape grammar, to create contemporary design variations through grammar variations, and finally to fabricate the new designs on a computerized loom.

Kuba textile designs can be described as compositions of simultaneous diversity. Women artisans incorporate spontaneity and improvisation in their designs to achieve uniqueness and individuality – part of their cultural aesthetics. The designs are most often characterized by semi-symmetry, achieved by the juxtaposition of distinct geometric motifs, and by controlled variations in texture, scale, shape, orientation, and/or color. As the knowledge and skills of elder generations die out, analysis of these art forms generates considerable interest in the contemporary design and arts community.

Shape grammars provide a powerful paradigm both for representing the structural complexity in existing designs, like Kuba, and for creating contemporary variations. They also provide a structured mechanism to express the recursion inherent in the artwork. Arrangements are formally captured as a finite sequence of Euclidean transformations (translation, rotation, scale, and reflection). Coloring techniques in the artwork are expressed as properties of basic shapes. Texturing, blending, and fading are employed as the primary coloring techniques.

By traversing the grammar's language or reworking grammars, artists, designers, and historians can wander freely in the "neighborhood" of an existing design, exploring variations and discovering elements that define the character of an existing pattern. By modifying a pattern to replicate another existing design, the artist or researcher can get a hands-on feel for the similarities and differences between them. The end product of such work may be new patterns or simply a better understanding of the ones under examination.

It is possible to generate interesting families of artworks by simple variations in their grammar rules. A child grammar may even retain the exact pictorial specification, but modifying coloring rules may yield a new design through different blending, line traits, or color assignments.

Once new designs are specified using modified shape grammars, pictorial specifications can be used to drive a computerized Jacquard loom and fabricate new designs.

**Acknowledgements**
This work is supported by grants from the Science and Engineering Research Council, Canada Discovery grant programme, Fonds Quebecois de la recherché sur la société et la culture, Appui à la recherché creation programme, the Social Sciences and Health Research Council, Canada Research/Creation in Fine Arts Programme, Hexagram, and Concordia University Faculty Research grants. We also gratefully acknowledge the deep involvement of our former graduate research students on this project: E. Hortop, D. El-Khechen, R. Rajagopalan, and Y. Joshi.

# Visual-Physical Design Grammars

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**Student Research Team**
Kenfield Griffith
Ayodh Vasant Kamath
Steve Preston
Tal Goldenberg

The objective of this project is the development of new kinds of low-cost, high-quality, mass-customizable building assembly systems that provide visually rich design variations for housing and other small structures. The building systems are intended to be tailored for particular cultures and communities by incorporating local, vernacular, decorative design into the assembly design.

Two complementary areas of computational design are brought together in this work: shape grammars and digital fabrication. The visual, aesthetic aspects of the research are explored through shape grammars. The physical design and manufacturing aspects are explored through advanced digital design and fabrication technologies, and, in particular, they build on recent work on mono-material, interlocking, component-based assemblies with parts that can be fabricated with CNC machines and assembled easily by hand. The long-term objective is development of visual-physical design grammars with rules that generate complete CAD/CAM data for fabrication of full-scale components for assembly design variations.

If successful, the results of this research will lead to new solutions for economical, easily manufactured housing, which is especially critical in developing countries and for post-disaster environments. These new housing solutions will not only provide shelter, but will also support important cultural values through the integration of familiar visual design features. The use of inexpensive, portable digital design and fabrication technologies will allow local communities to be active participants in the design and construction of their homes.

Beyond the specific context of housing, visual-physical grammars have the potential to positively affect design and manufacture of artifacts at many scales, and in many domains, particularly for artifacts where visual aesthetics need to be considered jointly with physical or material requirements and design customization or variation is important.

A proof-of-concept study was initiated to establish the potential of this research. A visual, vernacular language of ancient Greek meander designs is the basis for the study. Figure 1 shows an excerpt from a grammar that generates a language of meander variations. The grammar rules generate a wide range of meander patterns (Figure 2) by stacking, shifting, and reflecting rows of meanders. This two-dimensional visual language was then translated into a three-dimensional building system.

The components of the system are uniquely designed “meander bricks” (Figure 3). The components have integrated alignment features so that they can be easily fitted and locked together manually without binding materials. The meander bricks were 3D printed at desktop scale with a layered manufacturing machine to assess the visual and structural feasibility of the system. Figure 4 shows a wall being assembled. Figure 5 shows some of the many different meander-wall patterns that can be generated with the system.

The next steps of this study include construction of a full-scale mockup of a wall section and development of an automated visual-physical grammar for machine fabrication of full-scale components for wall-pattern variations. This research will undoubtedly open up new questions and provide the foundations for the longer-term, broader project on assembly systems for complete houses and other small-scale structures.

We are grateful for the support we are receiving for this project through a SGER grant from the **National Science Foundation** (grant number 0748992).

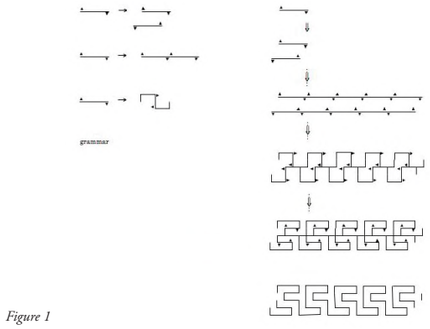


*Figure 1*

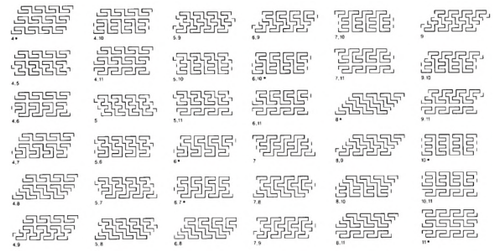

*Figure 2*

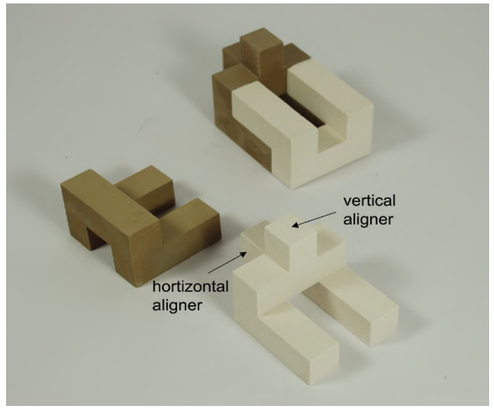


*Figure 3*

*Figure 4*

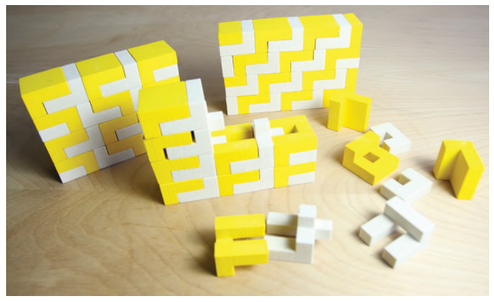

*Figure 5*

# Gantenbein Vineyard Façade, Fläsch

**Contact: Tobias Bonwetsch**
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Four hundred square meters of the brick façade on a winery were digitally designed and fabricated to serve as a prototype for this process. The masonry façade functions both as a temperature buffer and as protection from direct sunlight. The robotic construction technology, developed at the ETH Zürich by Gramazio & Kohler, Architecture and Digital Fabrication, lays individual bricks according to programmed parameters, precisely at the desired angle and at exact prescribed intervals. With this new digital production method, each wall was constructed to the desired light and air permeability specifi-cations, while creating a pattern of individually rotated bricks.

The façade is made up of 20,000 bricks. Each individual brick reflects light differently, depending on the angle at which it is set, and thus has different light-diffusion characteristics. Much like pixels on a computer screen, the bricks form a pattern on the façade. In contrast to a two-dimensional screen, however, there is a dramatic play among plasticity, depth, and color, depending on the viewer's position and the angle of the sun.

At closer view – in contrast to its pictorial effect at a distance – the sensual, textile softness of the walls dissolves into the materiality of the stonework. The observer is surprised that the soft, round forms are actually composed of individual, hard bricks. The façade appears as a solidified dynamic form.

In the interior, the daylight creates a mild, yet luminous atmosphere. The image of the landscape glimmers through the open gaps between the bricks.

To create the façade, the team designed a generative process using the animation software Maya and its embedded scripting language, MEL. The existing concrete-frame construction was interpreted as a basket and filled with abstract balls (representing grapes) that varied in diameter. By digitally simulating gravity, the process simulated balls falling into a virtual container. The digital basket was then viewed from all four sides, and the digital image data were automatically transferred as a rotation of the individual bricks. The joints were left open to create transparency.

In the built result, the visitor sees gigantic, synthetic grapes, as if they were inside the vineyard building. The wall elements were manufactured as part of a pilot project at the robot research facilities at the ETH Zürich, transported by lorry to the con-struction site, and installed with a crane.

The Gramazio & Kohler team wrote a script for direct post-processing of the generated design data into robot control language. The robot is directly activated by the design data, and there was no need to produce additional implementation drawings. As a result, the team was able to continue working on the façade up to the very last minute before starting production.

**Architecture** Bearth & Deplazes with Gramazio & Kohler
**Facade** Gramazio & Kohler, Architecture and Digital Fabrication, ETH Zürich
**Partner** Keller AG Ziegeleien



# Tropism

**Commonwealth and Joshua Davis**
www.commonwealth.nu
www.joshuadavis.com

Tropism is a biological phenomenon that descibes the movement of a plant or flower in response to a stimulus. Here, Tropism is a collaborative project that bridges the techniques and visions of two digitally oriented art and design studios: Commonwealth and Joshua Davis.

Commonwealth's language of form, generated within animation software, became the genesis of the Tropism porcelain vases. Output as SLA rapid-prototyped models, Commonwealth's design was directly translated from digital idea to material object. These rapid-prototyped prints were taken to Boehm Porcelain, a traditional fine-bone porcelain maker, and cast into a series of digitally driven porcelain vases.

Graphic compositions, created by freezing rule-based, animated programs written by Joshua Davis, were digitally output as sheets of ceramic paint and fired into the porcelain surface of the vase. Davis' graphics, inspired by Arthur Harry Church's "Types of Floral Mechanics," are algorithmic compositions of colors and forms produced by rule-driven systems. The printed sheets of graphic paint were fused into the figurative surfaces of Commonwealth's porcelain. The kiln-fired result is a series of unique objects demonstrating a kind of creative exchange facilitated by digital-design techniques and tools.

Joshua Davis' giclée watercolor prints were produced using the same generative techniques as those used to produce the graphic paint sets that were fired into the porcelain vases. This created a fluid relationship between print and object, and between planar graphic and porcelain form.

In all senses of the term, tropism describes an exposure to stimulus. Commonwealth, known for their experimental products and form, and Joshua Davis, known for his generative graphics, collaborated to create a work that expresses multiple tendencies within art and computational design.

*Painted and Glazed Slipcast Porcelain vases translated from rapid-prototype SLA prints.*

*Archival giclée prints on watercolor paper.*

# Omi.MGX

**Assa Ashuach**
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The Omi.MGX lamp is part of the Materialise.MGX design collection. The lamp, a single 3D-printed nylon object, is one of the first products to be produced and distributed directly from a selective laser-sintering machine. Its form, together with the natural flexibility of the polyamide, creates the impression of a biological mechanism. The versatile shape can be transformed, personalized, and manipulated to create different sculptural sensations, spaces, and moods.



# Ratio.MGX

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The design for Ratio.MGX is the result of a study of phyllotaxis (the principles governing leaf arrangement), mathematical structures, and the rational and irrational distribution patterns in nature. The lamp, together with the electric cables, rests unconnected in a concrete base. This allows the lamp to be taken out of its base and carried around like a torch. Ratio.MGX is the rational part of a twin design. The irrational counterpart has not yet been released.

# One_Shot.MGX

**Patrick Jouin**
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www.materialise-mgx.com

The One_shot.MGX foldable stool, designed by Patrick Jouin, was produced for the design collection of Materialise MGX. It was created with rapid-prototyping and rapid-manufacturing technologies, and provides an example of the application of these processes within the discipline of industrial design.

The stool is made from polyamide, using a 3D printing technology known as selective laser sintering. The seating surface and the legs of the stool emerge from the machine in "one shot," as do the hinges, which are concealed within the structure of the stool. With a simple, elegant twist, much like opening an umbrella, the array of vertical elements transforms into a stool.



# Strato

**Anna Silberschmidt and Nicola Sansò**
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Studio Aphorisma combines innovative designs and processes that push the boundaries of contemporary textile design. The studio collaborates with internationally renowned fashion and interior design companies and institutions such as the Bauhaus-Universität Weimar, for which the Studio recreated two Bauhaus textiles for the reconstructed Gropius Room.

Strato is a collection of textile-based jewelery and accessories created on a computer-controlled loom. The designs explore the links among materials, new technologies, and traditional crafts. The resulting textiles reflect a deep knowledge of materials and craftmanship, while the process represents an innovation in contemporary design.

Strato consists of two contrasting elements: a flat, rigid silver bracelet and a soft, flexible tube of woven silver threads. The tube is woven on a computer-controlled loom with light and dark silver threads, and the weave fully encapsulates the structural silver bracelet. Together, the two elements create a soft, flexible structure that makes the bracelet reconfigurable. The design sets rigidity in opposition with softness, stiffness with maleability, and two-dimensionality with three-dimensionality. The overall design balances the hard and soft elements – making the piece exciting in both a visual and a tactile way.

