

Meeting Alhambra

ISAMA

**The International Society of the
Arts, Mathematics, and Architecture**

BRIDGES

**Mathematical Connections
in Art, Music, and Science**



**UNIVERSITY OF GRANADA
FACULTY OF SCIENCES**

Meeting Alhambra

ISAMA—BRIDGES 2003

Organizers

Javier Barrallo
Registration and Reservation
School of Architecture
University of the Basque Country
20018 San Sebastian, Spain

José Martínez Aroza
Space Management
Faculty of Sciences
University of Granada
18071 Granada, Spain

Nathaniel Friedman
Art Exhibit
Department of Mathematics
University At Albany
1400 Washington Avenue
Albany, NY 12222

Reza Sarhangi
Conference Proceedings
Mathematics Department
Towson University
8000 York Road
Towson, MD 21252

Juan Antonio Maldonado
Space Management
Faculty of Sciences
University of Granada
18071 Granada, Spain

Carlo Séquin
Poster Session
EECS, Computer Science Division
Soda Hall # 1776
University of California
Berkeley, CA 94720-1776

Meeting Alhambra, ISAMA–BRIDGES Conference Proceedings, 2003.

Editors:

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

José Martínez-Aroza
Faculty of Sciences
University of Granada
Granada, Spain

Nathaniel Friedman
Department of Mathematics
University At Albany
Albany, New York, USA

Reza Sarhangi
Mathematics Department
Towson University
Towson, Maryland, USA

Juan Antonio Maldonado
Faculty of Sciences
University of Granada
Granada, Spain

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

ISBN:

Price: \$40.00

Distributed by MATHARTFUN.COM (<http://mathartfun.com>)

Front cover design: Polynomiograph of a Physicists' polynomial by Bahman Kalantari.

Back cover design: The step 2-octogonal tiling projected onto a dome and used as the basis for a zellij created by Jean-Marc Castera.

Cover layout and border designs: Chris Palmer.

© *Meeting Alhambra, ISAMA–Bridges 2003 Conference.* (<http://www.sckans.edu/~bridges/>). 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 © rights and responsibilities for individual articles in the 2003 Conference Proceedings remain under the control of the original authors.

Contents

Preface	xiii
Three Traditions of Self-Similarity in Fourteenth and Fifteenth Century Islamic Geometric Ornament <i>Jay Bonner</i>	1
<i>Volution's</i> Evolution <i>Carlo H. Séquin</i>	13
Classification and Phylogenetic Analysis of African Ternary Rhythm Timelines <i>Godfried Toussaint</i>	25
Hidden Inscriptions in the Laurentian Library <i>Paul L. Rosin and Ralph R. Martin</i>	37
Computers, Mathematics and Conceptual Art <i>Michael Mahan</i>	45
Mathematical Sculpture Classification <i>Ricardo Zalaya and Javier Barrallo</i>	53
Constructing and Classifying Designs of al-Andalus <i>B. Lynn Bodner</i>	61
Nodal Lines and Quasi-Space Filling Curves <i>Tiziana Giorgi and Caryn Werner</i>	69
On the Perception of Tone <i>Richard J. Krantz, Jack Douthett, and Richard Plotkin</i>	77
Computational Aesthetics Based on Gaze Patterns <i>Gary R. Greenfield</i>	85
Seashell Architectures <i>Kamon Jirapong and Robert J. Krawczyk</i>	93
Composable Art: Objects That Can Be Arranged in Many Ways <i>Marc van Kreveld</i>	101
Mathematics in Literature <i>Lorna B. Hanes</i>	109

