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ARRAY2024 - (Virtual) Presence in Hybrid Spaces

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Editorial

by Miriam Akkermann

When talking about performing music, the focus is usually set on an audible realization of sonic ideas within a physical space – a concert hall or performance location. However, this physical space has been extended by means of media in various ways on acoustic but also on visual levels, e.g. with the integration of audio recordings, video footage, and real-time implementation of audio-visual processing. With the developments in digital networks and the growing bandwidth for online-streaming, new possibilities opened up to extend concerts and performances to performers and listeners who are no longer necessarily physically present at the concert venue.

Latest since the restrictions imposed by the COVID-19 pandemic at the latest, complete musical performances in virtual space have become a new normal. With this, also performances in what can be called ‘hybrid space’ are emerging. While mostly being defined as emerging from the blending of physical and digital spaces, hybrid spaces also refer to spaces meant to be used for a simultaneous variety of functions (deSouza e Silva, Campbell, Ling 2025). Hereby, online and mobile socially networked spaces

and real-world places are connecting and converging in numerous and complex ways. A key question is how these layers of technology/media and social behaviors can change how we interact, how it affects the characteristics of presence in space but also, what kind of more subtle changes appear with regard to temporality and social behaviors.

Within the realm of musical performances, this leads to several questions: How do new forms and formats for performing music in hybrid spaces look like? What do their structure, new possibility but also probable restrictions mean for performing music and the music performed? What does change for composers, performers – and the audience? How does the very same performance change when being perceived in real, hybrid and virtual space? What does “presence” mean in these different settings?

The interdisciplinary and international Symposium “(Virtual) Presence!? Musical performances in hybrid spaces” explored these questions and was especially interested in bringing together perspectives of humanities research disciplines such as musicology and theatre studies and artistic positions from composers and performers on the staging of the performance, the

aspect of co-creation, the role of music technology, and intended, desired or neglected effects for the audience.

The Symposium took place on July 17th and 18th, 2024 at Freie Universität Berlin, and was organized together with students from the MA Music, Sound, Performance at FU Berlin.¹

This issue presents texts that have been created after the symposium, reacting and reflecting on the discussions at the event, but also extending on connected and ongoing research projects in music research and music practice that explore the boundaries of musical performances in various new spatial settings. It hereby directly links to the issue *Array2022* “Space. A frontier”, which provides a slightly broader perspective on the topic.

Notes

[1] A full program with abstracts is available under www.geisteswissenschaften.fu-berlin.de/we07/musik/Symposium-Virtual-Presence/Final-Programmheft.pdf (24.10.2025).

The symposium and the concerts were enabled by the funds of the Ernst-von-Siemens Musikstiftungsprofessur at Freie Universität Berlin held by Miriam Akkermann.



Figure 1. Poster of the Symposium

References

deSouza e Silva, Adriana, Scott W Campbell und Rich Ling (2025). „Hybrid Space revisited: from concept toward theory“, *Communication Theory* 35 (1), pp. 14–24, DOI: 10.1093/ct/qtac023.

Array2022 “Space. A frontier”, DOI: <https://doi.org/10.25370/array.v2022>.

Opaque Technology and Contemporary Network Arts: Artistic and Technological Strategies

by Juan Parra Cancino

Introduction Vintage Materialities

Period performance technologies are commonly associated with instruments such as pianofortes, gut-stringed violins, and valveless trumpets, as well as other instruments from the early music movement. Yet vintage is not limited to centuries long past, nor does performance technology pertain solely to music. Historical technologies and experimental musical instruments confront us with issues of material reconstruction and performance practice/production.

In this context, my work focuses on the relationship between composers and the tools and techniques used in the electronic music studios of the 1950s, 60s, and 70s, highlighting the tension between creative intention and technical affordance. I focus on identifying those elements, and the performative and experimental actions conducted in the studio during the creative process (loop manipulation, filter operations), to inform performative renditions of these early “fixed” works.

In this translation from aural analysis to physical reenactment, from fixed to dynamic, I put

special emphasis on the design of the instrumental interface for a reimagined performance. The controls that enable recall of performative choices and articulate the negotiation with the limits of the tools at hand are what determine the physical resistance. Whether from a knob, a fader, a button, or a switch, it is this resistance that enables aesthetic effects (and affects) on the performative outcome. A further layer of experimentation between the historically informed and the current is manifested by the incorporation of network technology for the realization of some of these performances. This not only allows the addition of a layer of mediated agency, in a live context, that was only present in the recorded works; it also serves as a reminder that technological means, then and now, leave their sonic imprint even in aspects where they are meant to act as “transparent.”

Virtuosity in Electronic Music Performance

The performative nature of these experimental interpretations invites us to take a closer look at the performer of electronic music. Building on this foundation of historical materialities, it becomes clear that the role of the electronic music practitioner constitutes a hybrid set of skills, a complex interplay of compositional, performative, and techni-

cal affordances. Starting from the notion of the electronic music practitioner as adopter of this hybrid role, I have experimented with the practice of interpretation and performance with electronic media using different strategies (Parra Cancino, 2014). These strategies allow for an experimental approach to interpretation that moves beyond traditional reproduction, opening possibilities for new creative outcomes in performance.

Over the years I have developed three categories to frame these interpretative modes:

- **Gloss:** interpretation informed primarily by compositional insight, reappropriating creative factors to solve musical problems in performance.

- **Analogy:** interpretation grounded in performative skills, reinterpreting a work’s challenges to suit the electronic media used.

- **Simulation:** interpretation based on technical skills such as digital lutherie, reconstructing the technical features and constraints of original setups to preserve their creative friction.

Although useful for research and for the framing of tasks during the development of a project, it is evident that these strategies are often in flux. It is rare that a single aspect of the skill sets required for electronic music performance is sufficient to fully explore the potential of a musi-

cal work. They rather serve as points of intensity that can vary over the course of the process of creating a new experimental interpretation.

Developing a sensibility for navigating and “playing with” these different interpretative skills is what I call virtuosity in electronic music performance, an adjective that transcends its conventional use in traditional instrumental performance, which tends to focus on an analogue of athleticism.

The development of this hybrid performer also presents the challenge of finding a suitable repertoire that either demands or invites such hybrid expertise. Particularly, works that either explicitly involve electronics or allow space for creative electronic reinterpretation (Impett & Parra Cancino, 2020).

Network Technologies: Contemporary Tools and New Possibilities

As electronic music continues to evolve, so do the technologies that shape its performance. A natural extension of this exploration is the use of current network technologies, which introduce new forms of technological friction and creative opportunity. I have engaged with these technologies in two complementary ways: first, as updated tools for reconstructing and performing early electronic repertoire; and

second, as a medium for original works that highlight the aesthetic implications induced by network idiosyncrasies. This dual approach acknowledges how network technologies—through latency, glitches, and spatial distribution—become integral to the creative process. The following case studies exemplify how these contemporary tools reframe seminal works within a telematic context, revealing new dimensions of sonic and spatial complexity.

Case Study 1: On Stockhausen's Solo(s) — Realizing Timbre Complexity Through Telematic Performance

Karlheinz Stockhausen's *Solo für Melodieinstrument und Rückkoppelung* (1965/66) holds a pivotal place in electronic music history for bringing tape delay into live performance. Our rein-

terpretation, developed in collaboration with music technologist Jos Mulder, is entitled *Solo(s)*. It builds upon Stockhausen's original concept by leveraging telematics networks to expand the work's timbral and spatial dimensions. While the original setup involved physical tape delays and three separate technicians' roles, our telematics approach condensed these into a single performer operating a digital system enriched by remote collaborators. By introducing live contributions from networked musicians whose gestures are unseen and sonically transformed, we embrace the coloration and latency inherent to digital media as creative resources rather than flaws (Parra Cancino & Mulder, 2018). This telematics version extends Stockhausen's exploration of instability and risk, preserving the fragile interplay between control

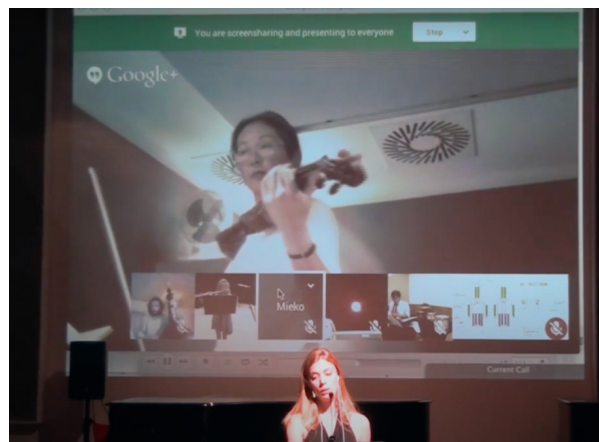


Figure 1. Still from the *Solo(s)* performance during the 2014 Re-search Festival of the Orpheus Institute, Ghent (BE). Performers: Elise Caluwaerts (voice, Ghent, BE), Seikyo Kuroda (shakuhachi, Tokyo, JP), Shoji Wataru (electronics, Tokyo, JP), Mieko Kanno (violin, Glasgow, UK), Brice Soniano (double bass, Vrads, DK), Kirsten Smith (flute, Perth, AU). Live mixing & diffusion by Juan Parra Cancino (Ghent, BE).

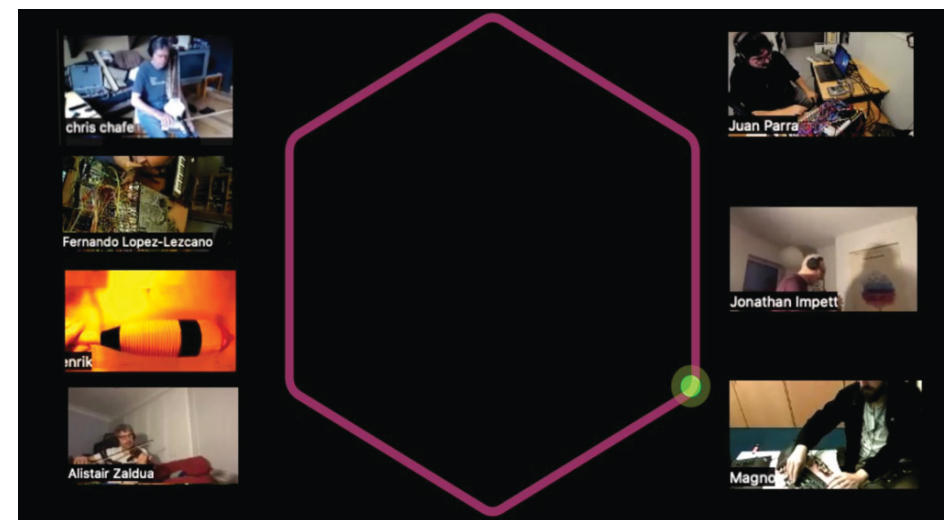


Figure 2. Still from *Second Structure*, NowNet Arts Conference (online), November 1, 2022. Performers: Magno Caliman (harmonica & synthesizer, Brussels, BE), Chris Chafe (dilruba, California, USA), Henrik von Coler (electronics, Berlin, DE), Jonathan Impett (trumpet & electronics, Norwich, UK), Fernando Lopez-Lezcano (modular synthesizer & electronics, California, USA), Juan Parra Cancino (modular synthesizer & network coordination, Ghent, BE), Simon Waters (bass guitar & electronics, Belfast, UK), Alistair Zaldua (e-violin, Manchester, UK).

and chance that defines *Solo*, while creating new sonic assemblages shaped by the network's unique artifacts.

