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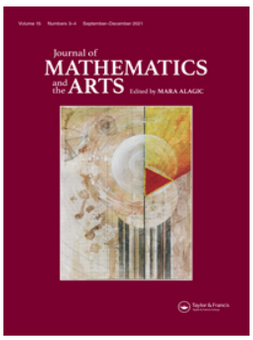

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Benefits of online meetings for the MathArt community: experiences from two events

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ABSTRACT

Recent years saw a rapid increase in conference formats that take place either fully online or in a hybrid fashion with some people on-site and others online. While these formats brought new challenges, they also opened up new opportunities. In the present article, we first outline advantages and disadvantages of different conference formats as discussed in the literature. We then share our own experiences based on two mathematics and art events that occurred during the respective annual meetings of the German Mathematical Society in 2020 and 2021. This is to illustrate the main benefits of online formats, in particular for the MathArt community. We conclude by highlighting two specific aspects – the facilitated presentation of large artworks and the availability of talk recordings – and give a brief outlook on hybrid events.

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Online meetings; inclusiveness; mathematics and arts community

Introduction

Due to the COVID-19 pandemic, several conferences, gatherings and events switched to online formats over the past two years. These formats – initially born out of necessity – brought with them new challenges. While online conferences and meetings have already been conducted before the pandemic, the vast majority of those events was held in-person (Seidenberg et al., 2021). Therefore, there was not much experience with both the organization of and participation in online events to build upon when the pandemic made online events a necessity. Yet, despite the challenges that many members of the scientific community faced, the emergence of online formats also opened up new opportunities. We focus on these throughout the paper. By presenting experiences based on two specific events, we particularly highlight how the MathArt community can benefit from online meetings.

To form a basis for our discussion, we first outline main advantages and disadvantages of in-person and online conferences that have been presented in previous publications. This is followed by an introduction of the two events our experiences are based on. We then exemplify main benefits of online conferences that have been identified in the literature on the basis of five cases, taken from these events. These highlight the specific advantages

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for the MathArt community. Finally, we summarize the key advantages of online meetings and provide ideas for future events.

Online vs. in-person conferences

Literature on the study of academic conferences is generally scarce. Yet, in particular with regard to online conferences, some advantages, challenges and limitations of different formats have been identified (Sá et al., 2019). Before we summarize the main findings, we will briefly define the two common conference formats discussed in this paper: in-person and online conferences.

On the one hand, in-person or face-to-face 'academic conferences provide a social space for people to present their work, learn about others' work and interact informally with one another' (McCarthy et al., 2004, p. 39). Participants travel from different home or work locations to attend these traditional conferences together in-person. Online or virtual conferences, on the other hand, are organized and attended via the internet. The participants can interact both synchronously or asynchronously, via online tools that allow for communication as well as collaboration (Anderson, 1996). Several combination of these two formats are discussed in the literature (for an overview, see Fraser et al., 2017). We will refer to one specific combination as a *hybrid conference*, in which participants can choose to attend either in-person or online. We will briefly come back to hybrid conference formats in the last section.

Sá et al. (2019) analyse and discuss different conference formats regarding their advantages, limitations and potentials. They come to the conclusion that the main advantage of online conferences is the facilitated participation due to omission of travel time and cost. This makes online conferences more inclusive and reduces inequalities. Other advantages of online conferences include the use of technology (given a stable internet connection), the possibility to watch video-recorded presentations asynchronously or after the conference and the reduction of carbon costs.

Despite these substantial benefits, online conferences also have their limitations. In contrast to in-person conferences, informal social interactions remain limited even though several digital tools try to improve the situation. Some conferences integrate online coffee breaks via platforms such as *gathertown* or *topia*, send smaller groups of participants to break-out rooms for informal discussions, and simulate receptions by sending conference packages with wine bottles to the attendees. Still, the network and 'schmooze factor [of in-person meetings] is hard to beat' (Sá et al., 2019, p. 43). However, Seidenberg et al. (2021) found empirical evidence that the overall value rating of social interactions on online conferences is not shifted towards the negative. As a possible interpretation, they state that 'people [might be] aware of the limited informal interaction and personal contact options in the virtual space and, thus, adjust their expectations accordingly' (Seidenberg et al., 2021, p. 1702). Another disadvantage of online conferences is a higher distraction factor due to other daily routines. This holds especially if the time of presentations is not in favour of ones own time zone (Sá et al., 2019). Hence, the consideration of different time zones can be challenging for the organization of the conference.

These (dis-)advantages of online conferences were established in the literature from both theoretical considerations and empirical studies of events in various fields. In this

paper, we strive towards giving tangible examples for the MathArt community. We draw these from two specific events that we will introduce in the following.