The woven patterns reflect both flexible structure and changing surface. Through its maleable structure and response to lighting conditions, the piece constantly reconfigures itself. This flexibility allows Strato to transform with inexhaustible variation.

# Mathematical Sculptures

**Bathsheba Grossman**
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I am often asked whether my designs originate in logic or intuition, and the answer must be both: my intuition is guided by logic, and it seeks order and symmetry. The sculptures come into existence as visualizations, which are translated into virtual 3D models. They enter the physical world by various computer-mediated manufacturing processes (in the case of these pieces, 3D metal printing). Lastly, they are hand finished by assembling, burnishing, or any other craft methods that may be required.

Thus the process moves backward in history: from imminent idea to high technology to hand-finished metal. Because the originals of my work are data, they transcend location, medium, and time, and they move us away from the history-bound, privileged-original model of art making. Art can now take its value from its inherent nature without reference to time, place, or artificial scarcity.

We are standing at the Gutenberg moment for sculpture, where to be digital is to be nameless yet immortal. These designs honor the emergence of sculpture as a digital medium, sounding a timeless note of purity and symmetry at this pivotal moment in the history of art.

The material of these sculptures is a sintered steel-bronze composite metal manufactured by Ex One's Prometal process, then hand-finished in my shop. Software includes Rhinoceros, Mathematica, Surface Evolver, Materialise Magics, and Perl scripts written by me. The Gyroid, Schwartz surfaces and the Snub 24-Cell are purely algorithmic; the remaining three designs are non-computed ("handmade" CAD models).

**Ora, Metatrino and Soliton**
Bathsheba Grossman

**Gyroid**
Bathsheba Grossman
Alan Schoen

**Schwartz' D-Surface**
Bathsheba Grossman

**Snub 24-Cell**
Bathsheba Grossman
Henry Cohn, Microsoft



# XURF, HyperSurfaces

**Haresh Lalvani**
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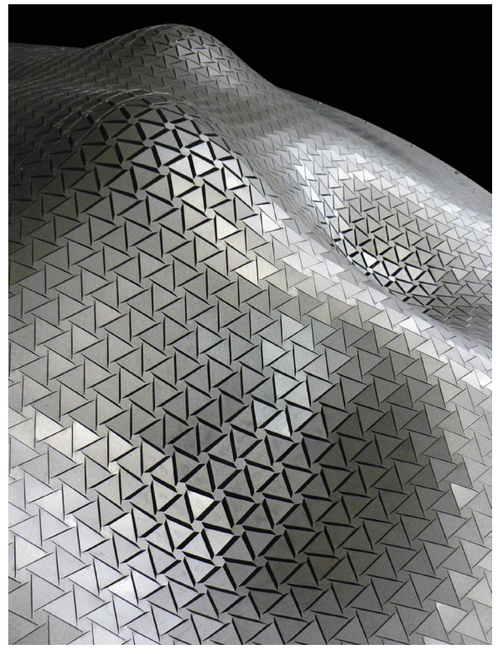

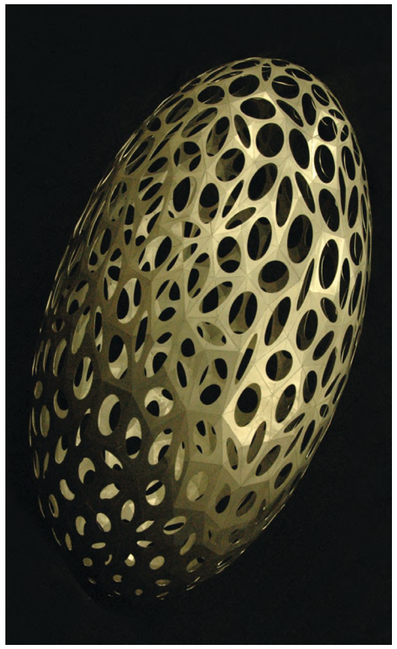

**XURF**

XURF (eXpandable sURFace) is an experiment in developing a performative surface with the emergent properties of curvature, strength, porosity and transparency. Constructed from continous sheet materials – metal, in this instance – XURF exemplifies a morphable rigid curved surface. Possible in regular as well as irregular pattern geometries, XURF can be variably formed by controlling the interplay between force and form.

The patent pending XURF system was invented by Haresh Lalvani in 1998 and has been under development since with Milgo. It is a highly scalable invention with applications ranging from nano and micro scales to product design and architecture. We envision XURF as yardage (as in textiles) so that responsive architectural skins can be tailored. Smart XURF, with digitally operable components, are a natural possibility.

**Fabricator and Sponsor**
Milgo-Bufkin
www.milgo-bufkin.com

**HyperSurfaces**

In 1981, Haresh Lalvani developed a geometric generalization of the Penrose tiling as a projection from higher dimensions. This work led to his discovery and subsequent patenting of a large class of number-coded convex and non-convex tessellations embodying the generative paradigm "Shape by Number". Milgo-Bufkin has introduced HyperGrills as one application of Lalvani's tiling designs in laser-cut sheet metal.

In the 80's and 90's, Lalvani extended these tessellations into large classes of 3-dimensional structures that could be constructed from systems of nodes, struts and panels. These patented inventions were amongst the first examples of modular construction systems enabling irregular and fractal spatial geometries in the building arts. Included amongst these were Lalvani's HyperSurfaces, a new mathematical class of surface subdivisions that combined aperiodic tilings with any curved surface.

The example of a hypersurface panel-system shown here is constructed from laser-cut stainless steel components. We are looking to extend these into active and passive smart structures in view of our interest in responsive architecture.

# Curved Origami

**Jeannine Mosely**
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Folding along curves is very different from folding straight lines. The most important difference is that when you make a curved crease, the two parts of the paper that lie on opposite sides of the crease cannot be made to lie flat against each other. So while in conventional origami, facets of the paper become layered and hidden, in curved origami most of the paper remains exposed to view. This usually results in larger spans of paper that must be self supporting, so even the materials used are different: most origami paper is as thin as possible, while curved origami often requires very heavy paper or card stock.

I strive to create designs in which complexity arises from the interaction or repetition of simple shapes, so that the results are both immediately comprehensible and unexpected. I begin with experimentation: I put some creases in the paper, bend it and see what shapes interest me. Shall I repeat the shapes symmetrically or transition to a different shape? How will the regions interact with each other, and what can be done with the paper between two regions to allow a smooth transition, without stretching or crumpling the paper?

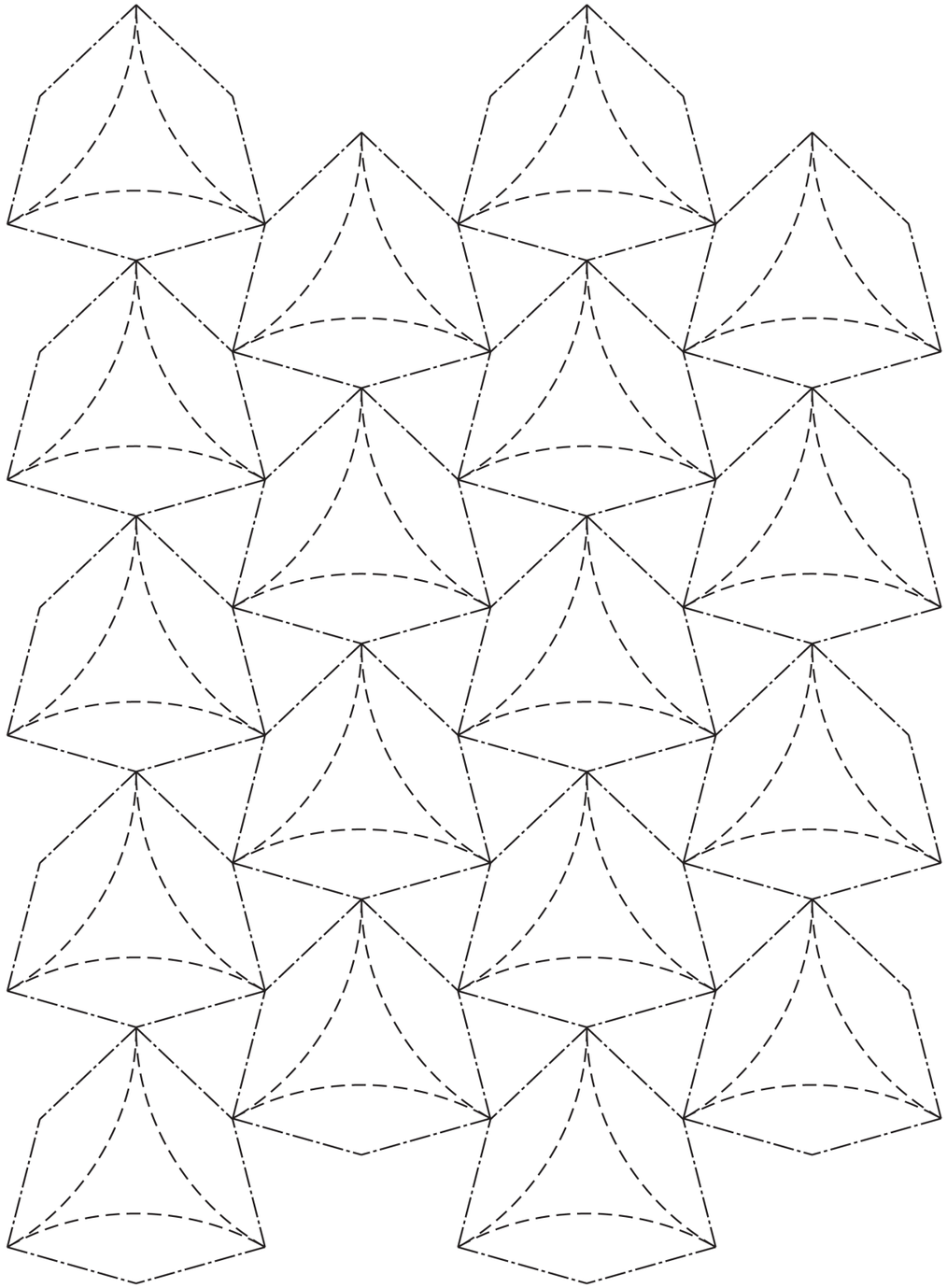
By modeling paper as an idealized mathematical surface and applying theorems from differential geometry, we can develop methods for analyzing and designing curved origami shapes. Paper can be represented as a "developable" surface, which means that no matter how you fold or bend it, at every point on the surface it is possible to embed a straight line in the surface passing through the point. Developable surfaces may be planes, generalized cylinders or cones, or tangent surfaces.

Intuition tells us that we cannot fold a sphere from a piece of paper, and yet the tops of the triangular pillows in Sails (see image and crease pattern) appear to be domed. Look closely, and you will see that they are in fact equilateral triangles with three tapering cylindrical sections attached. On the other side of the three curved creases are three cones that all come to a point below the center of the dome. These units are connected with a planar tiling of triangles. All the component surfaces are developable. Even for models where the curves are all circular arcs, like Sails, the length and position of those arcs cannot be calculated without computer assistance.

The constraints imposed to guarantee that the repeated units will tile the plane require us to numerically solve an equation containing an elliptic integral. Since the parameter solved for is not algebraic, we also need the computer to plot the resulting curves. I use Mathematica for these tasks.

Because of the malleability of paper, it is often possible to construct curved models that do not conform to theory, but I feel that such models incorporate a kind of lie that even the eye of the untutored viewer can detect, and that designs founded in mathematics have a greater appeal, as they reveal that truth visually.

*Photo: Dennis Helmar*



*Crease pattern for* Sails *curved origami*

# SIGGRAPH 2008
# Art & Design Galleries | Slow Art

**JURIED ART CHAIR**
Lina Yamaguchi
*Stanford University*

## SLOW ART: CALL FOR SUBMISSIONS

In our digital culture, we can task simultaneously, message instantly, and prototype rapidly, but, in doing so, do we create an oasis for contemplation, or do we fuel a hunger for yet more speed? As technology colors all aspects of our world, we see the inevitable pendular response in campaigns that advocate slowness.

The Italian membership organization Cittaslow's manifesto defines criteria for slow cities, focusing on improved quality of life. Internationally, people are organizing to protect regional food systems, traditions, and cuisine as part of the Slow Food Movement. There is a return to artisanship and a renewed focus on the local, as opposed to the global.

Throughout time, artists have pioneered the important task of illustrating and preserving humanity. For the SIGGRAPH 2008 art program, we are seeking art and investigations that address our overarching conference themes (Complexity and Accessibility, Future History, Global Responsibility, Impact on Society, and Professional Development and Education) through the filter of Slowness. Some questions we hope to explore are:

- In what ways do new media artists employ the tools of speed to address the issue of slowness?
- How does the speed afforded by technology affect the work we make?
- With the rapid changes in new media, how will these artworks be preserved, and do questions of legacy affect the creative process?
- How can new media art assist in the preservation of cultural diversity?

All submissions will be juried. International works are highly encouraged. All forms of digitally mediated work are eligible, as well as works made in traditional media that comment on technology. Selections will be made according to the following criteria: relevance to the SIGGRAPH 2008 themes, creative use of media, depth of critical exploration, and quality of accompanying artist statement.