Case Study 2: Rzewski's Second Structure — A Telematics Version

Complementing this exploration of historical works through network technologies offers an investigation into time, improvisation, and compositional thought within the ethos of *Musica Elettronica Viva* (MEV). Formed in

Rome in 1966 by, among others, Alvin Curran, Frederic Rzewski, and Richard Teitelbaum, MEV took inspiration from Tudor and Cage, using contact mics to amplify and expand the sonic palette of a variety of instruments and sounding objects. These were further expanded with a home-made synthesizer and one of the first Moog synthesizers in Europe. According to Alvin Curran, "In the name of the collectivity, the group abandoned both written scores and leadership and replaced them with improvi-



Figure 3. Still from *Artifacts of Not-Here*, NowNet Arts Conference (online), November 7, 2021. Performers: Magno Caliman (analog synthesizer, Brussels, BE), Daniela Fantechi (SuperCollider & piezo microphones, Florence, IT), Nicholas Brown (monochord & electronics, Dublin, IE), Jonathan Impett (trumpet, Ghent, BE), Juan Parra Cancino (electronics & network manipulation, Ghent, BE).

sation and critical listening” (Curran, 1989). MEV’s radical rejection of rigid performer-composer hierarchies and embrace of collective improvisation resonates with contemporary telematic performance practice (Rzewski & Verken, 1969).

Second Structure uses the grammatical concept of tenses to dissolve the boundaries between past, present, and future, enacting a temporal dialogue where memory and anticipation color each sound. Rzewski’s openness to electronic instruments anticipates the real-time transformations enabled by today’s com-

puter-extended instruments. Our telematics reinterpretation extends this by making relationships with time more flexible and explicit: looping, stretching, and reframing gestures are possible in ways that mirror and expand the piece’s original temporal architecture. Moreover, the telematics network adds a spatial dimension, mapping sound between near and remote locations, distributing the “present” across physical distances. This spatial-temporal reframing continues MEV’s spirit of technological exploration while revealing new layers of *Second Structure*’s imagination.

Case Study 3: Artifacts of Not-Here — Embracing Network Limitations as Aesthetic Material

Beyond reinterpreting historical works, current network technologies offer a fertile site for original creative investigation. The glitches, latency, and inconsistencies that arise from the technological limitations of telematic networks constitute a new form of artistic resistance—material obstacles that provoke new sonic gestures and aesthetic forms.

The *Artifacts of Not-Here* project embraces these limitations, treating them not as failures but as productive affects and novel sound objects in their own right. By foregrounding these technological frictions, we open a dialogue between past and present modes of electronic music-making, where constraints inspire invention. This perspective aligns with scholarship exploring the aesthetics of glitch and failure in digital media (Parra Cancino, 2022).

The project’s collaborative networked performances demonstrate how these limitations shape the sonic identity of telematic music today, enriching the palette of artistic strategies available to performers and composers alike.

Conclusion

In retracing the lineage from

early electronic music’s material and technological constraints to the expanded possibilities of today’s networked performances, this article has explored how technological resistance and interpretative virtuosity remain central to the artistic process. The interplay between compositional intention, performative spontaneity, and technical mediation—once bounded by analogue electronics and tape—has evolved into complex temporal and spatial dialogues enabled by telematics networks.

By revisiting the act of performance of works such as Stockhausen’s *Solo* and Rzewski’s *Second Structure* through the prism of contemporary technology, we illuminate not only the continuing relevance of these seminal pieces but also the new creative tensions emerging at the nexus of historical memory and digital innovation. These tensions provoke us to rethink notions of presence, virtuosity, and artistic agency in hybrid performance spaces.

Ultimately, embracing both the affordances and limitations of current network technologies offers a broad space of potential for reimagining electronic music’s future, where glitches and delays become meaningful sonic artifacts rather than obstacles. The performer’s role continuously adapts in response to evolving materialities.

References

Curran, A. (1989). "Musica Elettronica Viva." Nov. 15, 1989. <http://www.alvincurran.com/writings/mev.html>. (last access October 10, 2025)

Impett, J., and J. Parra Cancino (2020). "Thought, Technology and Performance: Lessons from the Future." *Music & Practice* 6. DOI: 10.32063/0604.

Parra Cancino, J. (2014). *Multiple Paths: Towards a Performance Practice in Computer Music*. Doctoral thesis, Leiden University. <hdl.handle.net/1887/29965>.

Parra Cancino, J. (2022). "Artifacts of 'Not-Here'." In *Proceedings of the 2022 International Computer Music Conference ICMC*. Ann Arbor, MI: Michigan Publishing Services. <https://www.fulcrum.org/epubs/8910jx22c>.

Parra Cancino, J., and J. Mulder (2018). "On Stockhausen's Solo(s): Beyond Interpretation." *Leonardo Music Journal* 28: 13-18. DOI: 10.1162/lmj_a_01036.

Rzewski, F., and M. Verken (1969). "Musica Elettronica Viva." *The Drama Review* 14 (1): 92-97. DOI: 10.2307/1144509.

Media (Videos)

Stockhausen's Solo(s) performance, mixed and diffused live by Juan Parra Cancino during the 2014 Research Festival of the Orpheus Institute, Ghent, Belgium, October 2, 2014. <https://www.youtube.com/watch?v=SgYO4XutXKw> (last access October 10, 2025)

Rzewski's Second Structure telematic performance at NowNet Arts Conference (online), November 1, 2022. <https://youtu.be/5YYbEwUOcM0> (last access October 10, 2025)

Artifacts of Not-Here telematic performance at NowNet Arts Conference, November 7, 2021. <https://youtu.be/w271ddQZMd8> (last access October 10, 2025)

In-Game Concerts and Ludo-musical Performances: A Brief Historical Overview

By Karina Moritzen

The story of this research (or, dare I say, its lore) begins at an extreme moment of our collective experience in contemporary society; a point in time overflooded with confusion, uncertainty, fear, and at its ultimate stages, grief. Bruno Latour's (2005) insightful theoretical contributions through Actor-Network Theory provide us with the appropriate tools to better understand the changes in sociability taking place back then: this non-human element, the Covid-19 virus, whose origin is still to this point unknown, affected intensely the flow of a vast array of societies, forcing a large part of the global population into isolation in their own homes, which led to a reshaping of the socio-technical networks that reflected their connections to family, friends, music, video games, scenes, work, leisure, and many other aspects related to daily life.

It was also during this time that our online engagement severely increased, many of us desperate to replace the human connections and collective experiences that we were suddenly required to lack. There were various consequences to this, such as the heightening of economic trends

connected to video games, personal relationship dynamics, as well as the reaction by large social media platforms strongly personified by the rebranding of Facebook into Meta. A symbol of Mark Zuckerberg's high investment into the hype cycle of a supposed "metaverse" that was about to overtake every aspect of our lives, this rebrand failed to achieve its goals. The "metaverse" as it was advertised and parroted uncritically around mainstream media and sections of academia did not materialize. Gamers everywhere were left confused by the buzzword coming out of Silicon Valley which ignored the vast history of virtual worlds dating to the very early beginnings of the internet itself, a great part of it connected to gaming. In the words of Elder Scrolls Online creative director, Matt Firor, cited from an interview (Firor and Sinclair, 2024, GamesIndustry.biz):

"That was last year's buzzword, right? This year it's all about AI and nobody's talking about the metaverse anymore. Metaverses, or what I prefer to call virtual worlds, need to be online communities. There's no reason why Reddit couldn't be considered one; it's a text-based virtual world. My earliest games were text-based, with no graphics at all, and they were very much virtual worlds where

people got together, chatted, and had fun. (...) the critical thing is that the metaverse talk from last year was very much a tech discussion, which is very big in Silicon Valley when you're looking for investment. (...) We've been doing [connected worlds] for 20 years. It's not new, and they should stop treating it like it's new and get input from people who have been doing this a while. (emphasis added)" (Firor and Sinclair, 2024)

This is very much in agreement what I found in my current research project entitled "Playing with In-game Concerts: Ludomusical Performances, Scenes and Hyperpop", in which I conducted semi-structured interviews and participant observation around the titles: BatMUD, Lord of the Rings Online, Minecraft, Roblox and Fortnite. I have contacted players through subreddits and Discord Servers, interviewed them on their playing and performative practices, as well as attended their in-game concerts to record them and later analyze them. In the following, I provide an excerpt of my first chapter, in which I define in-game concerts and conduct a historical overview of ludomusical performances taking place since the 1970's in MUDs (Multi-User Dungeons), a genre of online

gaming worlds which are text-based, tracking them up until the current experiences in contemporary games. I theorize ludomusical performances as they relate directly to in-game concerts; musical performances in and around video games, however, have been explored before by authors such as Dixon (2017), Cheng (2016), Fritsch (2018; 2021), Miller (2012) and Fernandez-Vara (2009).

In-game concerts are here conceptualized as social and immersive experiences that materialize inside online worlds focused on gaming, frequently including mini-games, side quests, exploration, inside jokes, connecting the aesthetics of the artists' to that of the game that hosts them and applying the game's mechanics to the live music situation, amplifying the playful possibilities of sonic engagement. Ludomusical performances, on the other end, are the results of the interaction between player and avatar inside in-game concerts, situations in which the player/artist interacts indirectly with the game developers (Miller, 2012), as the latter rule over the limitations/possibilities of the game's mechanics and affordances, and the first adapt creatively to generate ludomusical expression.