The minisymposia 'mathematics and arts'

The German Mathematical Society holds annual meetings, partly together with other societies, such as the Polish or the Austrian Mathematical Society. An integral part of these meetings are the *minisymposia*: smaller events centred around specific topics. Despite the more than 130-year history of the German Mathematical Society, there has not been any such event devoted to the interplay of mathematics and arts before 2020. As active members of the MathArt community, we wanted to change that. Hence, 2020 was the year of birth for the representation of such interdisciplinary interaction at an annual meeting of the German Mathematical Society: The minisymposium 'Mathematics and Arts'. This was followed up by a second rendition during the 2021 annual meeting.

Both minisymposia put a focus on those contributions, in which either artistic works and concepts are considered mathematically or mathematical content is implemented artistically. Furthermore, an emphasis was put on the point that the mathematical components were explicitly elaborated and not assumed to be self-explanatory. This led to 12 presentations in the 2020[1] and 15 presentations in the 2021[2] rendition of the minisymposium. These presentations were given by 36 presenters (sometimes presenting as teams), who came from 12 countries on 4 continents. For further discussion on the minisymposia, see Damrau and Skrodzki (2021a) and Damrau and Skrodzki (2021b).

In the following, we present a report on five selected presentations given at these two minisymposia. While the presentation format of the cases is highly subjective, it allows for insights into the benefits that online conferences have on a personal level. It illustrates the (potential) struggles several speakers (would) have with presenting their work in-person and how online conferences help alleviate or lessen those. More generally, the discussed cases provide concrete examples on how the MathArt community benefits from online conference formats as listed above.

Illustrating benefits of online conferences for the MathArt community based on five selected presentations

David Honda struggles a bit as he lifts his origami sculpture 'Big Boy Blue' in front of the camera. After all, the piece is about 46 centimetres in diameter and weighs about 3.5 kg, see Figure 1. The audience is entranced by the display as David begins to narrate the countless hours he spent crafting the building blocks that finally came together to form the sculpture. This is because unlike traditional origami works that are made from a single piece of paper, 'Big Boy Blue' is made from hundreds of origami elements that are tucked into each other to give the final shape.[3]

It is the result of several coincidences that 'Big Boy Blue' could be presented at a mathematics and arts event in 2020. Being a high-school teacher, it is virtually impossible for David to take time off during teaching periods. Thus, he usually has to wait for conferences to fall onto weekends or holidays to be able to attend. Even then, it is not easy for teachers to scrape together enough money to pay the event registration fees and travel costs, in

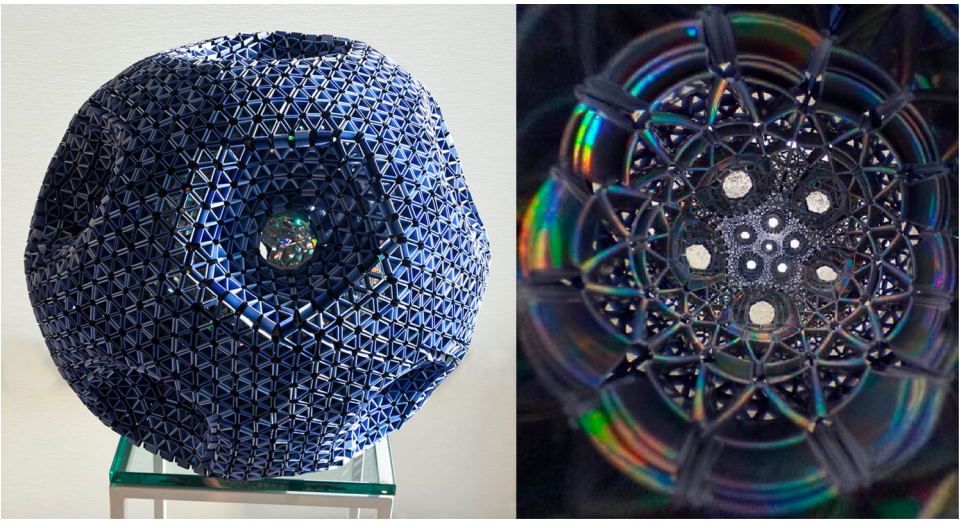


Figure 1. Big Boy Blue (2020), snapology origami sculpture of an 11-holed torus from by David Honda. Photo: ©Yana Mohanty. The left part shows an outside view of the sculpture while the right part shows a spherical image taken from the inside.

particular for international conferences. Hence, only the online format of the event enabled David's participation.

