CONFERENCE REPORT





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Abstract

The annual international Bridges Conference is the preeminent meeting on the connections between mathematics and art, music, architecture, education and culture. Bridges 2022 was held at Aalto University and Helsinki University in Espoo and Helsinki, Finland. This five-day conference included invited and contributed talks, workshops, a juried art exhibition, musical performances, a short film festival, a poetry reading and family day.

Keywords Bridges conference · Math · Art · National museum of Finland

The 25th annual Bridges conference (referred to here as *Bridges Aalto*) was held August 1-5, 2022 in beautiful Espoo and Helsinki, Finland. Jointly sponsored by Aalto University, the University of Helsinki and the University of the Arts Helsinki, the conference took place at Aalto University, with public lectures at Helsinki University, and a family day at the National Museum of Finland. Aalto University professor Kirsi Peletonen skillfully served as local coordinator for the conference. In addition to tireless attention to the day-to-day logistics, she arranged a reception at the Helsinki City Hall and family day at the national museum, venues that gave the conference a nice sense of local flavor and demonstrated the importance of the conference to the region.

This in-person event followed two consecutive virtual on-line conferences during the years of the Covid-19 pandemic. Despite the continued risks of pandemic travel, Bridges Aalto attracted 220 in-person attendees from 29 countries, plus an additional 20 persons who registered to access the livestreamed talks. (Normally, the bridges conferences attract 300 to 350 participants from about 30 countries.) Bridges Aalto

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was the second Bridges conference to be held in Finland, the first being Bridges 2016 at the University of Jyväskylä.

The bulk of the conference was held at the Otaniemi campus of Aalto University in Espoo, Finland, just west of Helsinki. Aalto University was formed in 2010, as a merger of the Helsinki School of Economics, the University of Art and Design Helsinki and the Helsinki University of Technology. The university is named in honor of Finnish architect and designer Alvar Aalto (1898-1975) who designed much of the campus. Indeed, Aalto designed the Aalto University Undergraduate Centre (originally the Helsinki University of Technology main building), which was the main conference venue. See Fig. 1.

The conference opened there on the morning of August 1, with two of a total of six plenary talks. The Reza Sarhangi Memorial Lecture was given by Daina Taimina. Her address, *What I Learned in 25 Years of Crocheting Hyperbolic Planes* was a richly illustrated reflection on one of the main themes of her life's work, creating mathematical models in the fiber arts. This was followed by writer and artist Rudy Rucker. Rucker, considered the founder of the cyberpunk movement in science fiction, entertained the audience with quirky musings on the interconnections between mathematics, computer science, painting and writing.

The first three afternoons of the conference featured paper presentations and workshops. In all, there were 33 regular papers (five given remotely), 50 short papers (12 given remotely) and six workshops, which provided active hands-on experiences. One highlight was Eve Torrence's workshop using origami to build colored topological surfaces that illustrate map coloring theorems.

In addition to the 17 regular and short papers presented remotely, all plenary lectures were livestreamed. Electronic copies of each paper are archived on the Bridges website. (See the link at the end of this article.)



Fig. 1 A Bridges lecture in the main auditorium of the Aalto University Undergraduate Centre, which was designed by Alvar Aalto and completed in 1964. (Photo by Henry Segerman.)



Fig. 2 The Bridges 2022 mathematical art exhibit. (Photo by Bruce Torrence.)



Fig. 3 Knots on $n \times n \times n$ Rubik's cube, by David Plaxco. An artwork in the Bridges art exhibition, his piece is a collection of 15 Rubik's cubes with non-standard solutions, showing all knots through 7 crossings. (Photo by Bruce Torrence.)

The Exhibition of Mathematical Art also opened on the first day, and remained up for the next four days. This year's exhibit was curated by Robert Fathauer and Bruce Torrence, with local arrangements by Taneli Luotoniemi and Markus Holste. A primary component of each Bridges meeting, the art exhibit featured works by 91 artists from around the world. See Figs. 2 and 3. A complete catalog can be found at the Bridges website.

The first evening concluded with a lavish and lively reception at the beautiful and historic Helsinki City Hall, a quick metro ride from the Otaniemi campus.

The second day opened with back-to-back plenary talks by wife-and-husband origami artists Miri Golan and Paul Jackson. Golan discussed the Origamertria Project, which incorporates paper folding into mathematics lessons. Each lesson uses a series of folds to explain concepts while leading to a final origami creation for the children to enjoy. The digital platform has been carefully developed to be easy for teachers to use in lessons and to provide excellent pedagogy. Jackson, a world-renowned paper engineer and origami artist, explained the development of his mirror symmetry collages and summarized the artistic decisions he made over many years to develop this series of works.

After an afternoon of contributed paper sessions and workshops, the day concluded with a reception for Bridges artists.

The morning of the third day saw two more plenary talks. Jessica Wynne discussed the making of her most recent book, *Do Not Erase*, a collection of photographs of mathematicians' chalkboards. Jessica traveled the world to photograph well-known mathematicians and capture the great variety and beauty of their work on chalkboards. She entertained the audience with anecdotes from her many interviews and photo shoots. Next, Andrew Witt's lecture *Formulations: Practices of Architectural Mathematics* explored various aspects of the role of mathematics in architectural design, with fascinating case studies from his design office and recent book. Witt suggests that a fusion of design and scientific processes can open new avenues in design. One fascinating example of this is his use of mathematics and computing to analyze and categorize reclaimed construction materials, and reassemble them in new designs.

The third evening featured Formal Music Night, a Bridges tradition that typically features performances by local musicians. Aalto University graduates Petteri Mäkiniemi and Tuomas Ahvas' performance, *Electronic Soundscapes*, was haunting and minimalist, using layers of sound to create a mellow sonic tapestry.

All events on the fourth day were open to the public, beginning with the morning's plenary addresses at Helsinki University. The first scheduled talk was *The Art of Inverse Problems*, by Helsinki University professor Samuli Siltanen. Although he was unable to attend his presentation because of illness, the audience was nonetheless transfixed by several of his highly entertaining and informative YouTube videos on inverse problems in areas such as tomography, image processing and ancient navigational practices. This was followed by an amusing and engaging performance by stand-up comedian/mathematician Matt Parker. Parker is the best-selling author of *Humble Pi: When Math Goes Wrong in the Real World* and *Things to Make and Do in the Fourth Dimension*.

The afternoon was *Family Day*, a Bridges tradition that is open to the general public and features hands-on workshops for all ages, a short film festival and a poetry reading. This year's family day was held at Helsinki's National Museum of Finland, which offered free admission to all Bridges participants. Completed in 1910, the museum building itself is a stunning edifice designed to reflect Finland's medieval churches and castles. Conference goers divided their time between Bridges events and museum exhibits.

The poetry reading, coordinated by Sara Glaz, included readings or pre-recorded performances of poetry with links to mathematics by some 19 poets.

The short film festival was organized and curated by Bianca Violet, and showcased 11 films selected on the basis of such factors as mathematical content, aesthetic appeal and craftsmanship.

The 2023 Bridges Conference will be held at Dalhousie University in Halifax, Nova Scotia. More details can be found at the Bridges website, www.bridgesmathart. org. The website also has links to all papers, films and artworks from the 2022 Aalto conference.

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