While interviewing player Druidsfire in 2024 (she/her, US

based, 51 years-old at the time of our interview) about her involvement with the Lord of the Rings Online ludomusical scene, I began to see MUD's (Aarseth, 1997) as the early representations of ludomusical performances and in-game concerts. When answering my question about how her relationship to video games began, she told me that:

"we had to role play music in the setting that people couldn't hear, because there was no audio, there was no video for the most part, it was all strictly through text. So **you had to write and express your musicality through text form. (...) I was brand new in the game, didn't really know the rules. I was expressing my music as I was playing a song and in my head, I knew what song I was playing, and I was saying which notes I was playing, the actual notes like B minor, C flat or whatever and that's not what they were looking for. They were looking for something that's more like reading a story in a book. They don't really care what note you're playing, they're trying to say: OK, so and so plays a plaintive chord on their guitar or is playing a doleful beat on their drum or something like that. So it's**

less about the nitty gritty of the music and more about the emotion." (Druidsfire, interview)

I found it fascinating to hear that even in text-based online gaming worlds, players discovered forms to perform musically. These text-based ludomusical performances can be understood under the lenses of sonic virtuality, an idea discussed by Grimshaw and Garner (2015, p. 31), when they state that "the thinking of sounds, the imagining of sounds, and all forms of what are typically described as auditory illusions or hallucinations are in themselves sound". In order to understand how these concerts began to take form, I researched in-depth the academic writing that is placed under the moniker of "virtual worlds". I also e-mailed Richard Bartle, one of the creators of MUD1, a game so influential that it became the name of a whole genre of virtual worlds. He confirmed to me that people would type songs as if they were singing them; unfortunately, he had no records to share with me, as the memory limitations during the 1970's meant, that, to keep these records, one would need to either print them or purchase expensive recording devices. I moved on to the subreddit r/MUDs, where I asked for examples of ludomusical performances described through text

inside gaming worlds. This is how I met research participant Amarth, one of the developers of BatMUD, a game dating from 1990, still up and running in 2025. Amarth shared with me old playing records that allowed me to analyze ludomusical performances such as the following:

The play is started by Tanta at Sun Apr 03 19:24:47 2005
 Sprite as herself
 Tanta as himself
 Kratos as himself
 [Tanta]: Tanta Enters to bar.
 [Tanta]: Tanta plays loud guitar furiously!
 [Tanta]: Tanta plays loud guitar furiously!
 [Tanta]: Tanta plays loud guitar furiously!
 [Kratos]: O_o goes Kratos
 [Tanta]: Tanta shouts 'what is this noise?'
 [Tanta]: Tanta shouts 'I really don't know but i don't like this!'
 [Tanta]: Tanta shouts 'I can silence that rage.'
 [Tanta]: Tanta sings few relaxing tones.
 [Tanta]: Tanta plays guitar slowly and softly.
 [Tanta]: Tanta says 'its working.'
 [Tanta]: Tanta says 'i couldn't taken this much longer.'
 [Tanta]: Tanta finally stops playing and climbs down from stage.

The play is ended by Tanta at Sun Apr 03 19:26:55 2005

The example above portrays a ludomusical performance taking place in BatMUD. The character describes literarily their performance, expressing rage and later self-control; clearly not in music theory terms, but in the form of adjectives and adverbs. Not every ludomusical performance is meant to evolve and collect more points inside the game. However, in BatMUD, these performances are also directly connected to the game-play. The bard's guild is required to undertake a successful ludomusical performance in order to advance their characters. These moments happen inside a separate auditorium in which players can perform for an audience watching from another digital room, so that their (again, text-based) chatter will not disturb the performers.

When graphics evolved and audiovisual gaming worlds appeared, ludomusical performances advanced and achieved new peaks of audience engagement and media reporting. As someone who was a music fan and not at all a part of gaming culture, I started this research by reading headlines in specialized magazines relating to Travis Scott's Fortnite in-game concert (Brown, 2020) and the independent events happening inside

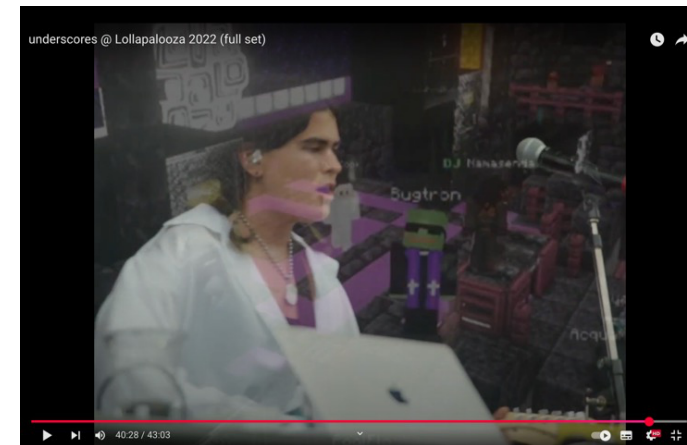


Figure 1: underscores's 2022 Lollapalooza set. Available at: www.youtube.com/watch?v=uZopR_Ai-III&t=2428s (last access Sept. 28th 2025).

Minecraft. These socio-technical networks (in Latour's terms) around in-game concerts are connected to the appearance of ludomusical scenes, in which member's engagement with music and videogames becomes the central focus of sociability, as I found in Lord of the Rings Online and Minecraft. In the Minecraft case, these ludomusical scenes served as catalysts to the development of Hyperpop, a label that has influenced the U.S. music industry through artists such as 100gecs and underscores. This statement can be exemplified in material terms by underscores' offline performance at Lollapalooza in 2022, in which she airs footage of Minecraft in-game concerts.

Tracking this history of digital sociability can be seen as a way to avoid falling into the hype cycles advertised by Silicon Valley

in search of a never ending influx of investment into at times unhelpful and uninteresting technologies. Through the collection of my research results, I conclude that players have been resorting to musical playfulness since the early records of online gaming, proving that sonic entanglements between music and games are an intrinsically part of play, refusing the idea that in-game concerts were a timely distraction to the overall limitations imposed by the Covid-19 pandemic.

References

- Aarseth, E. (1997). *Cybertext: Perspectives on Ergodic Literature*. Baltimore, Md., Johns Hopkins University Press.
- Bartle, R. (2010). "From MUDs to MMORPGs: The History of Virtual

Worlds". In: Hunsinger, J., Klas-trup, L., And M. Allen (eds.), *International Handbook of Internet Research*. Springer.

Brown, F. (2020). "Travis Scott's Fortnite show had a record-breaking number of players". *PC Gamer*. Available at: <https://www.pcgamer.com/travis-scotts-fortnite-show-had-a-record-breaking-number-of-players/> (last access June 15, 2025).

Cheng, W. (2014). *Sound Play: Video Games and the Musical Imagination*. New York: Oxford University Press.

Consalvo, M. (2011). "MOOs to MMOs: The Internet and Virtual Worlds". In: Consalvo, M., and C. Ess (eds.), *The Handbook of Internet Studies*. Blackwell Publishing Ltd.

Dixon, S. (2007). *Digital Performance: A History of New Media in Theater, Dance, Performance Art, and Installation*. Cambridge: The MIT Press.

Downey, S. (2014). "History of the (Virtual) Worlds". *The Journal of Technology Studies* 40 (2): pp. 54–66.

Fernandez-Vara, C. (2009). "Play's the Thing: A Framework to Study Videogames as Performance." *DiGRA International Conference: Breaking New*

Ground: Innovation in Games, Play, Practice and Theory (September 2009).

Fritsch, M. (2021). "Game – Music – Performance: Introducing a Ludomusicological Theory and Framework". In: Fritsch, M., and T. Summers (eds.), *The Cambridge Companion to Video Game Music*. Cambridge University Press, pp. 238–262.

Fritsch, M. (2018). *Performing Bytes: Musikperformances der Computerspielkultur*. Würzburg: Königshausen & Neumann.

Latour, B. (2005). *Reassembling the Social: An Introduction to Actor–Network–Theory*. Cambridge: Oxford University Press.

Miller, K. (2012). *Playing Along: Digital Games, Youtube and Virtual Performance*. New York: Oxford University Press.

Games

Balanced Alternative Techniques. (1990). *BatMUD*. Online Game.

Richard Bartle and Roy Trubshaw. *MUD1*. Online Game.

Turbine. (2006). *Lord of the Rings Online*. Online Game.

Sound, Ritual, and Presence in the Age of Telematic Dialog: A Polyphonic Conversation Across Distance

By Paulo C. Chagas and Cássia Carrascoza

Introduction

In a time when digital communication often substitutes for presence, and the screen mediates both intimacy and creation, music emerges as a paradoxical force—disembodied and yet deeply embodied, ephemeral and yet enduring. *Sound Imaginations: Telematic Immersion*, our recent collaborative project (Chagas and Carrascoza 2025a; 2025b), explores this paradox by engaging with sound, image, and gesture across space and time.

What does it mean to perform together when togetherness itself is technologically reconstructed? How does electronic sound alter not only the materiality of music but also the very way we perceive, feel, and think through it? Can rituals still emerge in a digital world, and what forms of presence are possible when bodies are no longer co-located?

This account centers on three guiding terms: sound, ritual, and presence. Over four years (2020–2024), we developed a telematic project that revealed new insights into our way of making music and presenting it

to audiences. In this context, sound is the primordial matter of music, experienced in acoustic, electroacoustic, and virtual forms.

In this project, the acoustic sound is produced by Cássia Carrascoza on the flute(s); this sound is captured by microphones, transmitted over the network with JackTrip as uncompressed, low-latency audio, processed electronically by Paulo C. Chagas, and finally re-projected online for the audience. Telematic music does not have a physically present audience nor the immediate feedback typical of traditional live performance. During social isolation, we built a telematic dialogue that became a space for artistic research and intense interaction. As Brazilian musicians, we brought the socializing spirit of our culture into the virtual environment. We involved musicians, technologists, and colleagues in exchanging ideas, holding open rehearsals, performing works by friends, and experimenting with creative processes.

In 2021, we created a project involving undergraduate students from the University of California and USP, marking the start of what would become the *Ensemble Telemático LaFlauta*. Between 2021 and 2024, Carrascoza served as Visiting Scholar at the University of California, Riverside, at Chagas's invitation, par-

ticipating in his remote graduate seminars—an experience that significantly deepened our joint research.

From 2023 to 2025, Carrascoza received support from FAPESP (São Paulo Research Foundation) for the research project *Telematic Music: Connectivity in Virtual Environments*, which equipped the LaFlauta Telematic Studio and supported a series of events, including telematic concerts, an in-person performance at ICMC 2023 (Shenzhen), and solo performances with live-electronics.

In 2024, we presented two *Virtual Studies* and *Mojave* at the international symposium “(Virtual) Presence!? Musical Performances in Hybrid Spaces” in Berlin. We also produced the film *Sound Imaginations: Telematic Immersion*, recorded entirely through telematic means with high audiovisual quality and professional post-production. The film premiered in Riverside in November 2024, concluding this creative cycle of the duo.

Rather than offering a unified thesis, this text unfolds as a polyphonic conversation across distance. We propose five central topics, each taken up in turn from Paulo’s perspective as composer (PC) and from Cássia’s as composer-performer (CC). Speaking from different yet intertwined positions—including the role of composer-videographer—we explore how telematic

music-making opens new avenues for sonic thought, emotional connection, and aesthetic form. Our responses alternate, at times echoing, diverging, or converging in a dialogic structure that reflects the collaborative spirit of the work itself.

Sound and Perception in the Telematic Medium

PC: The electroacoustic paradigm marks a decisive shift in how we perceive and relate to sound, as I argue in *Sound, Truth, and Paradigm* (Chagas 2021). Electronic sound does not merely extend or distort acoustic sound; it transforms our cognitive and perceptual frameworks, detaching sound from its immediate source and introducing new layers of abstraction, mediation, and spatial ambiguity.

The telematic paradigm furthers this transformation by redefining presence and simultaneity. Popularized during the COVID-19 pandemic, telematic performances blurred the boundaries between live and recorded music, revealing how digital mediation alters expectations of real-time experience. In such contexts, the distinction between a synchronous performance and an edited recording often becomes irrelevant, challenging our sensory grasp of “liveness.”

Delays, data compression, and transmission artifacts introduce

temporal and spatial discontinuities that disrupt traditional musical synchrony. This rupture has prompted new compositional strategies that embrace asynchrony as a structural principle. Chris Chafe’s concept of “imaged sound” (Chafe 2021) aptly describes how musicians mentally reconstruct the sonic whole when technological mediation occludes parts of the acoustic field. Telematic music, then, invites a reimagining of simultaneity—not as uniform time, but as a negotiated presence across distributed cognitive fields.