Our final exhibition will be a gallery at SIGGRAPH 2008, smaller than in past years. In addition, there will be an exhibition of curated artworks. Through both of these exhibits, we hope to showcase the strongest examples of current new media work.

Lina Yamaguchi,
Stanford University



## "FAST. IT'S NOT FOR EVERYONE."

Two "turtles," Bob and Karolyn Slowsky, promote this tongue-in-cheek slogan for Comcast's high-speed internet service, but the campaign is indirectly representative of a growing contingent of people who respond unenthusiastically to an increasing pace of a life in which speed dating, quick tips, and microwavable frozen dinners are commonplace. Proponents of The Slow Movement, originating with Slow Food, a response to the fast food industry, are re-examining cities, schools, travel, exercise, sex, and even design, to name just some of the descendant branches. Slow, in many cases, is equated with "bad" or "old." The Slow Movement seeks to reframe the concept in a positive light, calling our attention to quality, enjoyment, and balance.

Questions inspired by the Slowskys' campaign (since replaced with a genetically modified, turbo-engined rabbit/panther hybrid) are reflected in the explorations of SIGGRAPH 2008's Slow Art gallery. Showcasing works from 41 artists meditating on fast and slow living within a landscape of technology, the exhibit speaks to environmental issues, future history, leisure as an indispensible component of a well-balanced lifestyle, and the means by which we get from here to there. They share condensed perceptions of time and interrogate the limits of performance, distance, desire, and respite. The Slow Art jury, reviewers, and myself were delighted by the variety and quality of submitted artworks from over 300 artists, and we wish we could have accommodated more.

Thanks to the keen eyes and wisdom of jury and committee member Gemma Shusterman, we are pleased to present the works in themed areas: Erosion, Hybrids, Rhythms, and Traversal. I'd also like to thank jury members Gemma, Lee Arnold, Janeann Dill, Gerfried Stocker, and Victoria Szabo for their acute insights and endurance during the jury process. Additional thanks to Victoria, who also served on the committee, for directing our technology needs and for facilitating the creation of our audio tour. All submitters to this year's gallery received compelling and thoughtful evaluations from our 22 online reviewers. I was especially moved by the reviewers' enthusiasm and generosity, evidenced by the quality and length of their commentary.

Thank you also to Slow Art committee members Sue Gollifer and Jana Whittington for their advice, support, and good humor. To our enthusiastic XSVs (ex-student volunteers) Mikki Rose and Camille Trejo. To Rebecca Strzelec, Create Sphere Director, for cocktails and keeping us on track. To Phil Carizzi, Chair of The Studio, for colored pencils and handy iPhone access. To my counterpart Lira Nikolovska, Design & Computation Gallery Chair, for her collaborative spirit and moral support, and to our illustrious administrative assistant, Mona Kasra, for doing everything well and always with a big smile. To all of the SIGGRAPH 2008 committee members and contractors who helped make every aspect of Slow Art happen, with a special shout-out to Jim Clark for his infinite patience. To Kevin Mack for making the wonderful animations that grace the entrance to the gallery. To our sponsors, whose support makes the gallery possible, and last, but not at all least, to the Slow Art artists. Thank you for making this beautiful, fun exhibit, and for reminding people to slow down once in a while.

Lina Yamaguchi
Stanford University

# SLOWING ART

Speed is an implicit element of technological design. In most advanced technologies, faster is often equated with better, often for good reason. Strides in processor speed and bandwidth have given us access to lifesaving data, kept us connected with friends and family on the other side of the world, and enhanced our quality of life in a myriad of ways. But we tend to pay little attention to how speed influences the way we live our lives, even as we continually adopt new behaviors and expectations in response to its pressures.

We have altered our sense of time.

Some of us still remember dial-up, but we find our attention waning when a web page takes longer than a few seconds to load. Our cars must accelerate from zero to 60 in an unnecessarily short interval, and our news must be delivered with nearly clairvoyant timing. We demand performance from our objects and surroundings, and that demand comes back to us.

We are expected to maintain connections through our tools, and since we are connected, we must respond. We check email, voicemail, and SMS messages with compulsive enthusiasm. Our lives are fixed to the demands of our "time-saving" devices. Distance has come to be measured by the strength of a cell phone or wifi signal rather than a physical measurement. Space and time have been condensed by our fast-paced lives. As our machines maneuver around the "performance limits" suggested by Moore's law, they press us to imagine what is analogous for humanity. What limits do we have, need, or indeed want, when it comes to speed?  It is with this question in mind that we asked artists to reconsider the paradigm of speed and instead consider the concept of Slow Art.

The result was quite varied. Some artists chose to delve into the nature of their surroundings and investigate erosion and the effects of time. Others chose to work with materials that evoke a sense of nostalgia but connect them to contemporary concepts or objects, creating hybrids that highlight the momentum in our culture and its artifacts. Some draw our attention to the sensory realm, playing with rhythm and space-time patterns, vividly layering time and space. Others focus on a traversal of space over time. All of these works ask us to step out of the fast lane and consider the possibilities when speed is not an exigent force.

The concept of "slow" is gaining momentum in some areas of human culture. It has even spawned movements. "Slow food" and the popularity of yoga and meditation point to a public need for respite from our speed-driven culture. In the Slow Art gallery the interpretations are quite personal. Whether procedural or literal, material or conceptual, the works consider the component of life that is always in short supply: time.

Gemma Shusterman
AtomicBee



## EROSION

The process of erosion is undeniable and unyielding, whether through oxidation, gravitational stress, or obsolescence. These works investigate the nature of material existence. They incorporate the wear of time and repetition to highlight and explore the processes of disintegration and entropy.

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# S[tr]eam

S[tr]eam is a video art installation that straddles the boundaries between video projection and sculptural object. The project examines the capability of the digital to enhance or confuse the human perceptual experience of the environment. The mind's capacity for learning, pattern grouping, and reification enable swift perceptual comprehension. At the same time, the increasing pervasiveness of the digital redefines how we perceive and interact with the world around us. Digital media can combine virtual and physical space, presenting new and unique perceptual challenges. The virtual has the potential to extend or reinvent the physical, but it can reorganize and even fracture perception. S[tr]eam integrates organic phenomena with formalist approaches to explore fragmentation and fluidity, and to challenge our notions of logical and natural boundaries. S[tr]eam also explores the tensions and harmonies between the digital projection and the physical sculpture.



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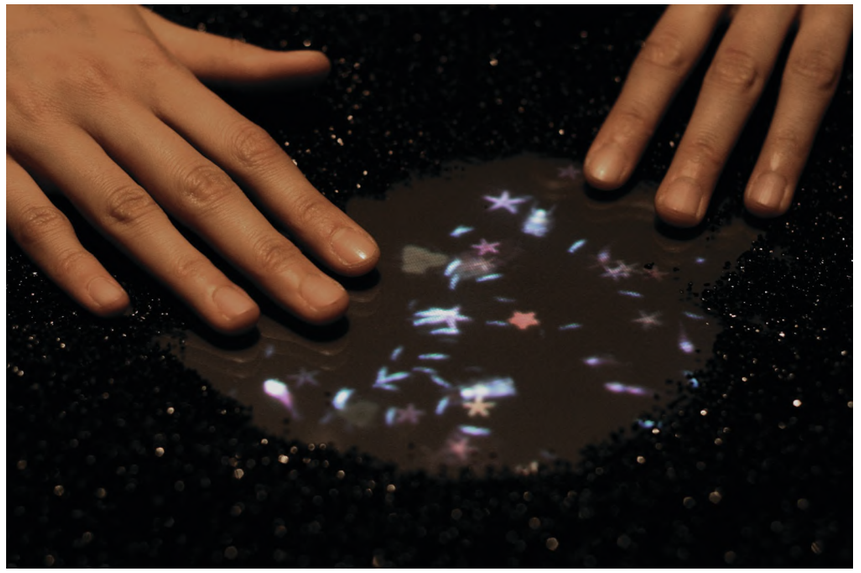
# <Oasis>



<Oasis> is an interactive installation that invites visitors to touch and play.

A surface covered with black sand turns into a virtual oasis when people grab and remove a handful of sand. In this micro-oasis, virtual creatures will be born and prosper. People can manipulate the population and spatial boundary of living by shaping the pond or moving pebbles. From a god-like perspective, people can enjoy touching the tactile material of this installation and watch it become full of life.

A real-time machine-vision engine is used to interpret the shape of the pond and positions of pebbles.

Swarm intelligence was implemented to simulate the flocking behaviors of virtual creatures, and their lifelike motions are programmed in Java with OpenGL.

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# Life and Death of Energy-Autonomous Devices

*Figure 1*

When contained in a fuel cell and fed with metabolized sugar, a micro-organism, rhodoferax ferrireducens, produces an electrical current. The current is produced as the electrons freed in the process accumulate on an electrode in the fuel cell. Based on this principle, we have designed a series of power-generating objects made of sugar. The objects contain the current-producing microbes and produce a charge when carbon electrodes are inserted into them. Rather than existing as static things, these sugar objects slowly evolve and change shape as the microbes inside metabolize the sugar. This figure shows the objects being made and how they might be used.

*Figure 2*

This large-scale radio is a design for a conceptual appliance. The radio contains several microbial fuel cells that generate an electrical charge to power the appliance. The radio is large so as to incorporate the required cells to produce a sufficient charge. The funnel at the top of the radio is used for feeding the cells' microbes with rotten food, insects, and most other forms of naturally occurring organic material. The pot at the bottom end of the radio's digestive system collects any waste, which in turn can be used to feed plants. The view of the rear of the radio shows how the cells contain a microbe-rich sludge, and how the organic matter used to feed the microbes can pass along and be recycled through the system.

Technology is often touted as the solution to a host of problems, not least our over-reliance on fossil fuels and the spectre of global warming. But what will it be like to live with the emergent technologies that are being devised to combat these threats? It seems the proposed solutions, and especially the more experimental and speculative, have the potential to alter our relationships with technology (sometimes radically). Take, for example, some of the efforts to rethink the production and consumption of power. These proposals not only move us away from consuming oil, coal, gas, and the like. They also allude to machines that will operate at a very different pace and rhythm because of their energy-production cycles. This installation encourages audiences to consider one such alternative to power production, namely microbial fuel cells (MFCs) and, in doing so, encourage reflection on a broader class of so-called "energy autonomous" technologies.

MFCs rely on the breakdown of organic material by a microbial substrate and production of an electrical charge via this process. The organic material might be a simple compound (for example, sugar or something more complex such as fruit, vegetables, or even insects). The substrate can consist of sludge similar to that found in the common pond.

Our installation presents a range of artifacts and media designed to encourage questions and debate around the developments in energy autonomous systems and their use. One collection of artifacts consists of three electricity-producing objects designed to be fueled using sugar (Fig. 1). These sugar-based objects provoke questions about our relationship with power sources that contain living microbes, but that have a fixed life span.

Another of our designs considers the production of electricity by incorporating the cells into a radio appliance (Fig. 2). Unlike the sugar-based cells, the radio is designed to run on cells that will last indefinitely, so long as they are supplied with organic material. This promised longevity of power supply is one of the distinctive features of MFCs. Our radio is designed to use a microbial substrate that will break down most organic material, including complex materials. Through this process, the microbial substrate is conditioned over time to operate most efficiently with particular sources of energy. This conditioning is related, in part, to the history of the materials the cells are supplied with. Thus the radio's life cycle and performance interleaves with its usage patterns and the timeframe of use, both expanding well beyond the immediate interactions one has with the radio.



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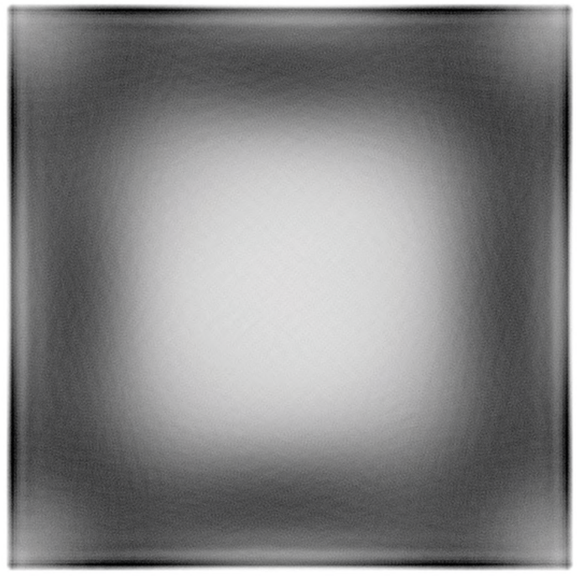
# Migrations

Migrations is inspired by experiencing observed animal behavior in the natural world. Each of these vignettes represents an accumulation of simulated flocking movement. Every individual image has a different interpretation of mathematized nature. The goal is not to render an accurate depiction, rather it is to comprehend time and movement aesthetically.

The images are rendered in an OpenGL frame buffer and saved for minimal post-processing. Simulations use 100-300 animals and run for 3-12 hours. Images are output via a chromia printer, a process that exposes photo paper with a laser from a digital file.



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### Dark Days - New York

This photography series addresses the isolation of contemporary urban life. The images depict scenes of an intersection in New York, from a distance, at night. The figures in the images are only visible with extreme enlargement. The photographs are intended to evoke a feeling of nostalgia and can be regarded as criticism of the inhospitable environment of cities. These photographs are a small excerpt of about 70 works that emerged from journeys to several cities in the winter of 2005-2006.