Dimension of Time in Strange Attractors <i>Robert J. Krawczyk</i>	119
Geometric Mosaic Tiling on Hyperbolic Sculptures <i>Irene Rousseau</i>	127
The Mathematics of Color-Reversing Decorative Friezes: Façades of Pírgi, Greece <i>David A. James, Loukas N. Kalisperis, and Alice V. James</i>	135
Computer-Aided Aesthetic Evaluation of Visual Patterns <i>Tomáš Staudek</i>	143
Frieze-Generation Using Artificial Life <i>Dirk Fischer, Eric Goles, and Mario Markus</i>	151
A Unified Theory of Proportion <i>Jay Kappraff and Gary W. Adamson</i>	161
The Art in Polynomiography of Special Polynomials <i>Bahman Kalantari</i>	173
Arraying Alternative Housing Archetypes: An Online Resource <i>Jin-Ho Park</i>	181
Play with Infinity <i>Jean-Marc Castera</i>	189
Two Perspectives on Inversion <i>John Sharp</i>	197
Finding the Dual of the Tetrahedral-Octahedral Space Filler <i>Eva Knoll and Simon Morgan</i>	205
Square Decompositions with Hyperbolic Consequences in Art, Chemical Physics and Mathematics <i>Robert G. Smits</i>	213
Polyhedral Designs of Detection Systems for Nuclear Physics Studies <i>N. G. Nicolis</i>	219
Leonardo's da Vinci's Bar Grids <i>Rinus Roelofs</i>	229
Fractal Geometry and Self-Similarity in Architecture: An Overview Across the Centuries <i>Nicoletta Sala</i>	235
Tangramoids <i>Samuel Verbiese</i>	245

The Sundial, Beyond Form and Time ... <i>Andrzej Zarzycki</i>	253
The Poincaré Surprises <i>Claude-Paul Bruter</i>	257
Quilt Designs Using Non-Edge-to-Edge Tilings by Squares <i>Gwen L. Fisher</i>	265
An Extended Mural for a House of Mathematics <i>Anna Campbell Bliss</i>	273
Hidden Geometry in Music of Bach and Schoenberg: Reflection, Rotation, Proportion <i>Jonathan Saggau</i>	283
An Introduction to the Tiling Properties of Precious Triangles <i>Stanley Spencer</i>	291
NEC Polygonal Groups and Tessellations <i>Domingo Gámez, Miguel Pasadas, Rafael Pérez, and Ceferino Ruiz</i>	299
Mathematics & Esthetics – Science and Art in the Bay Area <i>Benjamin Wells</i>	307
Sculpture from Symmetrically Arranged Planar Components <i>George W. Hart</i>	315
Easy Digitalization and Representation of Three-Dimensional Maps <i>Javier Bilbao Landatxe and Jorge Lázaro Domínguez</i>	323
Dynamical Systems: A Golden Gate from Auditory Physiology to Musical Aesthetics? <i>Julyan H. E. Cartwright, Diego L. González, Oreste Piro, and Domenico Stanzial</i>	331
Introducing Simple Arithmetic and Geometric Series in Complex Parametric Modeling <i>Jane Burry and Mark Burry</i>	339
Abraham as Bridge and Mediator: A Metaphoric Reflection on the Alhambra <i>Ozayr Saloojee</i>	347
Möbius Concepts in Architecture <i>Jolly Thulaseedas and Robert J. Krawczyk</i>	353
On the Shapes of Water Fountains and Times Tables <i>Stephen Eberhart</i>	361