CC: In the interaction between acoustic instruments and digitized sound, a temporal gap arises between the emission of the acoustic sound and its return through monitors or headphones. This creates a perceptual alteration related to time: the resonance time of sound in the physical space is combined with the temporal layer of the digital environment, which may or may not be modulated. In the context of telematic performance, this relationship becomes even more intense: the resonance time in the performer’s physical space coexists with the time of the transmitted and modulated sound in the telematic environment, where audio latency is a constant. The virtual space, therefore, has its own acoustic properties, which

are gradually learned by the performers. As Chafe (2018) affirms, the acoustics of the internet must be understood as a specific medium—just like air or water—capable of shaping the immersive experience of each musician involved in networked performance.

A fundamental aspect of this collaboration—beyond the audio apparatus—was the construction of a home studio dedicated to video transmission. In this space, tools such as chroma key, video camera, computers, and audio and video interfaces were used to configure the virtual stage, which we adopted as the main space for instrumental performance. In this context, the virtual stage demands deep emotional integration that goes beyond the sonic dimension and encompasses the body, image, and presence in performance.

Ritual and the Virtual

PC. Telematic music reshapes the ritualistic dimension of musical performance. Drawing from Byung-Chul Han’s *The Disappearance of Rituals* (Han 2020), rituals are understood as symbolic repetitions that structure time and make the world habitable. In contrast, neoliberal logic displaces these practices with compulsive productivity and data accumulation. Telematic music, by resisting this trend, becomes

a site for reclaiming ritual through mediated presence.

Music historically operates as ritual, shaping collective and individual identity. As Saint Augustine observes in *Confessions* (Augustine n.d.), sound powerfully moves the soul, revealing music's capacity to bind inner experience with outer expression. Jacques Attali's categories of music—from ritual sacrifice to representation, repetition, and composition—help trace this evolution, situating telematic music within a new phase of distributed ritual (Attali 1985).

Building on Vilém Flusser's notion of the "telematic society" (Flusser 2011), I see telematic dialogue not as a passive transmission of content but as a creative partnership between humans and technical apparatuses. Unlike the embodied synchronicity of string quartets, telematic rituals unfold across distances, where liveness is redefined by interaction with machines. In *Sound Imaginations: Audiovisual Immersion*, we explore how gesture, sound, and space generate a shared ritual—one grounded not in physical co-presence but in symbolic and cognitive resonance.

CC: Musical performance can be understood as a form of ritual. As Nicholas M. Hobson and colleagues state, "In rituals, the most ordinary of actions and

gestures become transformed into symbolic expressions, their meaning reinforced each time they are performed" (Hobson et al. 2017, 1).

Concerts, in this sense, may be interpreted as ritual practices involving technical and emotional preparation, the construction of the performer's self-image, and the relationship established with the audience. These are performative cycles in which the repetition of gestures and actions enhances their symbolic significance.

In telematic performance, however, additional layers of gestuality emerge: the interaction with technical devices, the absence of a physically present audience, and, most importantly, the remote connection with other performers. In this context, technology-mediated interaction can assume spiritual and ritualistic dimensions, as Roy Ascott suggests (Ascott 2003), framing the artistic experience as an expanded field of sensitive presence and shared transformation.

Presence and Absence

PC: Katherine Hayles (1999), in *How We Became Posthuman*, proposes a semiotic square contrasting presence and absence with randomness and pattern, challenging the notion of stable human subjectivity (idem, 248).

In the telematic paradigm, this shift is palpable: presence is no longer tethered to physical co-location but emerges through distributed cognition and mediated interaction.

Telematic performance reframes presence not as immediate embodiment but as affective and symbolic connectivity across space. In this sense, absence becomes constitutive of presence—what is not seen or heard is imagined and compensated by mental reconstruction. Hayles' concept of the "cognitive non-conscious" (Hayles 2017) deepens this view, emphasizing how cognition is not limited to conscious thought but arises through hybrid human-machine systems. The performer and listener become nodes in a shared, dynamic field of distributed agency.

This reconfiguration undermines the humanist ideal of autonomous subjectivity and supports a post-human model in which embodiment is plural, mediated, and partial. In telematic performance, co-presence is not diminished—it is reinvented through new temporalities, affective states, and collaborative imagination.

CC: A central aspect of our work concerns the notion of presence in the virtual environment. We constantly see ourselves reflected on the screen: we are, simultaneously, participants and

spectators of ourselves on the virtual stage.

Our visual compositions explore layered images of myself, with which I interacted throughout the execution of the pieces. *Mojave* and *Virtual Studies*, in particular, were visually constructed from a video of an improvisation I performed in the Mojave Desert—a moment of deep integration with the landscape, in which solitude within vastness, together with the visual and sonic elements of the environment, became, for me, a ritual.

This recording was created as part of a collaboration with Chagas' ongoing research on audiovisual immersion and was integrated into that investigative context. Composed of noise, sounds, voice, and bodily performance in the desert, the improvisation—captured using the project's technical equipment (Insta360 camera and Sennheiser Ambeo ambisonic microphone)—became the starting point for the visual and electronic composition of the piece, marking the beginning of our artistic collaboration.

As part of our collaborative research, we also worked on the piece *I Hear You Breathe* (2022) by Paulo C. Chagas. In São Paulo, I created a visual performance recording in which I developed a kind of ritual by painting my face white, transforming it into a mask. I also explored a very lim-

ited physical space to produce images that brought together parts of my body and the bass flute, constructing a dramaturgy of minimal movements and using the camera as a catalyst for proximity with the audience.

Chagas processed the video with TouchDesigner, applying a feedback algorithm that introduced visual delay and generated a new visual narrative. This treatment produced multiple combinations of bass flute and body while exploring different perspectives and amplifying the minimal movements captured in the original recordings.

In the telematic performances of *I Hear You Breathe* by Chagas, the live performance is superimposed onto images of multiplied presence, unfolding layers of time and space through overlays that represent the act of playing the bass flute both in the present and the past. For example, the close-up of the mask's eye produces a vector of meaning that extends beyond its boundary by directing attention toward the audience. This establishes a dialogue between physical presence and absence within the virtual space.

Collaboration and Trust

PC: Telematic music disrupts traditional notions of collaboration, which have historically relied on physical proximity and

hierarchies of authority. In the telematic space, composer and performer must negotiate distance through trust, intuition, and shared vulnerability. This shift decentralizes control and fosters a co-creative ethos in which roles become fluid.

Rather than following the conventional score-to-performance model, telematic collaboration often unfolds in real time, mediated by technological interfaces. The performer becomes an interpretive partner, shaping the work as it emerges. Such interactions challenge the idea of the composer as sovereign and highlight the necessity of openness to contingency, dialogue, and mutual adaptation.

In this context, trust is not only interpersonal but also technological. One must trust that systems will function, that sound will transmit, and that meaning will emerge despite latency, compression, or signal loss. This layered trust enables a unique form of artistic intimacy—one that bridges distance without collapsing it and redefines presence as an ongoing act of negotiation rather than a given state.

CC: The central issue in contemporary collaborative music practices is not necessarily the physical presence of the composer in the same space as the performer, but rather the nature of the collaboration itself. In col-

laborations of a technical nature, physical co-presence is not essential. However, in contexts of collaborative performance—where composer and performer act simultaneously and in an integrated manner, as in our telematic work—elements such as intuition, trust, and vulnerability in relation to technological interfaces become part of the performance dynamic.

In these situations, presence is not confined to the physical body but expands into a relational presence, as proposed by Roy Ascott (2003) in his concept of the telematic embrace, in which the artistic act unfolds within a network of connected consciousnesses, shaped by empathy, openness, and mutual transformation. This idea contributes to the understanding of how the technical environment may also become a space of sensitivity and affect.

Composition, Improvisation, and Co-Creation

PC: In *Noise*, Jacques Attali (1985) critiques music's function as a tool of social control, especially under regimes of repetition. Susan McClary (1985) expands this critique by exposing how musical forms encode gendered power dynamics, often rendering the composer's voice dominant and the performer's role submissive. These critiques resonate in the operatic narrative

of Bluebeard's Castle, where control, secrecy, and silencing operate as metaphors for patriarchal domination.

The telematic paradigm disrupts this power dynamic. With its emphasis on decentralization and co-creation, it challenges the composer's authoritative role and opens space for shared authorship. In our project *Sound Imaginations: Telematic Immersion*, improvisation functions as a dialogic practice that resists domination, foregrounding trust, vulnerability, and mutual listening (Chagas 2025). Rather than following precomposed scripts, performer and composer engage in real-time negotiation, shaping a piece that is contingent, emergent, and inherently plural.

This shift also reflects a broader ethical transformation: from control to collaboration, from authorship to relational presence. Flusser's notion of the apparatus as a site of freedom-in-constraint finds expression here, as improvisation within technological systems becomes a practice of emancipation. In this context, freedom is not pre-given but continuously constructed through the very act of making music together—across bodies, across distances, and beyond the boundaries of traditional musical roles.

CC: In a telematic environment, the creative process between

composer and performer becomes more intertwined than in face-to-face collaboration. Spending time together—especially during the early stages of creation—is essential. The virtual stage is not a given space; it must be imagined, constructed, and ultimately functions as a structural element of the narrative.

In our work this became particularly clear. The visual aspect of the live performance had to merge organically with the pre-recorded videos. In this context, live performance is also a video—a layered construction involving physical, sonic, and emotional presence. For such a narrative to emerge, an ongoing and mutual exchange of ideas was indispensable.

I see performance as an integral part of artistic creation in this format. The virtual stage is itself a performative construction—without it, immersion would not be possible. Composition, in this context, requires deep collaboration based on mutual recognition and a renunciation of fixed hierarchies between composer and performer. Creation happens in a space of listening, openness, and true co-authorship.

Improvisation was present throughout our collaboration, culminating in *Sound Imaginations Improvisations*—a fully improvised 28-minute piece in-

spired by your previous research. In that case, musical creation became my responsibility, and I consider it a genuine collaborative act. However, the recognition of improvisation as a creative practice is still challenged. George Lewis (2000) discusses how the dichotomy between composition and improvisation reflects a constructed asymmetry in Western musical culture, where composers are seen as “bringers of structure” and improvisers as sources of “effortless spontaneity,” often devaluing the latter.

Conclusion

The central concept of our telematic project was audiovisual immersion, aiming to emphasize the experience of presence through the convergence of sound, image, and performance. We focused on exploring images of Cássia’s performance, multiplied by the visuals in the videos. The emphasis was on the performer and the performance, keeping the technology invisible.

Our goal was to refine the audiovisual environment while creating the impression of live performance (liveness). We reached such a level of sophistication that viewers often could not tell whether they were watching a pre-recorded video or a real-time performance. In some concerts, we opened the camera to show the setting and confirm

that we were playing live. Still, the question remains: how can we create a high-quality immersive audiovisual performance while clearly conveying its “live” nature to the audience?