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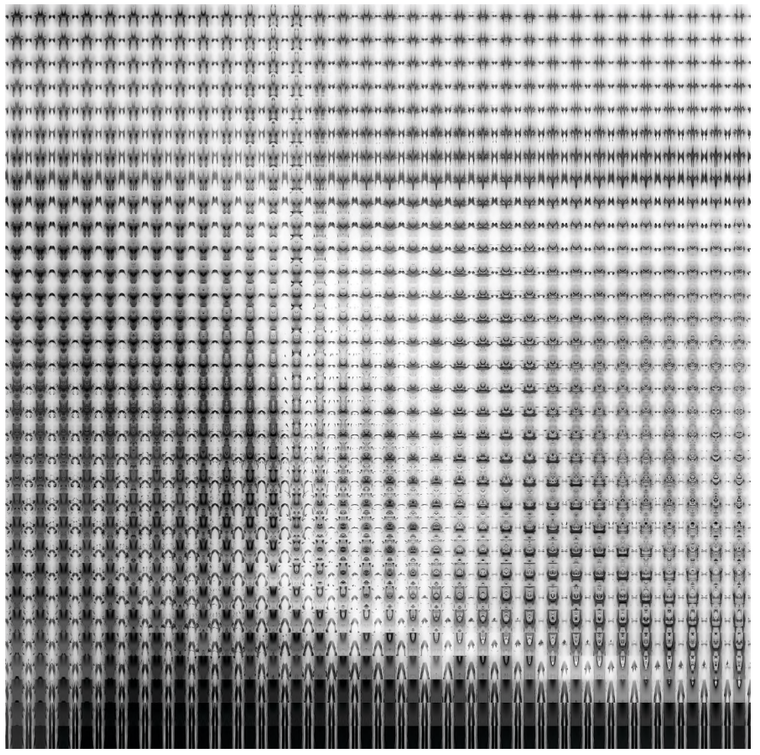
### Tiled Faces



In my Faces of Chaos series, I seek to visualize a chaotic dynamical system, using a unique mapping of the Lyapunov exponent to the image plane. Tiled Faces is one result of this exploration, and its 1,024 images combine to reveal the “face” of the four-dimensional system’s chaotic behavior. This emergent figuration draws the viewer in, closer to the surface, where a myriad of individual “faces” is revealed. Because I approach the challenge of representing four dimensions from an aesthetic perspective, I am free to bring the underlying equations to light, to visually and intuitively understand them. Tiled Faces juxtaposes order and chaos, artistic sensibility and mathematical depth, within its pixels and pigments.

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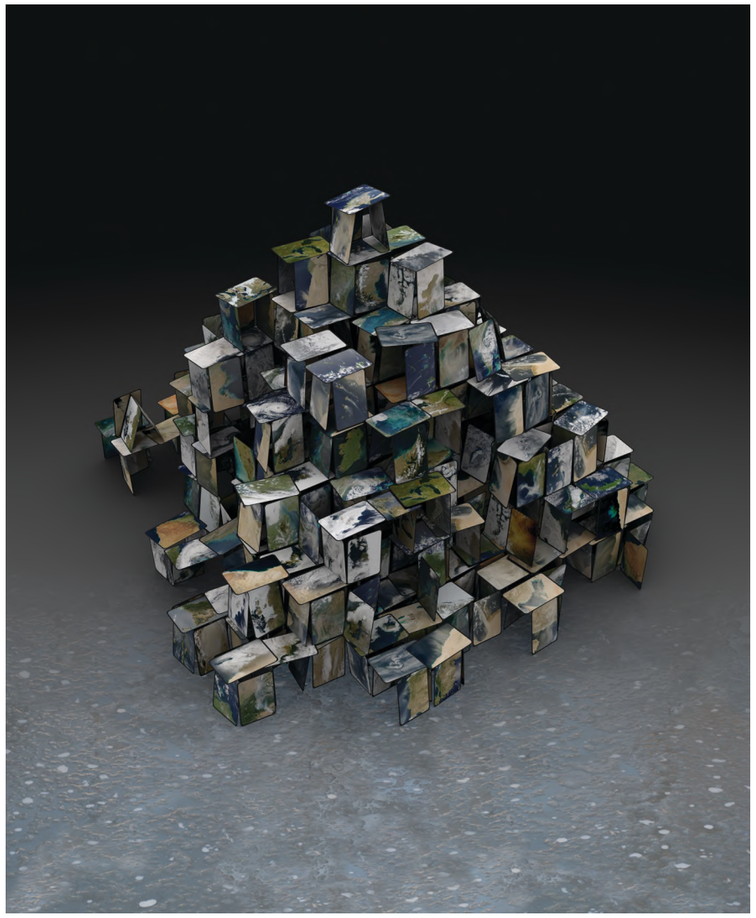
**The Verge**



We are facing a global climate crisis. This piece symbolizes our environmental underpinnings that could collapse in the near future unless we accept global responsibility and act. In the past, global climate change was thought of as a slow process. However, in recent years this slowness has been hotly debated.

A contrast is drawn between the complex balance of global climate change issues using an accessible, familiar approach: a house of cards. Satellite images of the Earth are used with accessible themes such as sea ice and cloud patterns. The implication is that complexity realized in this piece was very slow in developing and that the construction was a very slow, tedious process. A future history is represented where many of the environmental underpinnings have already given way, allowing the observer to experience the null space where components have disappeared. How close is this future history to our present?

Satellite images courtesy of the MODIS Rapid Response Project at NASA/GSFC.



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**Water Planet**


Our planet holds mostly water. In the water, much as in our lives, changes are slow yet difficult to keep up with. As we grow up, we hear stories about goodness and bravery, un-won battles and new lands unconquered for simple but unexplainable reasons. We envision joy on a princess' face when she is presented with silk and pearls sent on a ship under big white sails. We embolden the prince in shining armor, on a white horse, to fight a dragon and win a princess whose portrait is in a talisman he carries. These tales vary depending on the culture, but they create values that we can translate into contemporary media to help us understand reality. We transform old cultural information to meet the needs of the present audience; works of literature are remade as movies; traditional stories are retold with new metaphors and annotations; histories are modified and retold in ways that mollify, rather than inflame, an audience.

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The Echo Locations project is a series of site-specific installations utilizing motion sensing to invite observers to slow down, give the site their attention, and be still long enough for ghostly images to form of how people have moved through the site in the past. The project builds on motion capture, particle systems, and slow interaction techniques developed for Will.0.w1sp. However, whereas the Will.0.w1sp characters move through motion sequences captured in a studio, Echo Locations makes a stronger link to specific locations by capturing motion in "real life." The characters recreated by the particle software become similar to ghosts – repeating movements that once occurred in the location. Only when visitors to the site are still and quiet do the projections reform and return to their movements.

The intention of the piece is to use interaction to make visitors reflect on their personal impact on an environment as they move through a location, and to hint at its history. The installation uses sound in an attempt to awaken curiosity and invite visitors to various locations. The audio environment mixes samples recorded onsite together with simple melodies to create echoes of past inhabitants. If visitors to the site are calm and still, these sounds are played out very melodically, but if visitors move around or make noise of their own, the sound from the particle flows becomes very sharp, with aggressive scratches and hisses. Just as the motion of the particle dancers evokes the site's past history, so does the audio environment.



**HYBRIDS**

The objects in this section draw strength from unique combinations. When joined, these objects create timeless subjects rich with contrasts. They are at once nostalgic and innovative, natural and artificial, known and unknown. It is through these contrasts that we are drawn toward a deeper understanding of the familiar.

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**VR Comper ver. 5E:**
**A Perspective Primer**

The VR Comper series of slow-art constructions represents historical-futuristic visualization devices. As stand-in artifacts from an imagined past (a pseudo-Victorian period), they evoke peculiar overarching notions between "Alberti's Window," Duchamp's "Large Glass," and other visual mechanistic antecedents to today's electronic compositing systems. The artist's approach is one that encourages viewers' conceptual entanglements of faux realities. The piece is intended to create curious tensions in pinpointing its temporal (historical/current/futuristic) and/or conceptual (art/utility) locations, simultaneously both contentious and concrete.




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**The Intimacy Machine**

We live in a world of increased separation caused by fast-paced, high-technology lifestyles. Looking into another person's eyes, also known as eye contact, is a powerful means of forming connection, intimacy, and trust. Unfortunately, it is emotionally difficult to achieve. Eye contact arouses strong emotions, so typical eye contact lasts three seconds at a stretch. Breaking eye contact reduces stress levels, but also, sadly, reduces intimacy. The Intimacy Machine mediates intimacy, allowing people to overcome their normal social boundaries. The machine is a reciprocal high-technology peep show where eye contact is routed through a computer. In particular, it provides an indirect mechanism for people standing in close proximity to each other to stare at each other directly in the eyes, a feat that otherwise proves tremendously difficult for humans. Whereas telesex offers a way for people far away to feel close, the intimacy machine makes it possible for people who are close to feel distant.

## Dennis de Bel

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**Associative Audio Design**


These associative objects are derived from similarities in form and function of everyday items, as well as wordplay. Retro components, perhaps considered futuristic in their time, are re-formed to create new, contemporary devices illuminating the dialogue between art and design.

NAAITAFEL(sewing table) is a combination of functions. Instead of a needle from a record player, a sewing-machine needle is used. NOOTZUIGER(note sucker) is a harmonium (air organ) built into a device that also uses air pressure to operate a vacuum cleaner. STRATENSPELER(street player) is a device that makes urban patterns and textures audible. A microphone is used together with rotation to create an audio loop of the particular surface it's placed on.



## Tim Borgmann

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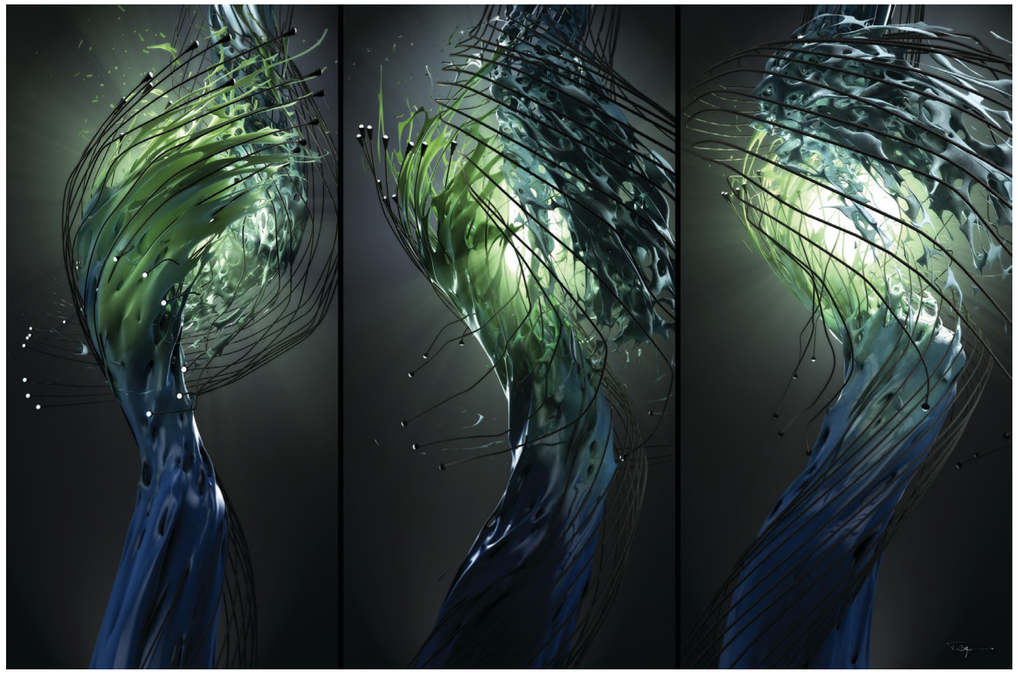
**fragment.0140.02b ('Silhouette')**
**fragment.1207.0304.3 ('Glint')**



The images of the fragment.series are an attempt to create dynamic forms and capture tension and beauty as they evolve. Creation of these images begins with a particle simulation. After defining conditions for the motion and behavior of the particles, I run a simulation and observe the process until I find a shape I am interested in. At that point, I freeze the shape and take it out of its dynamic context. Unlike real-life photography, I can easily change the simulation conditions, play the simulation forward or backward, in slow motion, or high speed, or I can orbit with the camera while searching for an interesting form or moment. I don't plan the image. The product is the result of computation and some controlled manipulation.

