

Bridges Donostia

Mathematics, Music, Art, Architecture, Culture



2007

Bridges Donostia



MATHEMATICAL CONNECTIONS IN ART, MUSIC, AND SCIENCE

Proceedings 2007

Reza Sarhangi and Javier Barrallo, Editors



**School of Architecture
The University of the Basque Country
San Sebastian (Donostia), Spain**

Celebrate the Tenth Annual Bridges Conference

BRIDGES DONOSTIA

Mathematics, Music, Art, Architecture, Culture

<http://www.BridgesMathArt.Org>



School of Architecture
The University of the Basque Country
San Sebastian (Donostia), Spain

**Conference Proceedings
2007**

Reza Sarhangi and Javier Barrallo, Editors

Tarquin publications

Bridges Donostia

Scientific Organizers

Javier Barrallo
School of Architecture
The University of the Basque Country
San Sebastian, Spain

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

Local Organizers

Angel Fernandez
Department of Mathematics
School of Architecture
The University of the Basque Country, Spain

Luis Martin
Department of Mathematics
School of Architecture
The University of the Basque Country, Spain

Santiago Sanchez
Department of Physics
School of Architecture
The University of the Basque Country, Spain

Alberto Zulueta
Department of Physics
School of Architecture
The University of the Basque Country, Spain

Bridges for Teachers, Teachers for Bridges

Mara Alagic
Department of Curriculum and Instruction
Wichita State University
Wichita, Kansas, USA

Paul Gailiunas
Newcastle, England

Bridges Visual Art Exhibit

Robert W. Fathauer
Tessellations Company
Phoenix, Arizona, USA

Ann Burns
Department of Mathematics, Long
Island University, New York, USA

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

Conference Website and Electronic Correspondence

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

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

Conference Board of Advisory

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

Carlo Séquin
Computer Science Division,
EECS Department, University
of California, Berkeley, USA

John Sharp
London Knowledge Lab
Institute of Education
University of London, UK

***Bridges Donostia, Mathematics, Music, Art, Architecture, Culture
Conference Proceedings, 2007***

Editors:

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

Javier Barrallo
School of Architecture
The University of the Basque Country
San Sebastian, Spain

© *Bridges Donostia Conference*. (<http://www.bridgesmathart.org>). All rights reserved. General permission is granted to the public for non-commercial reproduction, in limited quantities, of individual articles, provided authorization is obtained from individual authors and a complete reference is given for the source. All copyrights and responsibilities for individual articles in the 2007 Conference Proceedings remain under the control of the original authors.

ISBN: 0-9665201-8-1
ISSN: 1099-6702

Printed in the UK by Print Solutions Partnership

Distributed by MATHARTFUN.COM (<http://mathartfun.com>) and Tarquin Books (www.tarquinbooks.com)

Cover design: *Imaginary Garden* by Anne M. Burns
Logo: *A (7, 2) star polygon based on the Buzjani's approximation of heptagon* by Reza Sarhangi and Robert Fathauer
Cover layout: Jeffrey Rutzky
CDROM: Chris K. Palmer

Contents

Preface	xiii
Modular Kirigami <i>George W. Hart</i>	1
Some Monohedral Tilings Derived From Regular Polygons <i>Paul Galiunas</i>	9
Composite Diffusion Limited Aggregation Paintings <i>Gary R. Greenfield</i>	15
Symmetry and Structure in Twist-Hinged Dissections of Polygonal Rings and Polygonal Anti-Rings <i>Greg N. Frederickson</i>	21
Imaginary Gardens – A Model for Imitating Plant Growth <i>Anne M. Burns</i>	29
Allahverdi Khan Bridge (Si-O-Seh Pol) of Esfahan An Example of Art and Mathematics <i>Hourieh Mashayekh and Hayedeh Mashayekh</i>	37
Light, Movement and 3D – Light images Viewed as Photographs <i>Jack Tait</i>	39
Spiral Developable Sculptures of Ilhan Koman <i>Tevfik Akgün, Irfan Kaya, Ahmet Koman, and Ergun Akleman</i>	47
“Gödel, Escher, Bach”, in other Eras <i>Dirk Huylebrouck</i>	53
Mathematics and Symmetry: A Bridge to Understanding <i>Gail Kaplan</i>	59
A Proposal for the Classification of Mathematical Sculpture <i>Ricardo Zalaya Báez</i>	67
The Spirograph and Beyond <i>Susan McBurney</i>	75
Entwined Circular Rings <i>Rinus Roelofs</i>	81
2D and 3D Animation Using Rotations of a Jordan Curve <i>Peter Hamburger, Edit Hepp, and Richard Wartell</i>	91
Mathematical Models for Binarization and Ternarization of Musical Rhythms <i>Francisco G’omez, Imad Khoury, J’org Kienzle, Erin McLeish, Andrew Melvin, Rolando P’erez-Fern’andez, David Rappaport, and Godfried Toussaint</i>	99