This experience also led us to reflect on the ethical and social foundations of telematic music. Such performances require fast, stable internet connections and equipment like computers, interfaces, and microphones—resources unavailable to many communities. Does telematic music expand or restrict freedom of communication and expression? Does it open new possibilities for creative participation or reproduce the exclusion mechanisms of hegemonic power centers?

As Vilém Flusser (1983) notes, technological apparatuses contain a fundamental ambiguity: on one hand, they open new experimental possibilities; on the other, they impose limits through their programs, inducing automatic behaviors and suppressing critique. This contradiction applies directly to the telematic music environment.

In telematic practice, listening gained new depth. Without physically co-present eye contact or gestures, we developed an expanded listening—affffective, cognitive, and embodied—capable of perceiving nuances and anticipating intentions. We learned to trust sound as a

medium of connection and affection, and silence as a fertile space for co-creation. Listening not only enabled the performance but became a compositional space in its own right.

Ultimately, this experience taught us that presence is not just a physical condition but a continuous gesture of attention, listening, and care. Making music at a distance—as we did for four years—means imagining the other, touching and being touched beyond matter. The virtual stage has become, for us, not a substitute for the real but a space of aesthetic and human transformation, where sound, image, and gesture intertwine in new ways of being together.

Acknowledgments

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Music

Paulo C. Chagas and Cássia Carrascoza (2020/21), *Mojave*, P. Chagas: live video; live electronics; C. Carrascoza: live flute
Permalink:
<http://mediathek.slub-dresden.de/vid90004387.html>

Paulo C. Chagas and Cássia Carrascoza (2022), *I hear your*

breath, P. Chagas: live video; live electronics; C. Carrascoza: live flute
 Permalink:
<https://mediathek.slub-dresden.de/vid90004395.html>

References

Ascott, R. (2003). *Telematic Embrace: Visionary Theories of Art, Technology, and Consciousness*. Berkeley: Univ. of California Press.

Attali, J. (1985). *Noise. The Political Economy of Music*. Translation: B. Massumi. Minneapolis, MN: Univ. of Minnesota Press.

Augustine, S. (n.d.). *Confessions*, Book X, Chapter 33. Logos Virtual Library. <https://www.logoslibrary.org/augustine/confessions/1033.html> (last access July 20, 2025).

Chafe, C. (2018). "I Am Streaming in a Room." *Frontiers in Digital Humanities* 5: Article 27. DOI: 10.3389/fdigh.2018.00027.

Chafe, C. (2021). "The Qualities and Flow of Imagined Sound and Music." In Paulo C. Chagas, P. C. and C. Wu (eds.), *Sounds from Within: Phenomenology and Practice*, Cham: Springer Nature, pp. 57–73.

Chagas, P. C. (2021). "Sound, Truth, and Paradigm." In Paulo

C. Chagas, P. C. and C. Wu (eds.), *Sounds from Within: Phenomenology and Practice*: 1–28.

Chagas, P. C. (2024). "From Sacrifice to Telematics: On Music and Ritual." *Roczniki Humanistyczne* 72 (12): 69–79. <https://doi.org/10.18290/rh247212sp.6> (last access July 20, 2025).

Chagas, P. C. (2025). "Audiovisual Immersion: Exploring Telematic Rituals." *Journal SEAMUS* 34 (1–2): 22–32. https://seamusonline.org/wp-content/uploads/2025/06/Journal_SEAMUS_Vol_34.pdf (last access July 20, 2025).

Chagas, P. C., and C. Carrascoza. (2023). "With Love: Electroacoustic, Audiovisual, and Telematic Music". In M. Aramaki et al. (eds.) *Music in the AI Era*. Cham: Springer Nature, pp. 312–20. DOI: 10.1007/978-3-031-35382-6_24.

Flusser, V. (1983). *Für eine Philosophie der Fotografie*. Göttingen: European Photography.

Flusser, V. (2011). *Into the Universe of Technical Images*. Translation: Nancy Ann Roth. Minneapolis: Univ. of Minnesota Press.

Han, B.-C. (2020). *The Disappearance of Rituals: A Topology*

of the Present. Translation: Daniel Steuer. Cambridge: Polity Press.

Hayles, K. (1999). *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*. Chicago: Univ. of Chicago Press.

Hayles, K. (2017). *Unthought: The Power of the Cognitive Non-conscious*. Chicago: Univ. of Chicago Press.

Hobson, N. M., et al. (2017). "The Psychology of Rituals: An Integrative Review and Process-Based Framework." *Personality and Social Psychology Review* 21 (3): 263–285. DOI: 10.1177/1088868317734944

Lewis, G. E. (2000). "Too Many Notes: Complexity and Culture in Voyager." *Leonardo Music Journal* 10: 33–39.

McClary, S. (1985). "Afterword: The Politics of Silence and Sound." In Attali, J. (Ed.), *Noise*, pp. 149–158. Minneapolis, MN: Univ. of Minnesota Press.

McClary, S. (2002). *Feminine Endings: Music, Gender, and Sexuality*. 2nd ed. Minneapolis, MN: Univ. of Minnesota Press.

Media (Videos)

Chagas, P. C., and C. Carrascoza. (2025a). "Sound Imaginations:

Telematic Immersion – Complete Film – Sequence 1." YouTube video, 1:17:20. February 14, 2025. Published on Cássia Carrascoza's channel. https://youtu.be/_2AObafmjm8 (last access Oct. 6, 2025).

Chagas, P. C., and c. Carrascoza. (2025b). "Sound Imaginations: Telematic Immersion – Complete Film – Sequence 1." YouTube video, 1:17:20. April 24, 2025. Published on P. C. Chagas's channel. <https://youtu.be/x4QsFAx6Yy8> (Last access Oct. 6, 2025).

The (f)utility of immersive experience in a live classical concert with extended reality: A comment on Lee's unified conceptual model

by Mats B. Küssner, Gina Emerson, Christian Stein and Till Schwabenbauer

Between November 2024 and January 2025 concertgoers gathered in Karlshorst in the east of Berlin to witness a short excerpt of live music from Gluck's *Orpheus and Euridice*, performed by the JungesKammerEnsemble of the Schostakowitsch-Musikschule Berlin-Lichtenberg, in a special setup: once with virtual reality (VR) headset and once without (see Figure 1). The goal of our community-based concert series, Orpheus Reimagined, was to find out how extending the physical reality of a live classical concert with VR elements would affect concertgoers' overall experience and appreciation. Would they accept wearing a VR headset during a concert? To what extent would emotional, aesthetic and social processes of the concert be altered, augmented or attenuated? Would audience members feel immersed?

Although VR technology is not new, the use of virtual or augmented reality in Western classical concert settings is a recent development, with scarce empirical evidence of how such settings change the perception and

cognition of audience members and performers (Colotti, 2021; Selfridge & Barthet, 2019). The greater use of digital media in concert experiences has been driven in part by what Kavanagh (2018) describes as the "promise of the digital" for classical music institutions such as orchestras and concert halls: the possibility of reaching new audiences through new forms of distribution, mediation, and presentation. Blending physical and virtual elements or environments in live concerts leads to a sheer infinite number of possible configurations – and similarly varied are the mental states in which VR users find themselves. One key psychological concept associated with extended reality (XR), which is often used to refer to the broad range of virtual and augmented reality (AR) applications, is immersion. In a recent theoretical article, Lee (2025) discusses the concept of immersive experience in relation to other important terms that are commonly found in the literature, such as presence, involvement, or flow. The aim of his new "unified conceptual model of immersive experience in extended reality" is to provide a coherent framework for researchers interested in studying immersive experience in XR settings. Although much of the literature covered in his review is situated in gaming studies, he also draws on examples of XR in



Figure 1. A performance from the Orpheus Reimagined concert series in action: Each concertgoer experienced the musical excerpt once with and once without extended reality. The average number of concertgoers per concert was nine (range: 4–17), not counting under 18s who were not eligible to take part in the main study. (Photo taken on Nov. 16, 2024 by Mats Küssner).

musical performances (such as a hypothetical example of an AR orchestral concert; Lee, 2025, p. 4). The model proposes that immersion is a result of three core elements that are brought about by immersive systems and content: 1) physical presence, 2) social presence/self presence, and 3) involvement, which are interconnected through narrative engagement, sensorimotor engagement, and task/motor engagement.

The aim of this essay is to apply this new model to our Orpheus Reimagined concert series with a view to critically reflecting on the three core elements and the immersive system/content in a virtually extended live music setting. By bringing Lee's model into dialogue with existing empirical and theoretical insights into the Western classical concert setting and its conventions, we aim to explore the (f)utility of the concept of immersive experience in XR classical concerts: In

how far can a form of live musical experience such as the classical concert expand to include XR technologies? Would a truly immersive concert still be recognizable as a 'concert'? We will discuss each core element of Lee's model and offer reflections on the potential for XR to create immersive concerts, firstly in relation to the overarching concepts of 'presence' and 'involvement', and then in relation to Lee's proposed technical properties of immersive systems and content (plausibility, interactivity, interestingness), before drawing together further reflections on immersion and the futures and limits of classical concert experiences.

Presence: Physical Presence and Social/Self Presence

Physical presence is defined by Lee as "[t]he sense of being physically situated in a virtual environment and/or experienc-

ing virtual objects as if they exist in the real environment” (Lee, 2025, p. 6). In our XR concert series, we used the pass-through mode of Meta Quest 3 headsets such that audience members would find themselves in a cave-like environment with torches, lava, smoke, and floating ghosts, while still being able to see the musicians in front of them on stage (Figure 2) and, possibly, other audience members seated in the room in front of them. The content of the virtual environment and physical space were thus clearly separated: on the one hand, a digitally produced cave which cannot easily be mistaken for a real environment, and on the other, a small shot of the concert venue

viewed inside the headset through the lens of a camera. Audience members could turn their heads away from the stage, ‘immersing’ themselves more fully in the virtual world. The music was always live and never played through the headset. The length of the performance was ca. 8 minutes. The short excerpt of instrumental music from Gluck’s *Orpheus and Euridice* was from Scene 1 and 2 of Act 2 and was chosen as this passage lent itself to the creation of a virtual environment with a strong visual narrative. Given these coordinates of our setup, one can question whether the sensory input, both from the headset and the real environment, would have induced a

feeling of being physically present in a virtual world, or whether the virtual and real elements would have merged into a coherent feeling of physical presence.

Social presence is defined as “[t]he sense of perceiving virtual intelligences in a virtual or real environment as perceptually and/or socially real” (Lee, 2025, p. 7). The only “virtual intelligences” in our setup were the ghosts floating around the cave (referring to the furies that prevent Orpheus from entering the underworld in the second act of Gluck’s opera). Two further layers of social presence can be identified in the Orpheus setup: the musicians, who are visible through the pass-through mode and the other audience members in the physical room. Although most other audience members were not visible through the headset, a concertgoer wearing a headset not only knew they were there, but perhaps also sensed them through touch or audition.