## Steve Gompf

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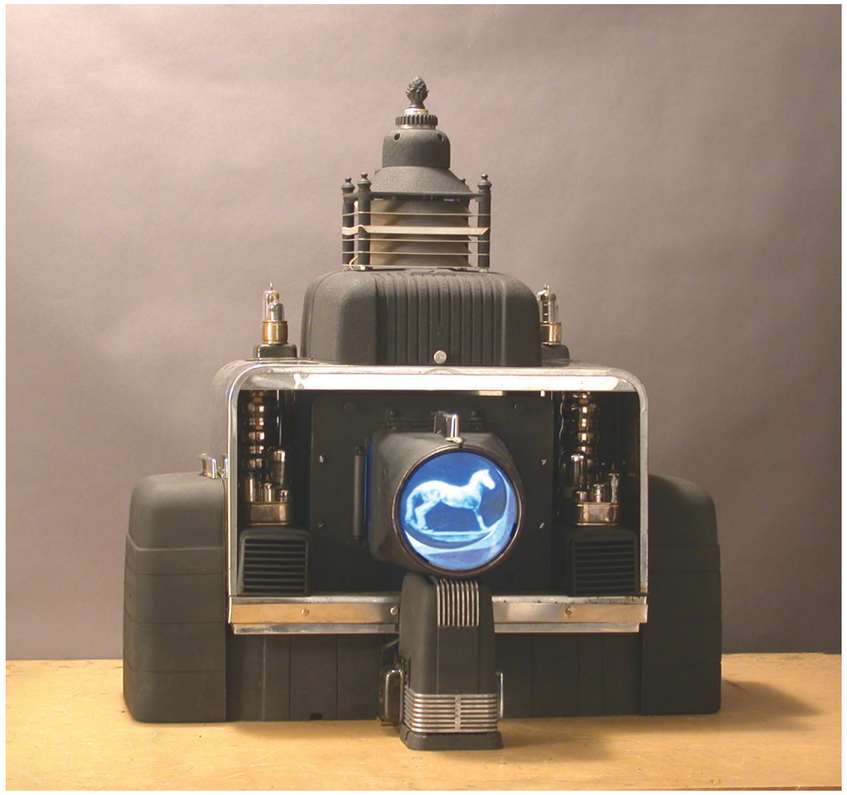
**Televisor 1910 German**



There are those who turn on their televisions to see if it is raining just outside the window. Vicariously, many viewers readily accept what they see on television as personal experience. Billions watch television screens religiously for many hours daily. The cathode ray tube has become a glass-faced altar.

Courtesy of Televisor Museum International
teleseum.org




## boredomresearch

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**RealSnailMail [RSM]**

RSM, a research project developed by Vicky Isley and Paul smith (aka boredomresearch), is the world's first use of live snails to carry electronic messages across physical space. boredomresearch aim to premiere the world's first web-mail service to use live snails for carrying electronic messages across physical space. Visitors to the Slow Art exhibition can access the realsnailmail.net web site and send email messages. Each message travels at the speed of light to the realsnailmail.net server, where it enters a queue. It waits there until a real snail in the tank at Bournemouth University wanders within range of a hot spot. The hot spot is the dispatch centre in the form of an RFID reader. This reader identifies the snail from the RFID chip attached to its shell and checks that it has not already been assigned a message to carry.

If the snail is available, it is assigned the message at the top of the list, then slips away into the technological wasteland. Located at the other end of the tank is the drop-off point. When, or if, the snail ever makes it there, it is identified by another reader, which then forwards the relevant message to the recipient's email address, once again at the speed of light. At each stage of the message's transit, the sender is updated with its progress, and when it finally arrives at its destination, it is appended with details of its carrier and a log of its journey. The realsnailmail.net web site encourages users to consider the efforts of a diminutive mollusc lugging their messages across a tank, and for this reason urges them to send a message of value. During SIGGRAPH 2008, a SnailCam shows live video of the snails in action.

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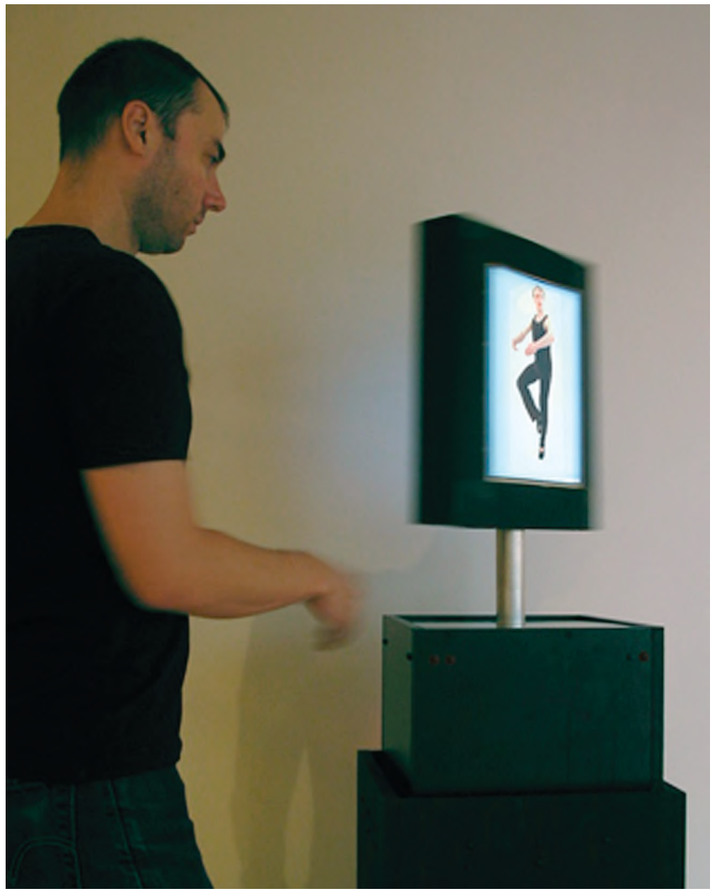
## Cross-Being: Dancer (The Spinning Screen)



In screen-based experiences, the screen itself can become an interactive element. The "move-ability" of the screen affords interactivity between the screen artifact and the viewer, and between the virtual space and the physical space. Cross-Being: Dancer features a movable screen interface, a spinning screen based on a two-sided monitor mounted on a revolving base. User interactions with the spinning screen can support diverse temporal and spatial responses, thereby enriching users' experiences. The spinning screen enables viewers to grasp the interplay between visibility and invisibility, creating an aesthetic experience. The angle and direction of rotation affects the displayed visuals and audio output. Inspired by a toy for young girls – a ballerina figure on a spinning plate – a virtual dancer on-screen spins along with the physical screen as the user spins it. Cross-Being: Dancer aims to explore the "doubling effect" of visual illusion that takes place between the physical and virtual worlds, and between visibility and invisibility.



**Wil Lindsay**

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## TimeFrames: Digital Magic Lantern Slides

By looking at past technologies, we are able to better understand our current technology-driven pace of life. The TimeFrames image series is created from a purely digital emulation of the long-extinct Magic Lantern slide format of the late 1800s. This older photographic technology made use of slow collodion chemistry, which, in contrast to contemporary CCD-based digital cameras, often took minutes to capture an image. The slow image-capture process often eliminates the fast motion of humanity and machines from the very landscape a photographer hopes to document. This can encourage the viewer to reflect on the condition of our very lives. And yet this aesthetic anomaly is rarely achievable with the fast-capture digital cameras of today. As high-speed digital photography supplanted the older chemical-based technologies, the long-exposure image and its aesthetic was left to history.

The TimeFrames digital lantern slides were created using a process borrowed from astronomical photography. The process starts with a digital video camera capturing hundreds to thousands of individual fast frames, and then algorithmically compressing them to a single image frame. This creates a perceived single exposure of many minutes, far beyond the capabilities of a single-image digital camera. The resulting image is digitally printed to toner and transferred to glass via a heat process. This transfer process causes a premature aging of the image, giving the overall image an antiquated look.

## Kevin Mack

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**Neurosymphonic Self Reflection**
**Divine Instruments of Technology**

My work is an exploration of the sublime beauty of infinity, complexity, perception, and consciousness. I have a passionate fascination for the powerful visions that inspire this exploration.

By creating imagery that exists at the threshold of recognition, I seek to invoke the unconscious imagination of the viewer and inspire a personal experience of awe and mystery. I endeavor to provide a purely aesthetic escape from worldly meanings, messages, and agendas. The content and meaning of my art are derived from each viewer's own psyche. This perceptual phenomenon causes a shift in consciousness that can quiet our normal mental chatter and still the mind.

I've developed and refined my process over many years. Digital paintings and 3D animations are transformed using 3D math functions to create evolving abstract dimensional objects and spaces of vast complexity. From within these spaces, I compose high-resolution images and animations. My process integrates intuition and intellect, deliberate design and random happen-stance, realism and abstraction, humanity and technology, painting and math, science and mysticism.

Abstract Dimensionalism describes the inspiration, the style, and the process.



## Paul Magee

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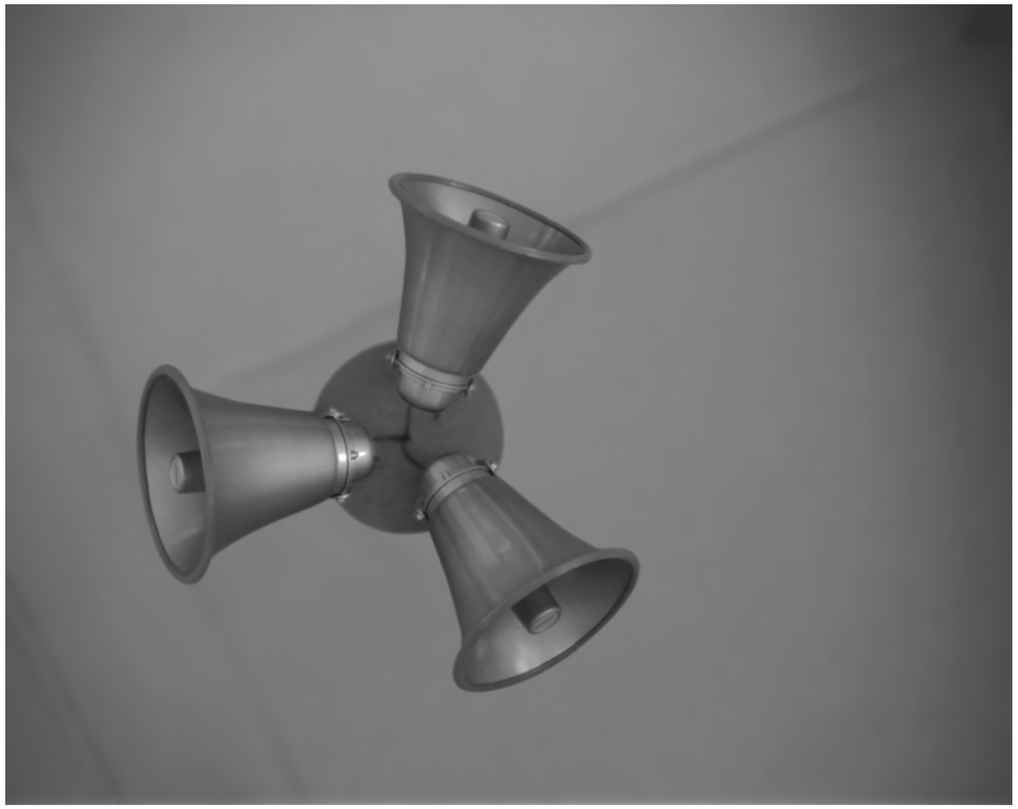
**Chorus**



Chorus continuously reinterprets and sings through the structure of the first passage of St. John's Gospel. Using the phonetic structure of this text as a template, the program assigns a random consonant to each consonant position and a random vowel to each vowel position. Pauses between words and at the end of sentences are preserved. Assigning each of the three speakers a separate channel and a separate note – F, C#, and G – the computer then sings its new construction of consonants and vowels. Once finished, it loops back to the beginning of the code and starts the whole process again.

My thanks to the soprano, Lucetta Johnson.

## Joo Youn Paek

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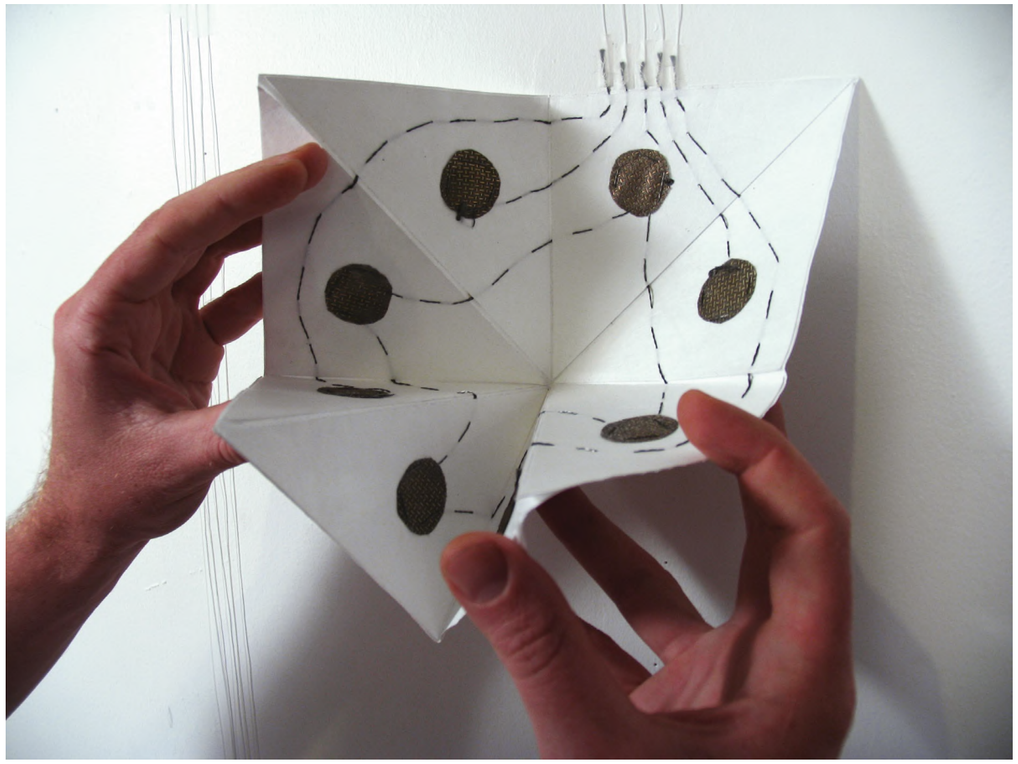
**Fold Loud**



Fold Loud connects ancient traditions and modern technology by combining origami, vocal sound, and interactive technology. It involves folding origami shapes that produce soothing harmonic vocal sounds. Each fold is assigned to a different vocal sound so that combinations of folds create harmonies. Users can fold multiple Fold Loud sheets together to produce a chorus of voices. Open circuits made out of conductive fabric are visibly stitched onto the sheets of paper, which creates a meta-technological aesthetic. When the sheets are folded along crease lines, a circuit is closed like a switch. Thus, the interface guides participants to use repetitive delicate hand gestures such as flipping, pushing, and creasing. Fold Loud invites users to slow down and reflect on their physical senses by crafting paper into both geometric origami objects and harmonic music.



