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# Mathematics and Computation in Music

8th International Conference, MCM 2022  
Atlanta, GA, USA, June 21–24, 2022  
Proceedings

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# Preface

The 8th Biennial International Conference for Mathematics and Computation in Music (MCM 2022) took place during June 21–24, 2021, at Georgia State University in Atlanta, Georgia, USA. MCM 2022 continued the pattern, initiated in 2007 at the first MCM meeting, of biennial international conferences held on alternating sides of the Atlantic: Berlin in 2007, New Haven in 2009, Paris in 2011, Montreal in 2013, London in 2015, Mexico City in 2017, and Madrid in 2019.

As the flagship conference of the Society for Mathematics and Computation in Music (SMCM), MCM 2022 provided a platform for the communication and exchange of ideas among researchers in mathematics, informatics, music theory, musicology, and related disciplines. It brought together researchers from around the world who combine mathematics or computation with music analysis, music cognition, composition, and performance.

The schedule is available at <https://mcm2022.org/>. The scientific program featured 28 talks and 10 posters, as well as two panel sessions and two plenary sessions. The presentations were grouped around the following subjects: Mathematical Scale and Rhythm Theory; Combinatorial, Graph Theoretic, Group Theoretic, and Transformational Approaches; Categorical and Algebraic Approaches to Music; Algorithms and Modeling for Music and Music-Related Phenomena; Applications of Mathematics to Musical Analysis; Mathematical Techniques and Microtonality.

On the afternoon of June 23, the conference organizers planned a public outreach event at the Museum of Design Atlanta (MODA). The goals were to (1) engage the general public in the area of mathematics and computation in music, and (2) demonstrate to actual participants how effective outreach activities can be implemented.

Four concerts took place, the majority by SMCM researchers. On the first evening, Emmanuel Amiot, Moreno Andreatta, and Giles Baroin presented a public concert-lecture titled “Music and maths: the geometric match”. The second concert was the performance *Positive and Negative Spaces* by the Terminus Ensemble of Contemporary Music. The third concert was part of the *Homage to Jack Douthett*, in which there were performances of Jack’s own compositions for classical guitar by Octavio Alberto Agustín-Aquino, as well as performances by some of his closest colleagues, and a work by Thomas Noll that is based on Jack’s research. The final concert was Emilio Luis Puebla’s concert-lecture, performing Rachmaninoff’s *Faust Piano Sonata Op. 28*.

We received 45 submissions of which 27 long papers and 10 short papers were accepted. All papers were peer reviewed. The submissions came from researchers in 11 countries in North and South America, Europe, and Asia.

We thank the following institutions for providing their infrastructure and human resources for the organization and promotion of MCM 2022:

- Department of Mathematics and Statistics, Georgia State University
- Society for Mathematics and Computation in Music
- School of Music, Georgia State University

- College of Arts and Sciences, Georgia State University
- Museum of Design Atlanta (MODA)
- Universidad Politécnica de Madrid
- Universidad Nacional Autónoma de México
- Universidad Tecnológica de la Mixteca
- Life University

The event was funded by the National Science Foundation, conference grant #2207257. Any opinions, findings and conclusions, or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

June 2022

Mariana Montiel  
Octavio A. Agustín-Aquino  
Francisco Gómez  
Jeremy Kastine  
Emilio Lluís-Puebla  
Brent Milam

# Organization

## General Organizing Committee

Mariana Montiel	Georgia State University, USA
Jeremy Kastine	Life University, USA
Emilio Lluís-Puebla	UNAM, Mexico
Guerino Mazzola	University of Minnesota, USA
Brent Milam	Georgia State University, USA
Octavio Alberto Agustín Aquino	Universidad Tecnológica de la Mixteca, Mexico
Thomas Noll	Escola Superior de Musica de Catalunya, Spain
Robert Peck	Louisiana State University, USA

## Scientific Program Committee

The Scientific Program Committee was responsible for the scientific content of MCM 2022. They coordinated and supervised the reviewing process for the submitted papers and prepared the final list of oral and poster presentations.