Self-presence is defined by Lee as “[t]he sense of being embodied into a virtual self in sensory and/or cognitive manners” (Lee, 2025, p. 7). In our concert setting, the virtual self played a very minor role and was only visible when audience members raised their hands or arms which were then translated into avatar limbs. Through motor engagement, though, concertgoers

would get a sense that the virtual hand is ‘theirs’. Our virtual environment had one hidden feature: people could push away approaching ghosts with their hands (who would otherwise ‘pass through’ the user). Only a few concertgoers were aware of this and tried it out, and it was perfectly possible to have the ‘full’ concert experience without using one’s arms. The concept of self-presence seems thus more relevant in XR settings where users see themselves as (full) avatars and/or interact with other virtual beings. As such, one could argue that most concertgoers probably felt disembodied because their bodies did not exist in the virtual environment. Head movements were likely the only indicators for embodying a virtual self-presence that could move within, and interact with, the virtual environment.

The concept of presence as discussed by Lee in these three dimensions of the model differs from existing conceptualizations of ‘presence’ in Western classical concert settings. While Lee’s model concentrates on the immediacy of the virtual experience, contingent on its believability and its modes of interactivity, presence in the literature on classical concert studies has tended to focus on the liveness and uniqueness of a specific event, as well as the sense of presence being a “sensorial and

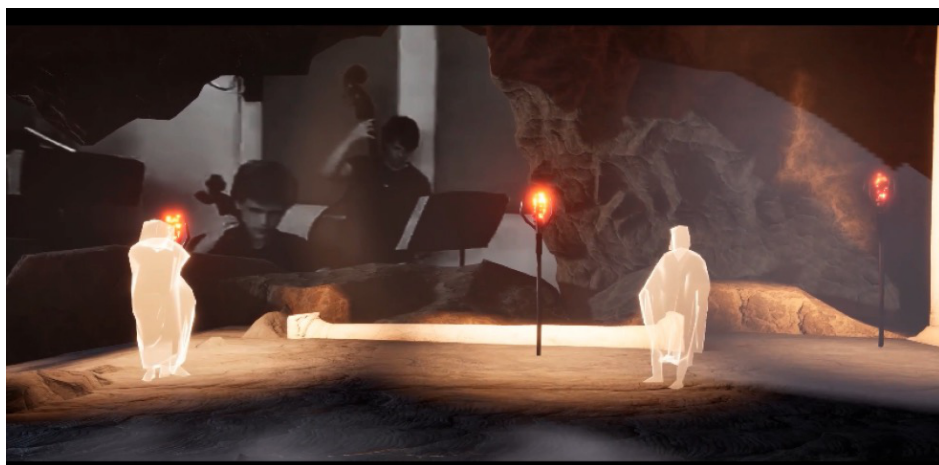


Figure 2. Virtual and real elements of the Orpheus Reimagined project. In the foreground: ghosts, torches, and a cave-like environment. In the background: musicians on stage as viewed through the pass-through mode of the VR headset. Half of the audience members are wearing VR headsets in pass-through mode, enabling them to see both the musicians on stage and a virtual environment.

intense physical experience" (Wald-Fuhrmann et al., 2021, p. 9; drawing on Gumbrecht, 2004). Rebstock (2020) identifies a "crisis" in the production of presence in classical concerts, a need to elevate the 'eventfulness' of such performances in order to fulfill a desire for presence in a world saturated with digital media. Forms of presence that relate to the value placed on "being there" physically at a specific event (Radbourne, Johanson & Glow, 2014) come into conflict with presence in virtual environments as formulated by Lee, who further draws on definitions of full immersion as becoming disassociated from the real, physical environment (p. 3) – a very different mode of 'being there'. The Orpheus Reimagined concerts, through our use of the pass-through mode, can be conceived of as a compromise between these forms of presence: the audience members are not fully physically immersed in either the virtual or the live experience but it is perhaps through the combination of both that a unique concert experience emerges. As Onderdijk et al. (2023) note in their survey of attendees primarily of VR pop music concerts, the ability of XR technologies, whether fully virtual or mixed reality, to create new experiences that cannot be obtained elsewhere is important to users and attendees.

Lee's conceptualization of social presence, which centers on social relationships primarily with virtual intelligences poses further challenges in translation between the worlds of virtual gaming environments and classical concerts. Live music concerts are widely discussed as meaningful social experiences with the power to connect audience members and create a strong sense of togetherness among attendees and between attendees and performers (O'Neill & Egermann, 2022; Pitts, 2005; Pitts, 2014; Wald-Fuhrmann et al., 2021). Such experiences of co-presence and connection are often cited as motivators for live music attendance (Mulder & Hitters, 2023; Onderdijk et al., 2023; Pitts, 2014). In the context of XR concerts such as the Orpheus Reimagined format, we have a complex social web of virtual and real 'intelligences' that are perceived through various senses. Social interactions that take place within the virtual environment are further embedded in the larger social context of the concert. It is possible that a more immersive virtual environment, with greater social presence from virtual characters or intelligences, would in fact have a negative impact on the live social experience or 'presence'. The basic act of wearing a VR headset in the concert situation potentially creates a more indi-

vidualized experience, thus conflicting with possible social motivations for concert attendance.

Involvement

Involvement is defined by Lee as "[t]he sense of deep cognitive and behavioral engagement with a narrative and/or a task" (p. 7). The Orpheus Reimagined concertgoers had no concrete task and whether they sensed a deep cognitive engagement with the story of Orpheus depended on how familiar they were with the plot and whether they were able to connect it to the visuals of the virtual environment. Considering how to apply Lee's criterion of involvement to the context of concerts of Western art music means confronting traditional notions of the 'aims' of a concert and the role of audience members. Western art music is a "presentational" musical culture (Turino, 2008, p. 52), in which there is typically a clear distinction between artists and audience members and active participation or even spontaneous response on the part of audience members is not usually expected. Creating participatory dynamics or engaging audience members in specific 'tasks' in classical concert settings still remains rare. In audience research and concert studies literature, contradictory definitions of the relationship between involvement or participation and immersion emerge. As Wald-

Fuhrmann et al. (2021) describe, the "frame" or situation of the concert has been conceived of as offering some audience members the conditions for "an undisturbed, attentive, even immersive listening experience in a specific time-frame", yet the behavioral restrictions (sitting still in silence, suppression of spontaneous responses) that make this form of listening possible also may at times hinder other audience members less familiar with such conventions from being able to connect with the experience (p. 6). Immersion has therefore been conceptualized as either undisturbed contemplation or as greater involvement, and research on participatory concerts brings out further insights into the push and pull between these two poles. In their study of newly commissioned works for audience members and professional ensembles, Toelle and Sloboda's (2019) audience-participants reported feeling a sense of community with the musicians and other performers and of "immersivity" (p. 13) in the musical work through their active participation. However, they also note that audience members felt at times as if their participation distracted from being able to fully take in the piece (p. 17). In a case study of a participatory installation in the field of experimental music, Emerson (2023, p. 134-152) discusses similar

gains and losses reported by audience-participants: on the one hand, audience members who participated actively in the installation reported more memorable and satisfying experiences than those who simply observed, but on the other hand, there were frustrations with the amount of agency afforded by the format (not enough for some, yet intimidating for others) and less of a sense of being able to take in the ‘whole’ work. In the context of live classical music, involvement or participation can therefore not be adopted as readily as a criterion for immersion, as Lee proposes.

Properties of the immersive system

When applying Lee’s three technical properties of an “Immersive System and Content” – plausibility, interactivity, and interestingness – to the Orpheus Reimagined format, it becomes clear that their relevance and weighting need to be adapted to the artistic priorities of the project. Lee’s model addresses immersive experiences in a general sense, often with the implicit aim of creating a believable and internally consistent virtual world. The artistic approach of the project deliberately diverged from this. Plausibility, in the sense of seamless integration between the virtual and the real, was not a primary goal but was

intentionally disrupted. The visual design – a stylized cave environment in pass-through mode, in which the musicians appeared only in the ‘cave opening’, rendered monochrome and at proportions differing from the physical reality – created a deliberate visual and spatial dissonance. This interplay between the virtual setting and the physical concert hall was intended to unsettle notions of space, reality, and narrative, while at the same time accentuating the liveness of the event.

Similarly, interactivity was shaped less by direct or task-oriented engagement, as might be implied by Lee’s framework, and more by the traditional modes of reception in classical concerts. The primary form of ‘interaction’ involved head movement and the act of turning or looking around to perceive visual and acoustic stimuli from different directions. Optional hand-tracking elements, such as “pushing away” ghost figures, were available for more active audience members, but they were not essential to experiencing the work. The intention here was to gently disrupt the habitual, front-facing orientation of classical concert listening and to stimulate a more active, spatially open mode of perception.

Interestingness – “the quality of an immersive system or content that captures a user’s attention,

curiosity or motivation” (Lee, p. 7) – proved to be a more ambivalent category. For some audience members, the attraction lay in the technological novelty and unpredictability of the format, especially given that this combination of live concert, XR technology, and selective pass-through is very uncommon in the classical domain. For others, however, the visual and interactive elements risked being perceived as a distraction from the musical core, or as undermining expectations of a ‘traditional’ concert experience.

Summary and Conclusion

Applying Lee’s model of immersion to XR concerts of Western classical music presents a number of challenges. Lee’s definition of ‘presence’, with its dimensions of physical, social and self-presence in the virtual, contrasts definitions from existing concert research, which center on the uniqueness of the live experience and the social experience of the concert situation. The dimension of involvement from Lee’s model comes into conflict with the presentational nature of Western art music culture, which traditionally does not involve direct participation from audience members. While involvement in Lee’s sense could enrich the audience experience, as empirical concert research suggests, it also comes up

against understandings of the classical concert experience as contemplative or as a space for differently ‘immersive’ undisturbed listening. On a technical level, Lee’s properties of the immersive system offer valuable points of reference. However, their weighting and technical implementation require adaptation for classical concert contexts: plausibility may be deliberately subverted as an artistic device, interactivity may be reduced to subtle bodily and attention-based engagement, and interestingness may arise from both aesthetic and technological dimensions.

A question that remains is what a truly *immersive* concert would look like. If immersion were defined according to Lee’s dimensions, the result would be very different from a conventional concert of Western classical music and potentially, for some, not desirably so; this represents the slight futility of merging these formats and discourses. However, there is much to be gained from rethinking and widening conceptualizations of what the classical concert experience can be and how it can speak to a broader range of potential audience members. As theatre and performance art scholar Claire Bishop has observed, performance and how we perceive it today is shaped by newer, digitally-informed ways of socializing and paying attention (Bishop,

2024). She proposes that the future of contemporary performance could lie in formats that allow for flexible, pluralized modes of paying attention (or for “hybrid attention”, Bishop, 2024, p. 46). Formats that hybridize or expand the live format through digital media, such as the Orpheus Reimagined concerts, could be a particularly productive cross section at which to be reconfiguring the classical concert. These efforts will need, as we have demonstrated, equally hybridized definitions of terms such as immersion and presence that are able to mediate between the live and the virtual and between tradition and innovation.¹

References

- Bishop, C. (2024). *Disordered Attention: How We Look at Art and Performance Today*. Verso Books.
- Colotti, C. (2021). “A review of contemporary practices incorporating digital technologies with live classical music.” In: Hepworth-Sawyer, R., Paterson, J., and R. Toulson. (eds.) *Innovation in Music: Future Opportunities*. Routledge, pp. 273–290.
- Emerson, G. (2023). *Audience Experience and Contemporary Classical Music: Negotiating the Experimental and the Accessible*

in a High Art Subculture. Routledge.