The presentation of David's 'Big Boy Blue' took place in the session titled 'The Artistic Object as Learning Inspiration'. In the same session, there was another example for how an online meeting can be a more accessible format than a traditional in-person conference. This example was given by Demian Nahuel Goos, a young mathematician from Argentina. To Demian, travelling from Argentina to Germany for a conference of just a few days did not seem to be a good use of the – quite limited – travel funds available to him. Also, it appeared somewhat irresponsible given that scientist all over the world try to reduce air travel to minimize their carbon footprint and to combat climate change. Hence, Demian was as excited as David when he heard that the minisymposium would take place online, as this gave him a chance to attend. He presented his work 'Incompleteness', see Figure 2(a), a digitized drawing of Kurt Gödel, printed on a jigsaw puzzle. The puzzle is used by Demian in his teaching: Students are tasked to complete the puzzle, which they cannot, because one piece is deliberately missing. This is representing Kurt Gödel's incompleteness theorem. Furthermore, it gives the students an opportunity of feeling the frustration of not being able to complete the task, a frustration felt by many mathematicians in the early twentieth century when they learned about Gödel's results.

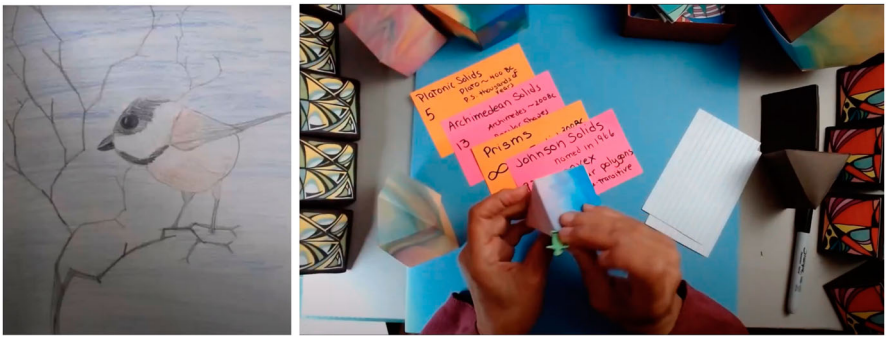
While it would have been possible for Demian to bring his puzzle with him to Germany to present it, packing an entire set of tablet weaving equipment would have proved difficult for Joshua Holden[4]. Tablet weaving is a method of making strips of cloth using very simple equipment. Vertical threads are passed through holes in tablets or cards, as shown on the far-left part of Figure 2(b). The cards are turned to manipulate the structure and pattern of the weave. The characteristic design element of this technique is an angled boundary between areas with stripes in the 'Z' (lower left to upper right) direction and areas with stripes in the 'S' (lower right to upper left) direction, as shown in the centre-left

Figure 2. Artworks by Demian Nahuel Goos and Joshua Holden. (a) 'Incompleteness' (2018), digitized drawing on a jigsaw puzzle by Demian Nahuel Goos. Alluding to Kurt Gödel's famous incompleteness theorem, a piece of the puzzle is missing deliberately and (b) Tablet weaving (2020) by Joshua Holden. From left to right: threads are passed through holes in tablets or cards, characteristic S or Z stripes emerging, a Markov chain simulation and the resulting weaving when following the pattern from the simulation.

part of Figure 2(b) (see Collingwood, 2015, p. 109). Joshua Holden has written a computer programme in the *Processing* language to generate random patterns according to the procedure defined above. A sample output is shown in the centre-right part of Figure 2(b). The far-right part of Figure 2(b) shows an example of the final woven product. A presentation of these aspects becomes quite more understandable if the presenter is able to hold up the weaving tools, just as Joshua did. Showing a prerecorded video of the equipment and its use at an in-person conference limits the presenter to fixed setup. Yet, having the equipment available allows for reaction to audience questions, requests for different viewing angles, or other modifications. This increases the interactivity of the online presentation.

One of the talks in the second rendition of the minisymposium was given by Loretta Walz. She is a practising visual artist based in Canada conducting visual art and animation classes. In the minisymposium, she shared a specific technique she employed in drawing classes with children. Namely, she introduces the learners to a simple mathematical shape grammar which starts with an initial Y -shape. Then, iteratively, straight segments of the current shape are replaced by Y -shapes again to achieve a branching behaviour, see Figure 3(a). This is paired with the children drawing a local songbird from their direct, relatable environment. Using this approach, the drawing abilities of children are easily amplified. Just like David, she does not have an institutional budget to tap into for travelling to conferences and presenting her work. Thus this problem is also encountered by artists, potentially at a worse degree, given their possibly irregular income. Without an institutional budget for travel or conference registration costs, it can be a painstakingly high investment to travel to an event and present their work.