Portraits of Groups II, Orientation Reversing Actions <i>Jay Zimmerman</i>	109
Baskets for the Mathematics Classroom <i>S. Louise Gould</i>	115
The Pentagonam: From the Goddess to Symplectic Geometry <i>Elisa Prato</i>	123
The Modular Color Palette: Systems of Color Selection in the Paintings of James Mai <i>James L. Mai</i>	127
A “Sound” Approach to Fourier Transforms: Using Music to Teach Trigonometry <i>Bruce Kessler</i>	135
Magritte: Analogies in Mathematical Reasoning <i>Rozhkovskaya Natasha</i>	143
Zany Projects – The Art of Mixing Compass with Computer <i>Rebecca Kessler</i>	147
Breaking Color Symmetry <i>Carla Farsi</i>	149
Addled Tangles of Sanguine Language—an Eclectic Syncretic Syntactic Taxonomy <i>Benjamin Wells</i>	151
Structure and Form in the Design Curriculum <i>M.A. Hann and B.G. Thomas</i>	161
Electrostatic Patterns in the Interior of a Circular Region <i>N.G. Nicolis</i>	169
Ricochet Compositions <i>I.A. de Kok, T. Lucassen, and Zs. Ruttkay</i>	177
Golden Fractal Trees <i>T. D. Taylor</i>	181
Anticlastic Form – Manifesting Fields of Tension <i>Benjamin Storch</i>	189
Patterned Polyhedra: Tiling the Platonic Solids <i>B.G. Thomas and M.A. Hann</i>	195
Frieze Patterns of the Alhambra <i>B. Lynn Bodner</i>	203
Modeling D-Forms <i>Özgür Gönen, Ergun Akleman, and Vinod Srinivasan</i>	209

A Simple Procedure to Generate Curves and Surfaces <i>Alan Sutcliffe</i>	217
The 7 Curve, Carpets, Quilts, and Other Asymmetric, Square-Filling, Threaded Tile Designs <i>Douglas McKenna</i>	225
Geometric Constructions and their Arts in Historical Perspective <i>Reza Sarhangi</i>	233
The Ideal Vacuum: Visual Metaphors for Algebraic Concepts <i>Jessica K. Sklar</i>	241
Inout Sculptures <i>Yutu Liu, Hernan Molina, and Ergun Akleman</i>	247
Painting by the Numbers: A Porter Postscript <i>Chris Bartlett</i>	253
Poverty and Polyphony: A Connection between Economics and Music <i>Rachel W. Hall and Dmitri Tymoczko</i>	259
From Modeling Foliage with L-systems to Digital Art <i>Glyn M. Rimmington and Mara Alagic</i>	269
Does it Look Square? Hexagonal Bipyramids, Triangular Antiprismoids, and their Fractals <i>Hideki Tsuiki</i>	277
Shape, Time and Chemistry: Some Platonic Meditations <i>Farzad Mahootian</i>	287
Shiva: Two Views of Burnside's Lemma at Work <i>James Mai and Daylene Zielinski</i>	289
Modeling High Genus Sculptures Using Multi-Connected Handles and Holes <i>Vinod Srinivasan, Hernan Molina, and Ergun Akleman</i>	297
Revisiting the Geometry of the Sala de Dos Hermanas <i>Ann Robertson</i>	303
Ancient Harmonic Law <i>Jay Kappraff</i>	311
The Effect of Human Experience on Formal Word Meaning <i>Russell Jay Hendel</i>	313
Transgenic Visual-and-Sound Compositions <i>Artemis Moroni, Rafael Bocaletto Maiolla, and Jônatas Manzolli</i>	315
Geometry and New Urban Order <i>Cristina Argumedo, M^a Francisca Blanco, Dora Giordano, and Miriam Pisonero</i>	323