Gumbrecht, H. U. (2004). *Production of Presence: What Meaning Cannot Convey*. Palo Alto, CL: Stanford University Press.

Kavanagh, B. (2018). “Reimagining classical music performing organisations for the digital age”, In: Dromey, C. and J. Haferkorn (eds.), *The Classical Music Industry*, Routledge, pp. 126–138.

Lee, H. (2025). “A unified conceptual model of immersive experience in extended reality.” *Computers in Human Behavior Reports* 18: 100663. DOI: 10.1016/j.chbr.2025.100663.

Mulder, M., and E. Hitters (2023), “Constructing the Live Experience at Pop Music Concerts: A Phenomenological, Multi-method Study of Concertgoers”, *Music Perception: An Interdisciplinary Journal* 41(1): 36–58. DOI: 10.1525/mp.2023.41.1.36.

O'Neill, K., and H. Egermann (2022), “Development of the Social Experience of a Concert Scale (SECS): The social experience of a live western art music concert influences people’s overall enjoyment of an event but not their emotional response to the music”, *Music & Science* 5: 1–22. DOI:

10.1177/20592043221106478.

Onderdijk, K. E., et al. (2023). “Concert experiences in virtual reality environments”, *Virtual Reality*. DOI: 10.1007/s10055-023-00814-y.

Pitts, S. E. (2005). “What makes an audience? Investigating the roles and experiences of listeners at a chamber music festival”, *Music and Letters* 86(2): 257–269. DOI: 10.1093/ml/gci035.

Pitts, S. E. (2014). “Musical, social and moral dilemmas: Investigating audience motivations to attend concerts”, In Burland, K., and S. E. Pitts (eds.), *Coughing and Clapping: Investigating Audience Experience*, Ashgate, pp. 21–33.

Radbourne, J., Johanson, K., and H. Glow (2014). “The value of ‘being there’: How the live experience measures quality for the audience”, In Burland, K., and S. E. Pitts (eds.), *Coughing and Clapping: Investigating Audience Experience*, Ashgate, pp. 55–68.

Rebstock, M. (2020). “Strategies for the production of presence”, In M. Tröndle (Ed.), *Classical Concert Studies: A Companion to Contemporary Research and Performance*, Routledge, pp. 134–140.

Selfridge, R., And M. Barthet (2019). “Augmented Live Music

Performance using Mixed Reality and Emotion Feedback”, *Proc. of the 14th International Symposium on CMMR*, 210–221.

Toelle, J., and J. A. Sloboda, J. A. (2019). “The audience as artist? The audience’s experience of participatory music.” *Musicae Scientiae* 25(1): 67–91. DOI: 10.1177/1029864919844804.

Turino, T. (2008). *Music as Social Life. The Politics of Participation*. University of Chicago Press.

Wald-Fuhrmann, M., et al. (2021). “Music listening in classical concerts: Theory, literature review, and research program”, *Frontiers in Psychology* 12. DOI: 10.3389/fpsyg.2021.638783.

Note

[1] Mats B. Küssner and Gina Emerson contributed equally to this work.

Dynamic interdependence in a hybrid configuration using Spatial Sampler XR by Greg Beller

In the context of contemporary explorations into hybrid and extended realities in performance art, The Synekine Project investigates how immersive technologies such as VR and AR can reshape the relationships between sound, movement, and space. This is particularly compelling as artists seek new modes of presence and interaction across physical and virtual domains, enabling innovative performance ecosystems that challenge conventional notions of liveness, embodiment, and authorship.

The Synekine Project investigates the artistic potential of an extended musical performance, where sound, image, and movement interact within a hybrid environment—physical, digital, and networked. Through real-time interactive systems, the project challenges conventional notions of stage presence, enabling performers and audiences to be physically or virtually distributed. By reimagining the relationship between bodily gesture, sonic production, and visual perception in a mediated space, The Synekine Project offers a concrete artistic response to the ongoing transformation of musical performance in the digital age. It engages with issues of

spatial fragmentation, shifting performer–audience roles, and expanded reception modes. **SpatialSamplerXR** is an extension of the instrument series of the Synekine Project. In the same way that a sampler is an empty keyboard that is filled with sounds, Spatial Sampler XR uses gesture capture to transform the surrounding physical space into a key zone for indexing, placing and replaying samples. With Spatial Sampler XR, the musician spreads sound around him/her through gesture, creating a spatialized and interactive sound scene. Movement links time (sound) and space. This makes Spatial Sampler XR suitable for movement artists as well, and for various applications.

The **Air Sampling series** questions the notion of stage presence in contexts where performers and audiences may be physically or virtually distributed. A key element is the real-time recording and transformation of instrumental performance, introducing a layer of virtualization at the very core of the act of performance. The sound, produced in the here and now, is captured, modulated, projected, or replayed instantly—creating a temporal (present/trace), spatial (localized/dislocated), and perceptual (de-linearized cause/effect) stratification. This process renders the performance inherently hybrid, blending

physical immediacy with mediated construction.

Air Sampling #006

explores the tension and interplay between physical and virtual presence through a live improvisation involving two performers and a VR headset. Eunice Martins, plays a prepared piano, generating a rich palette of acoustic textures. Greg Beller, equipped with a virtual reality headset and motion controllers, captures and samples these sounds in real time, placing them within a three-dimensional virtual space using the Spatial-SamplerXR. As the performance unfolds, a formerly empty sampler becomes populated with sonic fragments, constructing a virtual instrument that evolves live on stage.

In its hybrid configuration, The Synekine Project destabilizes traditional models of musical performance by staging a dialogue between physical and virtual agencies. Through the real-time sampling of a single instrument, immersive virtual environments, and live spatial transformations, it raises fundamental questions about co-presence, embodiment, and authorship. What emerges is not merely a coexistence of real and virtual realms, but a dynamic in-



Figure 1. Still from the performance at the Symposium "(Virtual) Presence? Musical performances in hybrid spaces", July 17, 2024 (Berlin, GER). Performer: Greg Beller (XR).

stantly reshaped across temporal and spatial disjunctions. The result is a performative ecosystem in which composition and improvisation, liveness and mediation, instrument and performer all merge into a fluid continuum, offering a critical and artistic response to the evolving conditions of music-making in a networked, post-physical era.

This performative ecosystem develops as performances with different musicians unfold, in a hybrid space of electronic composition based on virtual physicality. Thus, from spatial sampling to spatially located media, the introduction of virtual physical actuators enables the construction of sound sequences based on gestural interaction.

Virtuality Will Save Us All

By Sebastian Berweck

Introduction. Virtuality as Promise and Problem

The idea that “virtuality will save us all” is both optimistic and ironic. It reflects a belief that digital technologies can protect artistic works from technological decay, but it also points to the contradictions of this belief. Virtualization is not simply a technical operation; it is also an aesthetic and conceptual shift. While it offers tools for preservation and reinterpretation, it can reduce artistic works to data, treating them as interchangeable “content.” What is at stake is not only the longevity of works with electronics but also how their material, performative, and historical dimensions are reframed by digital systems. The following text begins with an examination of virtualization as a preservation strategy, highlighting its technical limitations and the difficulties of maintaining older electronic works. It then turns to virtualization as a compositional and performative tool, focusing on key examples by Brigitta Muntendorf, Michael Beil, and Stefan Prins, before drawing conclusions about the artistic potential and the inherent instability of virtual environments.

The Archival Mirage: Virtualization as Preservation

Virtualization is frequently discussed as a strategy to prevent works with electronics from becoming unplayable due to technical obsolescence. On paper, virtual machines and emulations appear to be the perfect answer to the disappearance of hardware, storage media, and operating systems. But in practice, things are rarely that simple.

Connecting a Zip drive made by Iomega today is already a challenge. Physical connectors have changed drastically over the past 30 years, and 30 years ago means 1995 — which is not very long ago, especially when we consider that the music heard in classical concert halls often dates back several hundred years. Even if the old hardware is still available, the operating systems required to read the data may no longer exist, and software tools are often deprecated or locked behind license servers that have been offline for decades. The mere act of installing such software can require hours of research in archived newsgroups and 1980s listservs, searching for workarounds to copy protection schemes that were never designed for longevity. During performances of older pieces, I often spend more time trying to restore and configure outdated software than rehears-

ing the actual music. The assumption that a work can be “saved” simply by transferring it into a virtual environment ignores the complexity of these systems. Virtualization does not remove obsolescence; it redefines it.

My work on the restoration of Bernard Parmegiani’s *Stries* (1980) illustrates these challenges clearly (Berweck 2016; Mode Records 2021). The survival of such a piece depends on far more than stored files or emulated systems. Reconstructing *Stries* required a detailed understanding of the instruments, signal flow, and aesthetic intentions that shaped its original sound. Virtualization can only translate these aspects; it cannot fully preserve them.

The process creates an archival

mirage: it suggests stability while digital ecosystems remain fragile. File formats change, operating systems become obsolete, and undocumented nuances disappear. Working on *Stries* demonstrated that the “virtual” is always partial — not preservation but interpretation. This is as much an aesthetic problem as a technical one, since it affects how we view these works as historical or living entities.

Lessons from the Reconstruction of Parmegiani’s *Stries*

The reconstruction of Bernard Parmegiani’s *Stries* (1980) provided concrete insights into the difficulties of preserving electronic works. The piece, written for tape and three analog synthesizers, is tied to specific instruments: an EMS Synthi AKS, a

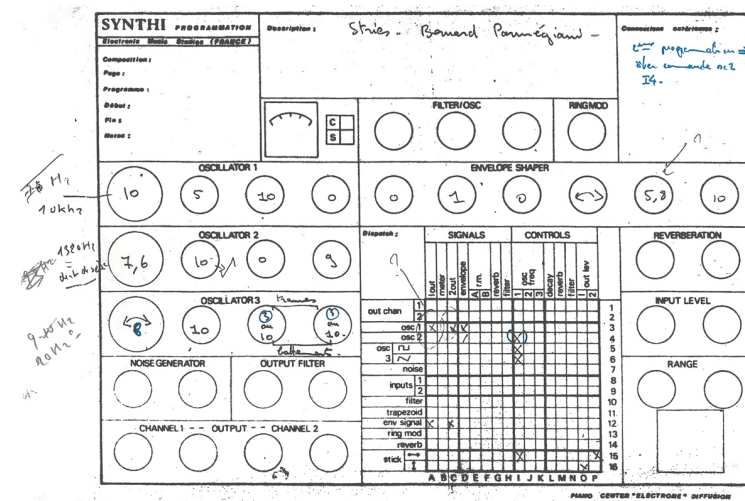


Figure 1. The original patch by Bernard Parmegiani for an EMS Synthi A

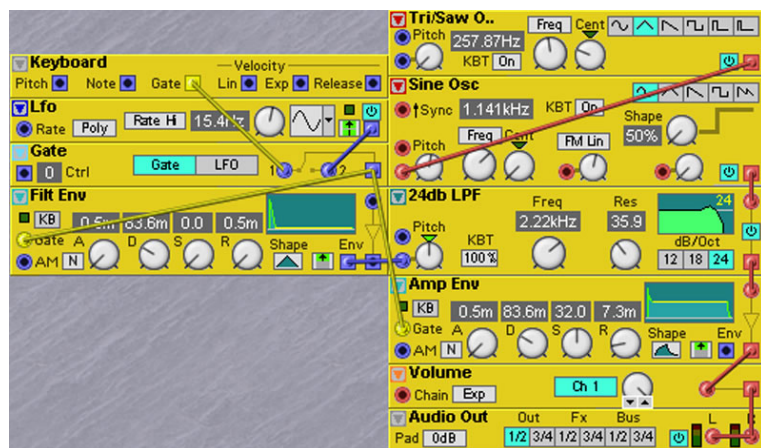


Figure 2. The transcription of the same patch for the virtual modular synthesizer Clavia Nord G2

Yamaha CS-40M, and a Roland System 100M Set D combined with the keyboard of the Roland System 100. These instruments are now museum objects, rare and costly, and each required technical restoration. Components such as capacitors degrade over time, and without maintenance the instruments are no longer functional.