## Ross Racine

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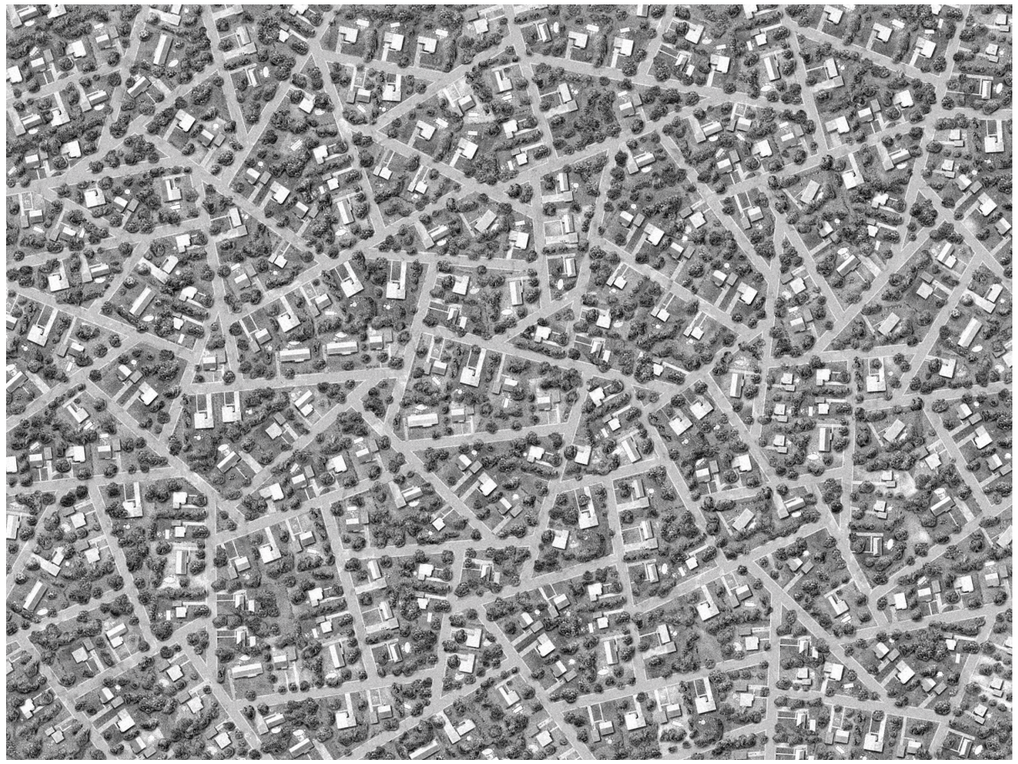
**Digital Drawings**



My drawings do not contain photographs nor scanned material. They are drawn freehand directly on a computer and printed on a high-end inkjet printer. My practice is an inherently hybrid process, mixing the languages of drawing and computer imaging to bring together some familiar opposites such as handmade and technological, organic and mechanical, physical and virtual. The subjects of my work may be interpreted as models for planned communities as much as aerial views of fictional suburbs. The images reference the computer as a tool for urban planning as well as image capture. They raise questions about the relationship between design and actual lived experience, subverting the implied rationality of urban design to expose conflicts that lie beneath the surface. These drawn digital works are a comment on the fears as well as the dreams expressed in suburban culture.

## Andreas Zingerle

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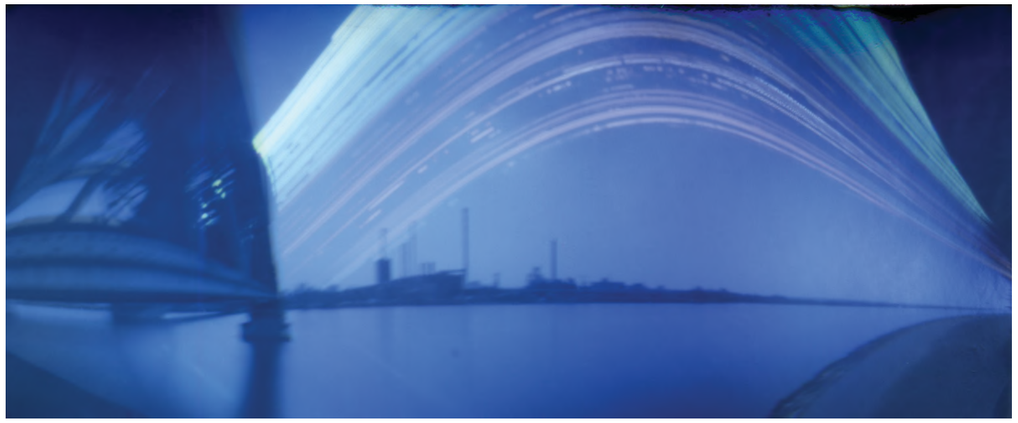
**Solargrafica**



Solargrafica records the paths of the sun by using a lens-less camera with exposure times up to five months. With this process, the invisible movements of the sun can be made visible as landscapes. A soundscape processed with granular synthesis samples creates a time-space relationship between light and sound. The visitor can interact with the sound by moving within the installation and focusing on the different camera modules.

The Interface Culture master and doctoral program at the University of Art and Industrial Design was founded in 2004 by Christa Sommerer and Laurent Mignonneau.

**RHYTHMS**

Rhythms are the patterns that adorn our journey from one point in time to the next. A breath, a heartbeat, a note from a song, have no significance without a reference to what comes before and after. These projects document patterns in time and add an element of play. At once disruptive and hopeful, their rhythms present the potential for a new examination of time and space.

## Joanna Berzowska

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## Di Mainstone

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**SKORPIONS: Kinetic Electronic Garments**

SKORPIONS are a collection of kinetic electronic garments that use the shape-memory alloy Nitinol to move and change on the body in slow, organic motions. They have anthropomorphic qualities and can be imagined as parasites that inhabit the skin of the host. They breathe and pulse, controlled by their own internal programming. They are living behavioral kinetic sculptures that exploit characteristics such as control, anticipation, and unpredictability.

SKORPIONS integrate electronic fabrics, soft electronic circuits, specially designed circuit boards, Nitinol, mechanical actuators such as magnets, and traditional textile construction technique. The cut of the pattern, the seams, and other construction details become an important component of engineering design. SKORPIONS are not interactive: their programming does not respond to sensor data. SKORPIONS shift and modulate personal and social space by imposing physical constraints on the body. They alter behavior, by hiding or revealing hidden layers, inviting others inside the protective shells of fabric, by erecting breathable walls, or tearing themselves open to divulge hidden secrets.

An XS Labs production by Joanna Berzowska and Di Mainstone, with Marguerite Bromley, Marcelo Coelho, David Gauthier, Francis Raymond, and Valerie Boxer.

Funded by The Canada Council for the Arts.



## Ed Cookson
## Edd Dawson-Taylor
## Adam Hoyle
## Lewis Sykes
## Olly Venning

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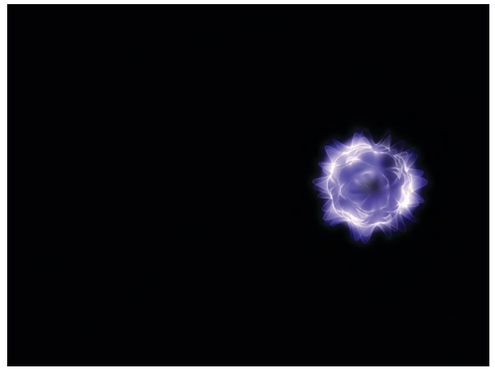
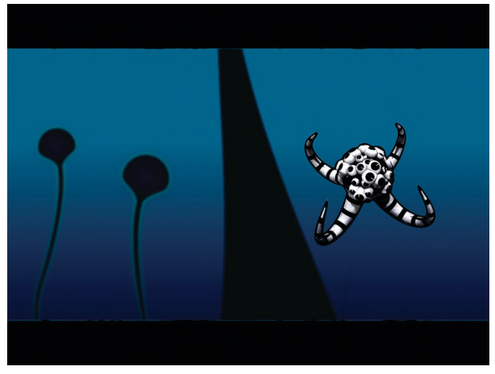
**Spacequatica**

The Sancho Plan creates real-time audio/visual experiences for modern audiences. Through our live shows and installations, we explore custom-built, interactive technologies that fuse film and animation, sound and music, interaction design and gaming, and live performance into unified works of immersive public entertainment. Visually and sonically, Spacequatica takes us on a descent through a musical ocean. Beginning near the surface, where phasing xylophones interact with schools of small exotic creatures, the animation explores deeper waters populated by robotic sharks, and the depths, where all that can be observed is a self-illuminating species occasionally blinking out of the darkness.





## Jason Freeman

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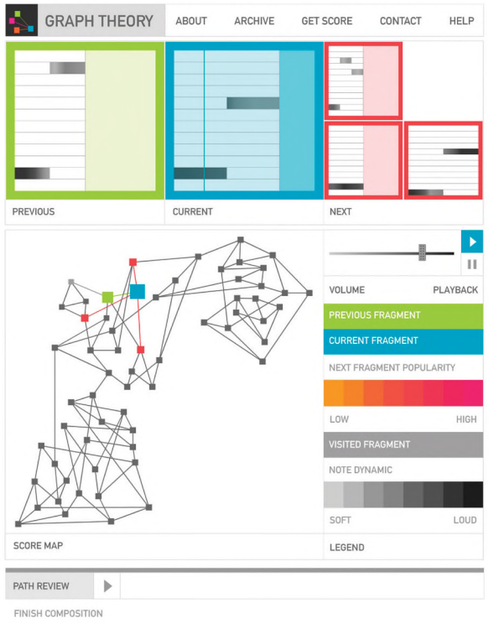
Contemporary technological and aesthetic developments challenge us to play a more engaged and active role as cultural consumers. We help create the content we enjoy: we curate the playlists we listen to, we compete in the online games we play, and we collaboratively filter the media we watch. Within this context, traditional concert performance, particularly of classical and contemporary music, seems increasingly anachronistic. Audiences sit in dark halls, often looking at a conductor whose back is turned toward them, afraid to cough or sneeze lest they disturb their neighbors.

Graph Theory aims to bridge this experiential gap. Through its availability on the internet, Graph Theory creatively engages audiences outside the concert hall. The project incorporates their activities into the context of a live concert performance. Web site visitors, who need not have specialized musical training, use a visual interface to navigate short, looping musical fragments to create their own unique path through the open-form composition for solo violin. Before each concert performance, the live performer, a violinist, visits the web site to print out a new copy of the score, the linear fragments of which are ordered based on the decisions made by site visitors.

Graph Theory is a commission of New Radio and Performing Arts, Inc. (aka Ether Ore) for its Turbulence web site. It was made possible with funding from the Greenwall Foundation. I created this work in collaboration with designer Patricia Reed and violinist Maja Cerar.