Lengthening, Expansion and Torsion: Three Geometric Operations for Aesthetics Creation <i>Delgado Olmos, A., Márquez García, L.</i>	367
Mathematical Bridges to Philosophy and Theology <i>Douglas Norton</i>	375
Whirled White Web: Art and Math in Snow <i>Brent Collins, Steve Reinmuth, Dan Schwalbe, Carlo Séquin, and Stan Wagon</i>	383
Quilts Inspired by Mathematics <i>Mary C. Williams</i>	393
Geometric Designs in Architecture and Textiles Revisited and Reconstructed Through Layered Planar Geometry <i>Benigna Chilla</i>	401
Fractal Geometry Describes the Beauty of Infinity in Nature <i>María Antonia Castro and María José Pérez-Luque</i>	407
Number Theory and Art <i>Vera W. de Spinadel</i>	415
Magic Geometry: Mosaics in the Alhambra <i>Miroslav Lovric</i>	423
Graphs and Circulation in Rural Housing <i>M^a Francisca Blanco and Miriam Pisonero</i>	433
Diversifying the Curriculum: The Tessellations Case <i>Reza Sarhangi, Gabriele Meiselwitz, and Goran Trajkovski</i>	441
The “Mathematics and Culture” Project <i>Michele Emmer</i>	449
Islamic Constructions: The Geometry Needed by Craftsmen <i>Raymond Tennant</i>	459
Developmental Morphology: X, Y, & Z Coordination as a Dynamic and Generative Cellular Process <i>Manuel A. Báez</i>	465
A Study on the North Dome of Masjid-I-Jami Isfahan <i>Marjan Ghannad</i>	473
Crossing the Equal Sign <i>Marion D. Cohen</i>	485
Great Kiva Design in Chaco Canyon: An Archaeology of Geometry <i>Chris Hardaker</i>	493

Petrie Polygons <i>Paul Gailiunas</i>	503
The Mathematics of Quilting: A Quilter's Tacit Knowledge of Symmetry, Tiling, and Group Theory <i>Katrina Hebb</i>	511
Hyperbolic Spirals and Spiral Patterns <i>Douglas Dunham</i>	521
Optimal Geometry as Art <i>John M. Sullivan</i>	529
Folding Polyhedra and Painting Mosaics <i>Chris K. Palmer</i>	533
Abstracts	
A Patterned Life <i>Jennifer Angus</i>	541
Origami: A Good Way to Communicate Mathematics <i>Ann Hanson</i>	544
Goldbach Tilings <i>Sharol Nau</i>	545
Conceptual Art and Algorithms <i>Susan Happersett</i>	547
Symmetry and Trigonometry <i>Steve Whealton</i>	549
Digital Monoprints: Mining Conchoid Nets <i>Stephen Luecking</i>	551
Cayley Tables as Quilt Designs <i>Gwen L. Fisher and Elsa Medina</i>	553
Duality: A Common Thread in Math, Science, Literature, and Art? <i>Michael de Villiers</i>	555
An Interdisciplinary Study of an Archetype: Across Cultures and Disciplines <i>Ann Hanson, Paula Frohele, Carol Haliday-McQueen, and Renee Hansen</i>	557
Space Blanket <i>Lorella Di Cintio</i>	558

On Mathematics in Art <i>Clifford Singer</i>	559
The Relationship among Proportions, Ottoman-Turkish Music and Architecture <i>Guney Kurdak</i>	561
Polyhedra in “Polyart” Style <i>Ulrich Mikloweit</i>	562
An Evaluation Approach for Circulation in Buildings <i>Mohamed Nada and Khaled M. Nassar</i>	563
Discrete-Event Activity Simulation for Predicting Occupants’ Movements in Buildings <i>Khaled M. Nassar and Mohamed Nada</i>	564
Why Do Penrose Tilings Diffract? <i>Robert V. Moody</i>	565
My Use of Number Sequence and Geometry in Art <i>Kathleen Hyndman</i>	567
New Pentatonic Scale Relationships with Visual Parallels <i>Veryan Weston</i>	569
Hexa-Twistor Triangular Section <i>Akio Hizume</i>	571
Some Mathematical Patterns in the Analysis of Selection and Deletion in Modern Short Stories <i>Masoudd Norouzian and Shadman Shokravi</i>	573
Golomb Rep-Tiles and Fractals <i>Imameddin Amiraslanov</i>	575
Two Geometric Sculptures with Distant Ontogenies <i>Benjamin Wells</i>	577
The Collapse Series <i>Andrzej Zarzycki</i>	578
Connecting Writing and Contextual Development with Mathematics in Introductory College Math Courses <i>Stan T. Yoshinobu</i>	579
Geometry in Dali’s Painting <i>F. Blanco, E. Reyes, and C. Santamarina</i>	580