## Spatial Audio in Online Presentations
*By Kerry Hagan*

The pandemic forced conferences to evaluate hybrid and online alternatives for academic and artistic presentations. Although many conference activities adapted quickly to online formats, e.g., paper presentations, some elements suffered more severe losses when moved online. In particular, online formats significantly impacted spatial music concerts.

Considering binaural recordings are currently the only method for reproducing spatial music in two channels, it made sense that conferences for spatial music relied on delivering binaural audio in various ways. Previous to ICMC 2022, I attended several online concerts that tried to provide spatial audio. In some cases, artists created VR simulations of their works. VR was especially interesting for spatial compositions with visual elements, but it was a convoluted method for creating binaural recordings for audio-only pieces. Additionally, composers without access to VR engines could not present with this method.

In other cases, the conferences relied on the artists to provide two-channel recordings of their work, and the organizers hosted those recordings. Several participants provided their works binaurally instead of mixing down to stereo. Given that most electronic and computer music audiences would attend online concerts with headphones, the results were relatively acceptable. The onus to encode binaural recordings fell on the composers.

In the case of the *Klingt Gut* festival of spatial music, the organizers acquired the multi-channel works from the composers and used a dummy head for binaural capture in their sound dome. This stream led to a more realistic experience, partly because the dummy head picked up the environment. Adding room noise may be counterintuitive since composers often try to reduce the physical space to create a virtual space in their work. But for an audience member, the experience felt more live, present, and engaging.

Due to this experience, ICMC 2022 organizers chose to stream audio from a dummy head for its spatial audio concerts. The feedback from

online delegates matched the experience of *Klingt Gut*. One audience member also mentioned that there was more intimacy because we positioned the dummy head inside the audience. Therefore, the stream contained environmental noises and applause from the audience's perspective, giving the online delegate a realistic concert experience.

The trade-offs of these different ways of presenting spatial audio online may be apparent. If the host requires composers to mix their binaural versions, some artists may find this restrictive depending on their software, hardware and laboratory access. Also, composers with more knowledge of virtual systems may find it easier than early career researchers or composers who work entirely in audio-only media.
The dummy head solution requires nothing more than what a composer would supply in any other multi-channel presentation. However, despite the positives of audience integration, composers may wish to have more control over the mix than the dummy head provides. Additionally, good dummy head microphones can be prohibitively expensive for concert or

conference organizers.
There is one more factor that none of these solutions address. Spatial concerts delivered online also face the same problem as regular online concerts: streaming audio requires compression, and most streaming services compress audio as MP3 or comparable. Although some online platforms may enable 'original audio', other common platforms compress audio significantly. When combined with the simulation HRTF that binaural audio employs, compression can hurt spatial images. Many composers are vocal in their disappointment with compression through standard channels.
Ultimately, conferences and festivals attempt to provide the best approximation of the in-person experience. Audiences, composers and organizers seem to have different needs regarding online spatial audio concerts, and there currently isn't an ideal solution that satisfies all stakeholders.
ICMC 2022 chose the dummy head solution. The compression that came from streaming didn't impact too severely, though there were some instances where the format was not ideal. Though the pandemic is slowly ending, permitting more

travel, other issues, such as climate change, motivate organizers to continue employing online or hybrid options for delegates. It stands to reason that future research should address the composer and audience experience and the technologies for streaming audio, especially for electronic and computer music and spatial audio.