## David Gladstein

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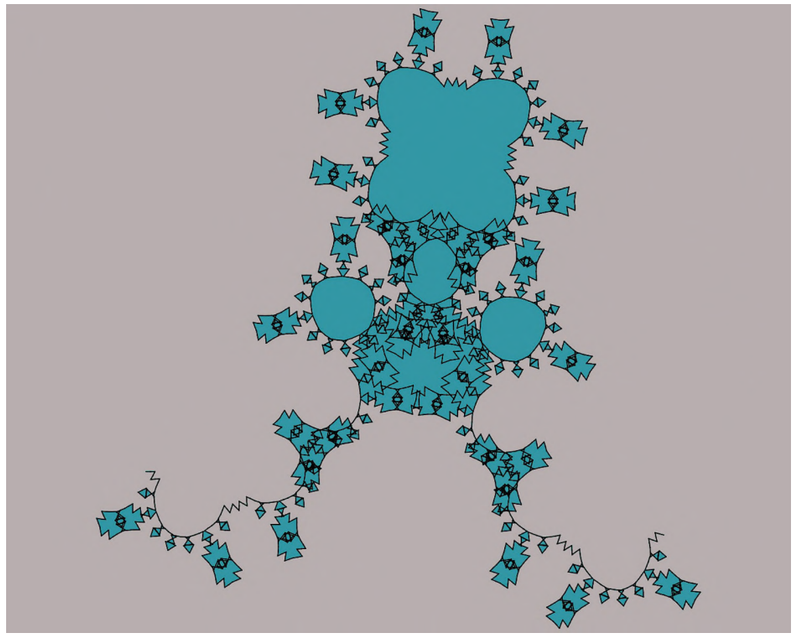

This animation was a happy accident. I was interested in seeing what kinds of shapes could be generated by simple L-systems, so I coded a Python/PyQt application to iterate the replacement rule and draw the resulting string using the typical turtle geometry interpretation. I quickly saw that changing the angle parameter about a degree could produce very different shapes, and that haphazard exploration of the angle parameter might miss interesting shapes. So I added an animation feature to vary the angle systematically and save out the resulting frames. By trial and error, I settled on .01 degree as an increment that produced a small but noticeable change in the picture. I rendered the 18,000 frames into a movie for review and was surprised to find that at 30 frames per second the animation was interesting and fun to watch for 10 minutes, and that the eye could easily pick out single-frame shapes that differed substantially from the neighboring frames.

## Takahiro Hayakawa

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**KASHIKOKIMONO -Ver.J-**

The words “animation” and “animism” both derive from the Latin word “anima,” which means life principle or soul. This work is a visual expression of the triangular realm formed by these three words. Animism here represents Asia’s ancient religion, and the title, Kashikokimono, stands for “the innumerable gods and deities of Japan.” With this work, I have tried to create images that express this profusion of gods representing all of creation. With the goal of creating a new type of organic visual expression, I used a combination of hand-drawn animation and software-based generative animation.




## Kenneth Huff

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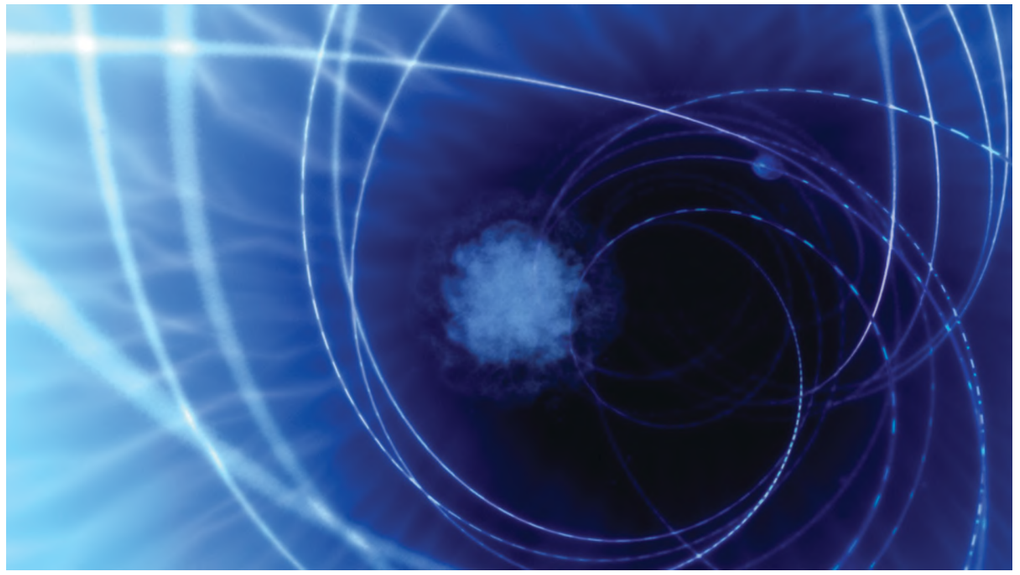
**2006.7 (Elemental Series)**



There are many natural events I find fundamentally intriguing: for example, sparks flying from embers of a fire, waves of lightning rolling in a thunderstorm, or trees swaying in a breeze. With sustained observation of these events, I find myself in a meditative state, relaxed but also actively, mindfully engaged. I develop my work to explore similar ephemeral phenomena, to gently abstract their essences, and to create new contemplative experiences. I evoke many overlapping natural rhythms and time scales, from the darting of our eyes as we take in the world to the ever-changing rhythms of our breathing, from the breaking of waves to the changing of seasons. In this work inspired by underwater patterns of light, life, and movement, we are accompanied by a series of companions, one constant, others slowly passing as they emerge from the darkness.  The exact subject matter is kept purposefully ambiguous, encouraging a broad range of associations.

## Through The Time Tunnel


**Miseong Lee**
**Tek-Jin Nam**

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Through The Time Tunnel is an artistic exploration of the scientific principles that govern time and space. This artistic interpretation of a time machine allows users to interact with past events through a playful interface. It is inspired by two facing mirrors that create infinite reflections of the present moment. Like an imaginary mirror, Through The Time Tunnel shows reflections of time from past to present in different time spaces. It uses a video camera, a green screen, and control buttons to record layered video sequences, and it creates a tunnel-like effect by stacking the recorded video images. The speed and direction of navigation within the tunnel are controlled by the user, providing a compelling time-based experience.



## The Dreaming Pillow (L'Oreiller Rêveur)


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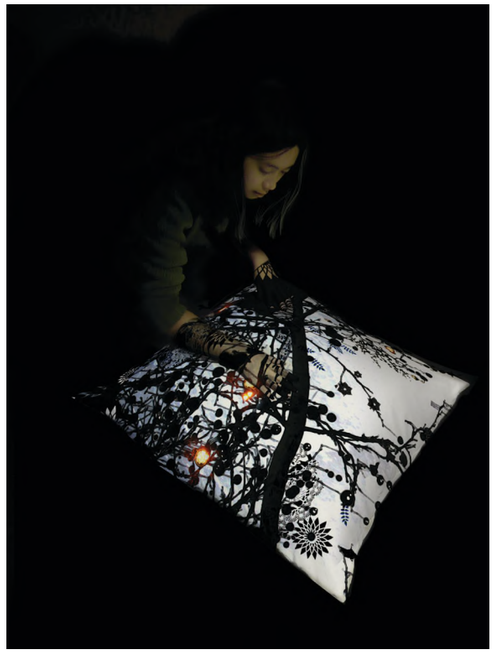
The Dreaming Pillow proposes transformation of everyday objects from mundane accessories to real actors. This approach is inspired by "Object Theater," in which objects play a transformative theatrical role. The introduction of technological augmentation can imbue an object with an entirely novel set of functions, thus offering an enhanced interaction between the audience and the object. In this instance, the object in question is quite familiar, even banal: the pillow. We associate it with rest, sleep, well-being, and softness. The Dreaming Pillow offers several interactive scenarios that are representative of sensations generally associated with dreams, providing the audience an evocative oneiric journey.


With the help of L'Ecole des Mines de Paris

## Qian Li

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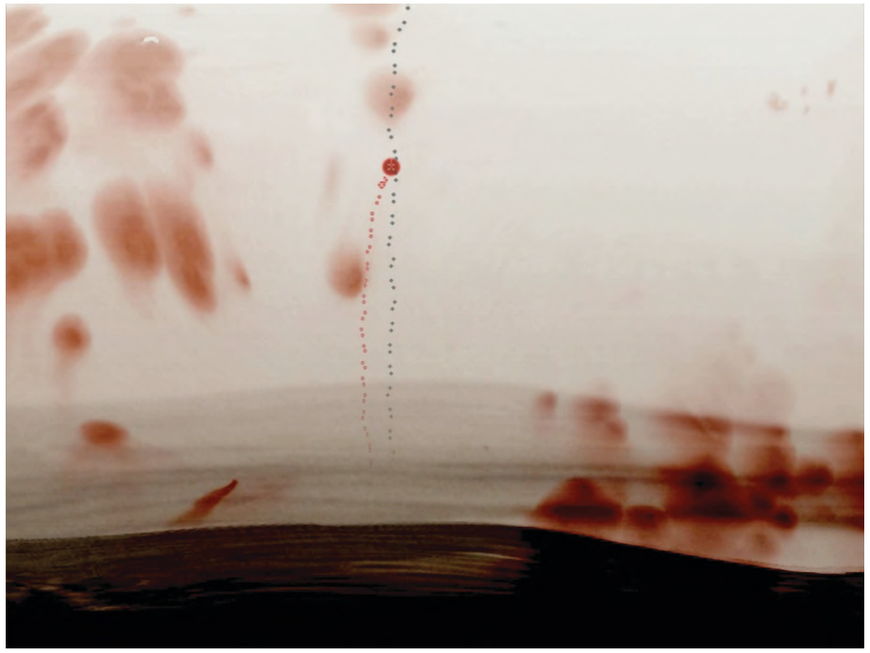

This video, inspired by a dream, is the life story of two humanized dots discovering love and hardship in today's society. The piece intends to evoke personal memories that are emotionally tied to the viewer's own experiences. The visuals are strongly influenced by traditional Chinese brush painting. The rising and falling life of the dots is synchronized with the music, with the intent that they empower one another. The piece mixes classical music with cutting-edge technology to create a deeply unique experience.

Trained as a traditional Chinese painter, I have adopted the principle of "expressing the spirit through form." Along with painting, I have studied Chinese philosophy and researched Buddhist art. During the past few years, I have traveled to Dunhuang and Tibet to study their art and attempt to understand their spirit, both visually and philosophically. These themes in art and lyrical composition have served as the foundation for my work as a new media artist.






## Takahiro Matsuo

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Explore a fantasy world experience at some time, somewhere in our memory. Phantasm is an interactive installation in which participants are illuminated in a small, dreamlike space. As you grasp a glowing sphere, the area lights up in pale blue light, and white butterflies appear from nowhere as a soft piano melody flows. Butterflies fly slowly and gloriously, gathering toward the sphere, and chase you as you move the sphere. The sphere is the key to the real world and fantasy. Participants can experience the nostalgia of playing with butterflies by moving around or holding the sphere in the air. Beautiful white butterflies draw wing strokes in the air as if they are symbols of a fantasy world; they delicately lead you into their world. If you cover the sphere with your hands to shut out the light, the butterflies gradually disappear, leaving silence and lingering light, bringing you back to reality. You will find yourself perplexed, as if you have experienced a fleeting dream.

## Mark Stock

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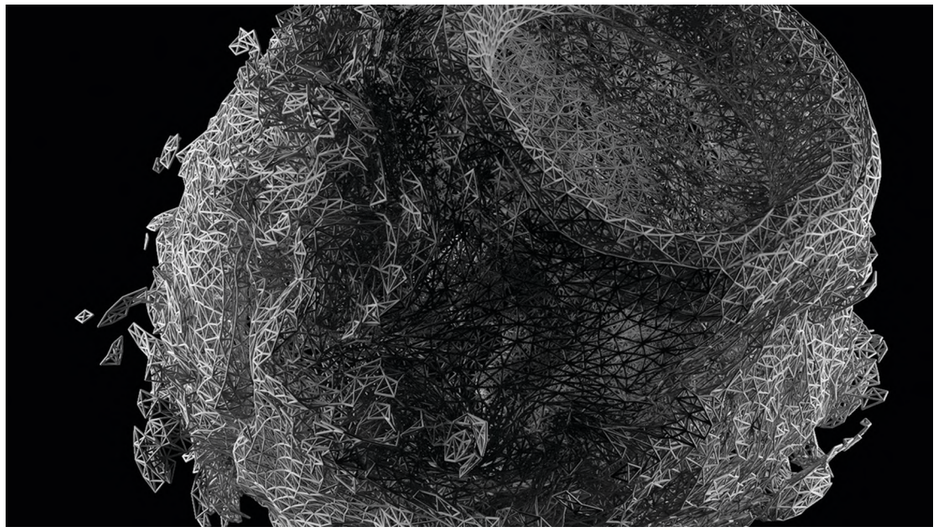
### Smoke Water Fire



Smoke Water Fire is a digital animation of a deforming blob of fluid that has been slowed down and stripped of environmental context in order to explore the shape of ephemeral media. The animation addresses several interrelated themes: context and speed, commonality of the equations of physics, and ephemerality of fluid media. It does this through its use of scale-free computational fluid physics, abstract digital representations, and projected moving pictures. Because of its purely computational nature, Smoke Water Fire removes any context of material or physical scale and leaves the viewer with little more than the dynamics of the shape itself.




## Ryoko Ueoka
## Hiroki Kobayashi

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### Wearable Forest: Feeling of Belonging to Nature

Wearable Forest is bio-acoustic clothing that interacts with a remote forest using network technology. The intention of the project is to provide users with an opportunity to feel connected with nature regardless of their physical location. Wearable Forest introduces a new interactive sound system that creates a sense of unity between the user and a remote soundscape through remote-controlled speakers and microphones.

Wearable Forest is conceptually based on human-computer biosphere interaction in that it uses wearable technology to enable bio-acoustical interaction with the subtropical forest of the southern Ryukyu Islands of Japan. The clothing uses embedded speakers, LEDs, an embedded CPU system, and a wireless connection to process and play acoustic data received from the forest. Sensors allow the user to transmit pre-recorded acoustic data back to the forest installation, creating a bio-acoustical loop.