The Power and Potential of Art in Literature to Teach Mathematics <i>William P. Bintz and Sara Delano Moore</i>	331
Planar Symmetry with Turtles <i>James Dean Palmer</i>	333
Fractal Knots Created by Iterative Substitution <i>Robert W. Fathauer</i>	335
Sculptures which Stellarize Non-Planar Hexagons <i>Douglas G. Burkholder</i>	343
Edge-Constrained Tile Mosaics <i>Robert Bosch</i>	351
Hyperbolic Semi-Regular Tilings and their Symmetry Properties <i>Ma. Louise Antonette N. De Las Peñas, Glenn R. Laigo, and Eden Delight B. Provido</i>	361
Fractal Art: Closer to Heaven? Modern Mathematics, the art of Nature, and the nature of Art <i>Charalampos Saitis</i>	369
Images of the Ammann-Beenker Tiling <i>Edmund Harriss</i>	377
Symmetric Embedding of Locally Regular Hyperbolic Tilings <i>Carlo H. Séquin</i>	379
When is a picture not a picture? What is really in a Random Tandem? <i>Simon Bexfield</i>	389
A “Circle Limit III” Calculation <i>Douglas Dunham</i>	395
Designing a Modern Tower in a Mathematically–Based World <i>Zafer Sagdic and Barbaros Sagdic</i>	403
Amazing Labyrinths <i>Samuel Verbiere</i>	405
The Automorphism of Amalgamation Polytopes and Tessellation <i>Lin Hsin Hsin</i>	413
Geometrical Transformation: A Method for the Creation of Form in Contemporary Architecture <i>Ülkü İnceköse</i>	415

Bridges for Teachers, Teachers for Bridges

Understanding Math via Arts, Creating Arts via Math <i>Mara Alagic and Paul Gailiunas</i>	423
Imaginative Quilted Geometric Assemblages <i>Elaine Krajenke Ellison</i>	425
The Geometry of Asian Trousers <i>Penelope Woolfitt</i>	427
Math/Art Projects <i>Ann Hanson</i>	431
Building Models to Transition from Dimension to Dimension <i>Robert McDermott</i>	433
Exploring Cubes Woven on the Skew <i>Felicity Wood</i>	441
Using Art to Teach Maths, Using Maths to Create Art <i>Julie Dobson and Jenny Gage</i>	445
From Folding and Cutting to Geometry and Algorithms: Integrating Islamic Art into the Mathematics Curriculum <i>Carol Bier</i>	453
Zome Workshop <i>Paul Hildebrandt</i>	459
Index	465

Preface

Celebrate with us this tenth year of Bridges! The conference began in 1998 and has evolved into the premier annual event for the interdisciplinary study of mathematics and the arts. You are holding the tenth in the series of annual proceedings volumes recording the diversity, richness, and depth of ideas presented by conference participants. For many artists, mathematicians, computer scientists, and educators, the Bridges Conference is an essential annual excursion to meet with like-minded multidisciplinarians and recharge one's creative batteries. The talks, workshops, exhibits, and performances inspire each of us to grow beyond our individual specialties. These Proceedings will also bring some of that energy to those who can not attend in person.

We are most pleased this year to hold the conference in Donostia, or San Sebastian, Spain. The local arrangements are headed by Javier Barrallo, with the assistance of Angel Fernandez, Luis Martin, Santiago Sanchez, and Alberto Zulueta. This is a wonderful location with outstanding sights, food, and culture, so we are especially grateful to Javier Barrallo for making this possible. In 1998, the same year as the first Bridges Conference, Javier helped organize a Mathematics and Design conference in San Sebastian, where many of us first met him. Then Javier worked with Nat Friedman in organizing the 1999 ISAMA conference here. We are most pleased to have Javier's support in arranging for the Bridges Conference to be held this year at The University of the Basque Country.

This year is the first time that Bridges is being operated independently of Southwestern College, a private liberal arts school in Winfield, Kansas. They were our original sponsoring organization for the conference and we thank them for years of support. The conference grew and traveled to other sites: Towson University, Maryland, the University of Granada, Spain, the Banff Centre, Canada, and the University of London, England. And through it all, Southwestern College kindly took care of our financial records and provided valuable staff support.

Now we operate as the independent non-profit Bridges Organization with a small board of directors and an enthusiastic group of volunteers dividing the workload. This year, Reza Sarhangi and Javier Barrallo are the scientific organizers and edited the proceedings, aided by many anonymous reviewers. Mara Alagic and Paul Gailunas are the coordinators of the workshops. Jeffrey Rutzky designed the proceedings cover art. Chris Palmer prepared the CDROM. Robert Fathauer, Anne Burns, and Nat Friedman organized and curated the conference art exhibit. George Hart maintains the web site, for which Anne Burns formatted the art exhibit material into web pages. Craig Kaplan runs the conference announcement mailing list. Robert Fathauer manages our credit card billing services. By creating the non-profit organization and dividing the conference workload, we expect the Bridges Conference is now in a position to evolve and adapt, growing stronger each year.

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