From this work, four key observations emerged:

1. Impossible without the originals. The characteristic sounds of Stries cannot be reconstructed without reference to the original instruments. They serve as the only reliable point of comparison for timbre and dynamics.
2. Notation limitations. The score refers to parameters that are specific to these ana-

log synthesizers — for instance, a marking of “3” on a filter knob gives no indication of the actual frequency (Parmegiani 1980). Karlheinz Stockhausen’s Oktophonie faces a similar problem: conceived as a live performance rather than a fixed tape, it is now practically impossible to reproduce because the original software has vanished, leaving only ambiguous numerical references (Bernardini and Vidolin 2005).

3. Analog-to-digital transfer. Through careful measurement of filter curves, oscillator frequencies, and modulation depths, we were able to transfer the patches to a digital instrument (Nord Modular G2). The differences between analog and digital timbres were comparable to those between two violins, yet

in performance the choice of loudspeakers, the room’s acoustics, and the instruments themselves exerted a far greater influence on the sound than the subtle distinctions between the instruments.

4. Notation vs. archiving. The main difficulty was not archiving but notation. If the sound parameters had been described independently of the instrument models — for example in terms of absolute frequency or modulation depth — the reconstruction would have been far more straightforward.

Images 1 and 2 illustrate this translation process from analog to digital.

Virtualization as a Creative Tool: Brigitta Muntendorf, Michael Beil, Stefan Prins

If virtualization fails as a universal preservation method, it is nevertheless an important compositional resource. Composers such as Brigitta Muntendorf, Michael Beil, and Stefan Prins use digital layers — videos, samples, live electronics — not as archival backups but as integral parts of their works.

Brigitta Muntendorf – *Public Privacy #2*

Brigitta Muntendorf’s *Public Privacy #2* (2013) juxtaposes

the world of YouTube amateur pianists with the concert stage (sebseb3000 2014). The work projects videos of non-professional players performing at home — in living rooms, bedrooms, or practice spaces — alongside the live pianist. These performers open up their private spaces and their playing, exposing themselves to the public gaze and commentary. They are, in a sense, as brave and bold as the “Piano Hero” on stage, and the responses they receive in the comment sections are often as supportive and encouraging as the applause a piano virtuoso would receive in a concert hall. This creates an interesting tension with the cult of the classical soloist, who is celebrated like a gladiator battling with the instrument to wrest beauty from it and to emerge victorious. Muntendorf’s work questions this narrative by aligning the virtuosity of amateurs — imperfect, intimate, authentic — with the heroic aura of classical performance.

Michael Beil – *Doppel*

Michael Beil’s *Doppel* (2009) places the idea of duplication and mirroring at the center of both visual and musical structure (Beil 2012). The piece integrates live video and audio in such a way that the pianists’ gestures are not only seen but also refracted, repeated, and distorted. A rising arm gesture,



Figure 3. A rising hand gesture in Michael Beil's Doppel

for example, is echoed by an ascending scale and mirrored on screen, blurring the boundary between the real performance and its virtual double. The virtual layer is not subordinate to the live action; it functions as an equal and sometimes disruptive counterpart. Beil employs temporal manipulations — speeding up, reversing, and looping — reminiscent of the time-bending effects of Christopher Nolan's *Inception* (2010). The result is an unstable field of perception, where the audience constantly negotiates what is live and what is mediated. This deliberate interplay raises questions about presence,

authenticity, and agency. The performers and their images are locked in a dialogue that destabilizes the conventional hierarchy of stage and screen. The virtual projection is not simply a supplement to the music but an active, performative element that reveals how mediated images can acquire the same weight as live sound.

Stefan Prins – *Piano Hero #1*

Stefan Prins' *Piano Hero #1* (2011) replaces the traditional piano with a MIDI controller that triggers video samples of pianist Frederik Croene playing his piano *démécanisé* — a deconstructed grand piano stripped of its mechanism.

The live performer operates the video as though performing a kind of virtual puppetry, controlling both the sounds and the visual fragments of Croene's recorded performance.

Yet this illusion is broken by the fact that the performer is physically present on stage, his gestures and body exposed to the audience's gaze. The piece emphasizes this tension: the performer is simultaneously manipulating a virtual double and being observed as himself, shifting between operator and performer.

Midway through the piece, this relationship is complicated further when a live video camera captures the performer from

behind, including the first rows of the audience. These images are projected onto the screen, effectively placing the listeners themselves into a performative role. The audience, who until then were observers, suddenly become part of the staged visual layer, their presence mirrored and mediated like that of the performer.

Although the software for the piece is not overly complex — the Max patch essentially functions as an audio and video sample player mapped to the middle register of the keyboard, with controls for sample playback speed in the upper register and two commands for the camera in the lowest keys — it still

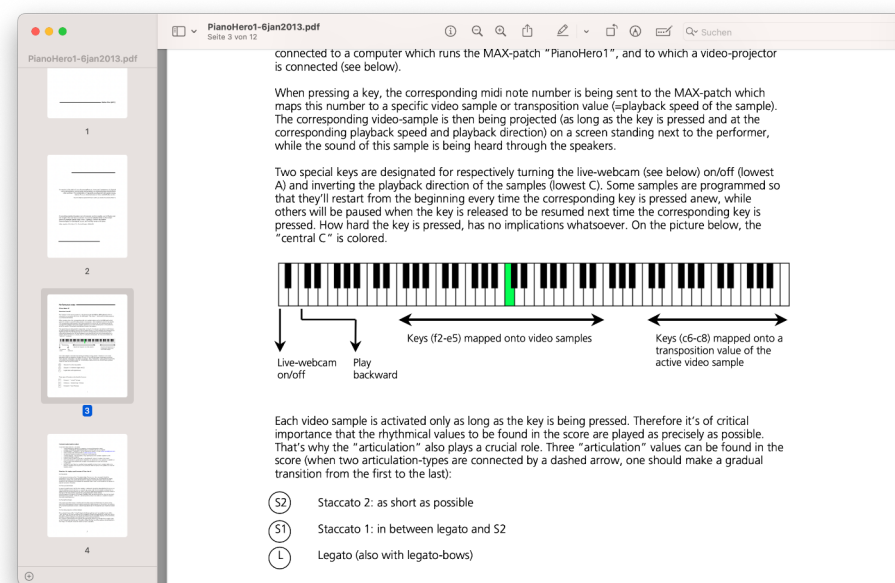


Figure 4. The MIDI keyboard assignment for Stefan Prins' *piano hero #1*

falls into the same trap as older electronic works. Prins works closely with a programmer to maintain the technical setup. The performers regularly report problems to Prins, who then communicates these issues to the programmer. The programmer sends back a new version of the patch, which the performer tries out. This is an iterative process that never works the first time around. Prins must revisit the Max patch almost every year: changes in operating systems, audio drivers, and hardware layers alter the behavior of the work. An OS update might introduce latency, a driver change might disrupt routing, and new hardware may break parts of the patch architecture. The computer is not a static instrument; it is a fluid environment that evolves continuously, often requiring adjustments to keep the piece performable.

Conclusion

Virtuality will not save us all, at least not in the sense of securing the future of electronic music. It cannot guarantee that a work will remain playable in 10, 20, or 50 years. Older works, especially those built on obsolete systems, require substantial effort, technical expertise, and interpretation to remain performable. The solution to the problem of preserving old pieces lies not in the archives or in “permafrosting”

old works within virtual spaces, but in a notation that allows their revival and reinterpretation — similar to the way we approach the works of Beethoven or, within our own field, contemporary music written for acoustic instruments.

However, as a creative resource, virtuality opens possibilities that extend beyond preservation. It enables composers to work with the interplay between live performance, mediated presence, and technological transformation. The challenge is to use virtualization critically and artistically, while acknowledging its limitations as a preservation strategy.

Music

Brigitta Muntendorf (2013), *public privacy #2* (premiere), S. Berweck: piano
Permalink:
<http://mediathek.slub-dresden.de/vid90004388.html>

References

Bernardini, N., and A. Vidolin (2005). “Sustainable Live Electro-Acoustic Music.” In *Proceedings of the Sound and Music Computing Conference '05*, Salerno.

Berweck, S. (n.d.). “The Restoration of Bernard Parmegiani’s Stries (1980).” *eContact! 17.4*.

https://econtact.ca/17_4/berweck_parmegiani.html (last access Sept. 22, 2025).

Parmegiani, B. (1980). *Stries*. Unpublished manuscript. In the possession of Maison ONA.

Media

Beil, M. (2013). “Doppel (2009) ” YouTube video <https://www.youtube.com/watch?v=ihR7TWYkgoQ> (last access Sept. 22, 2025).

sebseb3000. (2013). “Piano Hero #1 (2011), by Stefan Prins.” YouTube video. <https://www.youtube.com/watch?v=mTupC1BRp18> (last access Sept. 22, 2025).

sebseb3000. (2014). “Public Privacy #2: Piano Cover (2013), by Brigitta Muntendorf.” YouTube video. <https://www.youtube.com/watch?v=0r-km5QFe5s>. (last access Sept. 22, 2025).

Mode Records (n.d.). “Stries (Mode328).” Bandcamp. <https://moderecords.bandcamp.com/album/stries-mode328> (last access Sept. 22, 2025).

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Greg Beller works as an artist, researcher, teacher and computer designer for the contemporary arts. Founder of the Synekine project, he invents new musical instruments combining sound and movement, which he uses with various performers or in computer-assisted composition. In his research, he focuses on the relationships between gesture, movement, dance and space, as well as between AI and the creative process.

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Juan Parra Cancino obtained his MA with a focus on composition and performance of electronic music. In 2014, Juan obtained his PhD degree from Leiden University. As a guitarist, Parra is a member of various guitar ensembles such as the Berlin Guitar

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Till Schwabenbauer studied art and visual history, music and media, and musicology at the Humboldt-Universität zu Berlin. At the same time, he was a member in the conducting class of A. Gelovani and founded his first orchestra when he was 17. Nowadays he works as a permanent conductor of several classical ensembles. Currently, he is enrolled as a doctoral student to investigate multimodalsensoric concert events.

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