*Photo by Masaharu Hatta*

**TRAVERSAL**

As humans, our paths define our relationship with time. Our daily commutes, our leisure activities, the floor plans of our homes, form the circuits that bring us through a series of successive moments to our destinations. Whether on foot, in autos, or on bikes, where we are, or where we think we need to be, can transform our perceptions of our bodies and their surroundings.

## Santiago Caicedo

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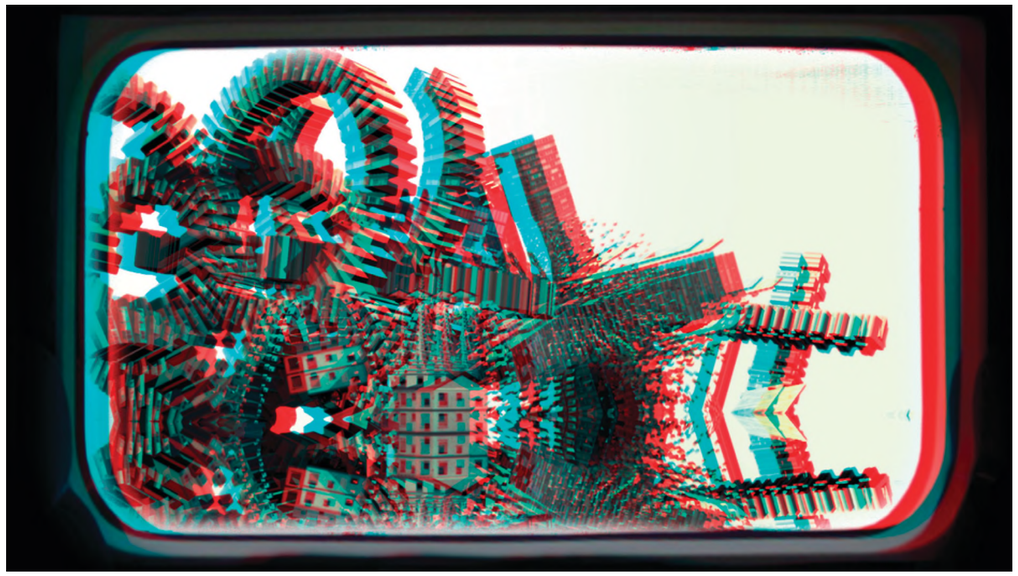
**Moving Still**



To be a routine traveler. No surprises at the starting point, no surprises at the point of arrival. To feel the monotony of a recurring journey made too many times. Looking through the window of a train, imagining all that happens outside, following the rhythm, and then choosing not to.

Asking ourselves whether we want to, or if we can, still change roads.

Moving Still is a stereoscopic short film that uses an experimental technique from a single camera shot mixed with CG elements that build and destroy the city.

The film infuses routine travel with fantasy, challenging the monotony of our metaphorical journeys.

## Jorn Ebner

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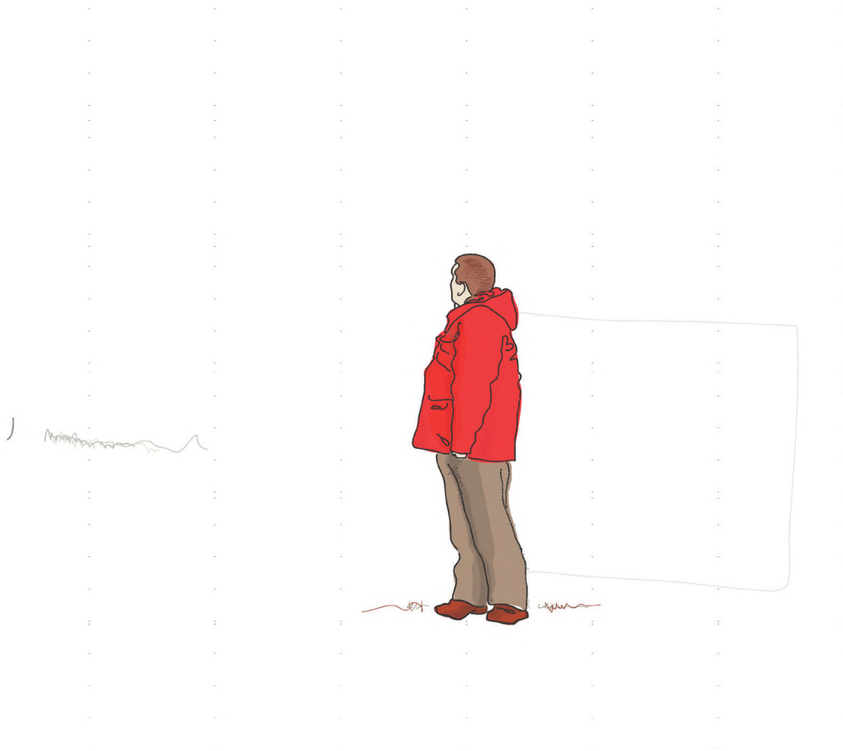
**Navigator**



Navigator is a Flash-based CD-ROM with circuitous navigation of environments, both real and representational, as its theme.

At the end of each figurative, abstract, or photographic animation sequence, users must make choices without knowing where they are about to be led. The Flash animations contain abstract and figurative imagery combined with digital photography. Each animation depicts a navi- gation of an environment. The imagery is based on children's drawings and digital photographs that have been redrawn and animated by the artist. Users navigate with a series of buttons that lead to randomly called sequences. At the end of each animation, the buttons oscillate and need to be discovered.

The actions in Navigator parallel the random nature of real-life decision making.




## Dylan Moore

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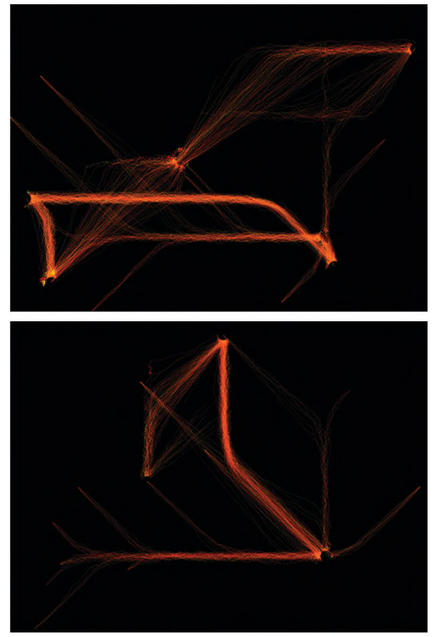
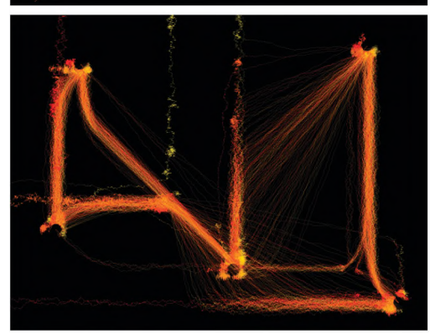
**Meros: Remapping Experiences of Light in the Urban Daily Journey**

This project examines the everyday journey of bicyclists and pedestrians in the New York City area by mapping their paths using data captured from ambient lighting conditions at various times of day. The end result is two-fold. First, a duration-based animation shows the cityscape over a 24-hour period, not through geographical representation, but from light and dark information captured by the cyclist. The second outcome consists of an illuminated glasswork pane that is marked with a composite of the map. The project uses light to remap space in an effort to re-examine familiar locations.

Light plays an important role in the function of a city. Light conditions, whether natural or artificial, inform our perceptions and responses. By aggregating data over time, we transform the urban landscape into a digital painting of light.





## Hye Yeon Nam

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### Wonderland (2007)

Space takes on multiple definitions. I understand space as the sum of cultural and social forces that act on me. Through space, my body feels all changes around me instantly and intimately. When I moved from Korea to the United States, my body became a gauge that not only felt my displacement and recognized the conformity inflicted on me in the United States, but also allowed me to deconstruct the hometown rules that I had taken for granted as normal.

In my video piece, I attempt to convey the feeling of displacement and conformity by the act of walking. I walk forward, and other people seem to be walking backward. However, in the real scene I was walking backward, and I simply reversed the video. The space of being neither here following correct rules nor there following incorrect rules is precisely what I try to convey in this video.





## Aaron Oldenburg

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### The Mischief of Created Things

The purpose of The Mischief of Created Things is to create an interactive environmental narrative dealing with new images of West Africa and philosophies of game design. The content is based on my two years as a development worker in Mali. The imagery is intended to inspire players to find the magic in the mundane, and it references a hybrid of traditional Malian and Western culture overlapping between magic and technology.

My process involved creation of a three-dimensional environment in Flash, which the player can explore non-linearly. The environment includes characters, with whom players converse; the conversations are based on a fluid navigation system similar to the environment's exterior navigation. Stories are based on my diary entries and letters home, and were chosen for their personal, surprising, and multi-layered nature.

Rather than use traditional game-design methods, I chose to start with narrative and imagery and create the game structure from them. During play, the user discovers narratives that build on one another throughout the course of the experience. The player uses these to form a meaningful picture of the environment as a whole. The order of events changes each player's interpretation, since the experience of certain events directly influences the sequence of subsequent events. The surprising and non-sequitur nature of the narrative makes the game characters and environment seem more real.

## Lily & Honglei

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**Forbidden City**

Forbidden City is an experimental animation that uses digital technologies to preserve traditional eastern aesthetics. In order to create an aesthetic space where history and the contemporary encounter each other, the animation uses two- and three-dimensional animation techniques combined with Chinese cut-paper design, a form of Chinese folk art. The intention is to convey the serious social and cultural significance associated with this highly symbolic art form. Not surprisingly, this can result in both conflict and dialogue. In Forbidden City, the violence in recent political events confronts the superficially peaceful everyday life in China. As Chinese new media artists, we transform traditional Chinese artistic techniques by employing updated digital technologies. We do so in order to preserve traditional Chinese aesthetic and cultural values, specifically the fundamental theory of Chinese arts that says hardness comes from softness, and quickness comes from slowness, based on the Taoist thinking that "yin" and "yang" are complementary opposites. Each fundamentally relies upon, and gives birth to, the other.

Music by David Williams
University of Massachusetts Dartmouth



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**Ch'an Mind, Zen Mind Series: "Infinity" and "Purity"**

Everything we see is changing and losing its balance moment by moment. This is where beauty exists: when one has a calm mind, when behind the endless change a background of perfect harmony is revealed. Infinity (top) reflects that in the realm of Ch'an, infinite and constant change performs against a background of perfect tranquility, which also indicates that change and evolution are the key ingredients of infinite beauty in our lives. Navigating across the sky, the birds are symbols of change. The mighty, serene mountains convey the idea of perfect harmony. Connected by many white circles and lines that originate from the ancient Chinese numeric system, the space, interchanging forms, limitless time, distance in between, and countless elements address the conception of infinity in this image.

Compared to other images in my Ch'an Mind, Zen Mind series, Purity (bottom) has less symbolic meaning, but more sensuous and emotional inspiration. The calmness and serenity of this image is rooted in memories of my own pilgrimage to Buddhist temples. My choice of a Chinese painting of the lotus, abstract brush works of sitting figures, and even the use of colors was intuitive. While creating, many of my decisions are not rational deductions; I simply try to capture what I sense and feel at that moment.

As a Chinese artist living in the western world, I am aware of art and philosophy from both cultures. I create artworks for the sake of my own spirit, for color and arrangement in each image, and for making visible the concepts that gave birth to the images. I want my viewers to look at my images through magical windows into a deep, secondary space, enriched by my spiritual experience.

My artistic images form a visual communication that interacts in several collective dialogues. These dialogues are between eternity and transience, oneness and variety, existence and emptiness. At the core of my art is an attempt to attain moments of transcen-dence, to reach artless-art, emptiness, self-unconsciousness, and self-forgetfulness. In other words, artistic creation is a process of expressing my true nature via "being" human.

# Japan Media Arts Festival


The Slow Art Gallery presents award-winning works from the 11th Japan Media Arts Festival. Since 1997, the festival has encouraged creation and development of art, entertainment, animation, and manga. Over the years, the number of entries has gradually increased. In 2007, the festival received 2, 091 entries including 429 applications from 42 countries and regions outside Japan. The 2007 prize-winners, including the Grand Prize work ("nijyuman no borei") by Jean-Gabriel Periot, are as follows:

**nijuman no borei (200000 Phantoms)**
Jean-Gabriel Periot/France
(c) Envie de Tempete Productions

**Issey Miyake A-Poc Inside.**
Masahiko Sato + Euphrates/ Japan
(c) Issey Miyake Inc.

**Super Smile**
Effie Wu/Germany
(c) Effie Wu

**20010218-20060218**
Fujii Shiro/Japan
(c) Shiro Fujii

**Aperspectival House**
Van Mcelwee/US
(c) Van McElwee

**electric life line**
Kosakai Shogo/Japan
(c) Shogo Kosakai

**SHATTER/Japan**
Nakama Kouhei
(c) Nakama Kouhei

**Sweet Dream/Taiwan**
Huang Po-Chih
(c) Huang Po-Chih

**Waxx**
Paul Kopetko/Australia
(c) Paul Kopetko 2006

**Empty layer**
Keisuke Shimada/Japan
(c) Keisuke Shimada

**Musashino Plateau**
Nobuo Takahashi/Japan
(c)2006 Nobuo Takahashi Laboratory/Yoshida Gakuen