Mariana Montiel	Georgia State University, USA
Octavio Alberto Agustín Aquino	Universidad Tecnológica de la Mixteca, Mexico
Francisco (Paco) Gómez	Universidad Politécnica de Madrid, Spain
Jeremy Kastine	Life University, USA
Emilio Lluís-Puebla	UNAM, Mexico
Brent Milam	Georgia State University, USA

## Local Organizing Committee

The Local Organizing Committee consisted of students and other local participants at the conference who helped with logistical issues.

## Reviewers

Carlos Agon	Isabel Barbachano
Octavio Agustín-Aquino	Giles Baroin
Giovanni Albini	Louis Bigo
Aitor Álvarez	Sonia Cannas
Emmanuel Amiot	Norman Carey
Moreno Andreatta	Rodrigo Castro López Vaal

Elaine Chew  
David Clampitt  
Richard Cohn  
Jose Miguel Díaz Bañez  
Andrée Ehresmann  
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Ciro Visconti  
Jason Yust

## **Collaborating Institutions**

Department of Mathematics and Statistics, Georgia State University  
Society for Mathematics and Computation in Music  
School of Music, Georgia State University  
College of Arts and Sciences, Georgia State University  
Museum of Design Atlanta (MODA)  
Universidad Politécnica de Madrid  
Universidad Nacional Autónoma de México  
Universidad Tecnológica de la Mixteca



## **An Afternoon of Math+Music@MODA (Abstract of Invited Talk)**

At the final plenary session of MCM 2019, Paco Gómez discussed the need to promote our field of research through public outreach. In response, in conjunction with MCM 2022, we hosted an event at the Museum of Design Atlanta (MODA) designed to expose the general public to our areas of research, as well as to allow the members of our organization to learn from one another how to implement effective outreach activities in the future.

The event, called Math+Music@MODA, took place at MODA (see [museumofdesign.org/](https://museumofdesign.org/)) on the afternoon of June 23rd, 2022 from 1:30 PM to 4:30 PM. The following activities were presented:

- Jeremy Kastine (organizer of the event) presented an activity about composing canons with monophonic composite texture. Participants learned how this problem can be formulated in terms of finding maximal cliques of a graph.
- Thomas Noll presented “The Collective Public Fourier Performance.” In this activity, three participants control Fourier coefficients by holding flags at varying heights, which are interpreted by mobile devices and processed by a central computer, producing a histogram that indicates how loudly each of seven other participants are to play their assigned note of a diatonic scale.
- Paco Gómez presented “Matherhythm or rhythm is a killer,” which puts forward mathematical content - exact division, division with remainder, greatest common divisor, Euclid’s algorithm and evenness principle - along with musical content - time span, pulse, rhythm formation, and timelines -, and shows how those mathematical ideas can be used as a tool to understand music and also as a principle for composing music. Participants were able to perform music based on these concepts using Boomwhackers.
- Luis Nuño presented an activity about his “Harmonic Wheel,” a physical tool that combines a Tonnetz transformed into a polar grid with a plastic disc containing the lines that define the major, harmonic and melodic minor scales, together with the scale degrees and the symbols of the corresponding seventh chords. The Harmonic Wheel is a powerful and versatile tool for analyzing and composing music, as well as providing an efficient mnemonic notation.
- Maria Mannone presented an activity about the “CubeHarmonic,” a novel musical instrument employing the concept of the triad Tonnetz through the physical manipulations of the Rubik’s Cube. Participants experienced this instrument firsthand through two mobile apps developed by Maria’s colleagues: Takashi Yoshino and Pascal Chiu.
- Gilles Baroin presented a collection of mathemusical virtual reality movies and interactive models. Participants used virtual reality headsets to clearly visualize concepts that would otherwise be difficult to explain and comprehend.

We would like to thank the National Science Foundation and Georgia State University for providing grant funding for this event, as well as the following institutions for

providing space and equipment: MODA, Fulton County Library System, Life University, and Atlanta Public Schools.

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