Paula Krieg is another artist from North America. Based in the USA, she creates intricate paper sculptures and develops her own patterns to print and build the sculptures of. Instead of having to either pack the delicate paper structures carefully to travel to a conference or



(a) (b)

Figure 3. A songbird drawing from the course of Loretta Walz and the paper model solids by Paula Krieg. (a) 'Black-capped chickadee' (2019), graphite, watercolour on paper by child of eight years. The tree is clearly following a Y-grammar construction and (b) a demonstration of different solids, performed by Paula Krieg. Starting from the Platonic solids, going via Archimedian solids and prisms (currently shown in hand), she finally arrives at the Johnson solids.

rebuild the necessary material on-site, Paula was able to take the audience on a virtual tour through her workshop. With a camera pointing vertically down to a table, she was able to present her creations in a way such that the audience is able to follow her every move. Consider for instance Figure 3(b), where she illustrates the uniformity of a solid's vertex via a small paper person 'sitting' on said vertex. This camera technology is not readily available in regular seminar rooms. Hence, during an in-person conference, to get up-close with the models, the audience has to wait until the end of the talk to come to the front and examine them. Yet, in an online conference, the models can immediately be shown on a large screen, giving the attendees a sense of direct tangibility.

These examples from the 2020 and 2021 minisymposia show how mathematics and arts meetings can benefit from online formats[5]. These provide the opportunity to bring together a great host of more diverse people more easily than is possible for in-person conferences. The diversity is present in the background of the attendees, their geographical location, and their access to travel funding. In the following, we summarize the main advantages and discuss two more key aspects of online meetings we find beneficial for the MathArt community.

Key aspects for the MathArt community and outlook

In this article, we have concentrated on examples from the two minisymposia on 'Mathematics and Arts' during the annual meetings of the German Mathematical Society in 2020 and 2021. We have shown that online events contribute to an increased inclusiveness as they are more accessible for people with limited travel or time budgets as well as those that have to embark on long-distance journeys to present their work. Additionally the following two aspects have a substantial effect on events of the MathArt community.

A first aspect to mention is the facilitated presentation of large, fragile artworks and equipment. Such cannot be shown easily by the artist at in-person conferences, when shipping is too dangerous for the art of simply too expensive. Hence, presentations are only

possible as video or photo, which strips away all interaction possibilities by the conference attendees. At an online conference, however, it is possible for the artist to be in the room with their artwork and equipment. Thus, they can present it and engage with it directly. During intermediate questions or a Q&A, the presenter can show specific regions of an artwork or repeat a certain process with their equipment, something a prerecorded video does not offer. While this enables the direct presentation of the work by the artist, it does hinder the direct interaction of the audience with the piece, if shipping to the conference is possible.

The second aspect to mention has also been identified in the literature and is important mostly to those who did not attend the meeting or a given presentation. Namely, giving the talks online provides an easy opportunity of recording them. After all, talks have to be given at a certain time in a certain timezone. Thus, even with easy online access as well as low registration fees, people might not be able to listen in, due to other commitments or because the talks are taking place in the middle of the night in their timezone. The recordings preserve the talks for future audiences to go come back to and listen in. Most talks of the two minisymposia are therefore now available to be watched on demand, see DMV Minisymposium "Mathematics and Arts" (2020, 2021). In particular for the MathArt community, this allows to experience the artists' presentation of their artwork, which are frequently more insightful than, e.g. reading an artist statement about it, as the video presentation captures the emotional level – at least to a certain extent.

As discussed in the literature, online events also come with their respective downsides. It is significantly harder to network and especially to meet new people in a pure online setting. This is something that in-person coffee breaks simply do best. Also, playing with small trinkets or puzzles that have been brought by conference attendees and physically examining artwork of a conference-wide exhibit is not possible during online events.

Going forward in the next years, what can we learn from these experiences and how can we incorporate the new, positive aspects into future events? One possibility we want to advocate for are hybrid meetings: Giving presenters the opportunity to attend both in-person and online, depending on their respective availability of funding and time as well as the specific content they want to present. This ensures that events of the MathArt community stay as inclusive as possible, which creates a larger diversity of creators and their content. From this, the entire community benefits.

Notes

1. List of talks 2020: https://ms-math-computer.science/projects/dmv_math_art_20.html.
2. List of talks 2021: https://ms-math-computer.science/projects/dmv_math_art_21.html
3. 'Big Boy Blue' is an example for so-called Snapology origami. It was pioneered by Heinz Strobl (see Goldman, 2011; Strobl, 2010) and it naturally lends itself to exploring various mathematical concepts (polyhedra, convex and concave surfaces, saddle points, topology, etc.) in a tactile way.
4. The following description as well as Figure 2(b) are reproduced with permission from an article presenting several talks from the 2020 minisymposium in a unified framework (see Damrau et al., 2021). For a detailed discussion of the topic see Holden (2021).
5. See Damrau and Skrodzki (2021b) for a more in-depth discussion on the history of interactions of mathematics and arts as well as reasoning for the need of further formats in this interdisciplinary area.

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