

Article

Navigating an Urban Archive: An exploration of wavefield synthesis as soundscape composition

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Abstract

This article examines the creation of *an Urban Archive as an English Garden*, a work that uses GPU-accelerated low-resolution wavefield synthesis (WFS) to combine field recordings, live performance and generative audio in real time. Owing to computational overhead, WFS is often pre-rendered, leading to a less dynamic and more static scope for the embodied and intersubjective nature of human sensory understanding, a tendency that can also be found in traditional soundscape composition. We argue that engagement with real-time WFS offers a new approach to soundscape composition, wherein musical-system design may have multiple agencies, or that of virtual environment, co-creator, archive and hybrid instrument. Through a post-phenomenological lens, an analysis of the work's creation through different domains reveals how these technologies afford novel practices to engage with our sonic environments. Additionally, the article unpacks how this same process, grounded in site-responsive design offers new approaches to composition, performance and artistic collaboration across these practices.

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1. Introduction

This article explores the use of real-time GPU-accelerated low-resolution wavefield synthesis (WFS) as an innovative spatial sound technology. It examines, in particular, how work with such a system offers new ways into soundscape composition and collaboration thereof. We highlight how such creative engagement introduces a resistance not only to the usual static nature of pre-rendered WFS work but also the staticity of traditional soundscape compositions, which bypasses the embodied and intersubjective nature of human sensory understanding (Ingold 2011).

The findings build on the collaborative artistic practice of the two authors as they relate to their work on *an Urban Archive as an English Garden* (Franzson 2019). Here, we detail how critical engagement with a spatial technology during the creation of the work enables new methods of composition and performance, as well as new approaches to artistic collaboration across the practices of composition and performance. Building on autoethnography, including stimulated recall in relation to audiovisual documentation, allows us to attend to the peculiarities of different situations in order to further explore the social and material formation of technologically and environmentally mediated processes (Suchman 2007).

2. Background

2.1. Wavefield synthesis technology and spatial composition

WFS technology was originally developed in the late 1980s at the Delft University of Technology in the Netherlands. It is a spatial

audio-rendering technique that uses phase manipulations of a signal spread into a large number of speakers to create an artificial wavefront and through the wavefront's curvature and high density of speakers it offers the listener a proximal sensation of sound (Barrett 2022: 182). As such, the technology can create virtual acoustic environments and a holophonic representation of sound. WFS is inherently different from stereo or surround-sound systems, which require listeners to be in a 'sweet spot', instead, as Baalman (2010) describes, listeners enter a 'sweet area'. In this space, they can navigate a 'sonic environment' where electronic sounds have direction and position, allowing the listener to position themselves in relation to the sound in space.

WFS is computationally quite intensive, as it requires a per speaker calculation for each sound source's phase, amplitude and filtering, with multiple phase-adjusted streams mixed into each speaker. This means that the number of calculations grows fast with each added sound source. Rather than using pre-rendered materials or zones or grids to speed up calculations, the system utilised in *an Urban Archive* employs GPU acceleration to run the phase and mixing calculations in parallel rather than sequentially, enabling real-time use of a high number of speakers and sound sources without reduction in location accuracy.

The approach of *an Urban Archive* uses a sparse speaker array to produce a flat surface across the performance space, within which the performer and listener move and position themselves. Taking advantage of the holographic nature of WFS, sound sources can appear as stationary or moving in the field relative to the listener rather than on a sphere surrounding them, allowing them to move around sounds, sense them moving in space, or feel them wash over them. Gone are some of the problems inherent to multichannel compositions, where differing spaces and speaker layout can upset the spatial picture, resulting in audiences having

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an uneven position within the spatial sound-field. Through this, as noted by Baalman (2010), sound sources can be more accurately placed in space, contrasting ‘a source with a fixed position versus a source which moves along when the listener walks through the sound field’ (ibid.: 214).

2.2. Field recording and soundscape composition

The concept of soundscape composition can be traced to the emergence of the field of acoustic ecology in the late 1960s – the study of the sonic relationship between living beings and their environment. It is sometimes referred to as ecoacoustics or soundscape studies. Importantly, the conceptual roots of acoustic ecology are in environmentalism, in part responding to noise pollution and a preservationist strategy to survey and capture specific soundscapes (World Soundscape Projects (WSP)). Such soundscapes were classified by R. Murray Schafer (1994) into hi-fidelity and lo-fidelity soundscapes, with hi-fidelity soundscapes – for example, those typically natural or historic with low levels of man-made noise – considered more valuable than lo-fidelity ones – soundscapes containing more urban or modern and man-made sounds.

‘Soundscape’, as an ideological construct, has been critiqued as objectification and aestheticisation in many recent writings on sound studies (Blessner and Salter 2007; LaBelle 2019) and through the work of artists who have critically engaged with and challenged some of its artistic methods (Biserna 2021; Norman 2011). Biserna’s critique of WSP methodologies has, for example, highlighted how ‘sound-making is often subordinated to listening, and “playing the environment” while traversing it doesn’t become a research or artistic methodology in itself’ (Biserna 2021: 302). This ties in with a critique aired by Tim Ingold, who questions the concept of soundscape or, rather, the assumed passivity of our perception of the soundscape, a stance that has excluded the embodied and intersubjective nature of sensory understanding (Ingold 2011).

Another significant critique is the assumed transparency of the recordist. Salomé Voegelin likened this act to ‘sonic butterfly catching’, noting a ‘lack of understanding of the anthropological intrigue of the recordist rather than the recorded’ (Voegelin 2014: para. 1). Steven Feld’s ethnographic technique, using a camera setup to capture ‘the body’s tracing of space’ (Feld in Lane and Carlyle 2013: 206), was an early attempt to address this issue. Similarly, the recordings of the original WSP were from the outset used as material for edited tape montages or compositions grounded in the idea to preserve, enhance and exploit the environmental context (Truax 1984). The practice of soundscape compositions, however, became interlinked with the acousmatic tradition. As Drever (2002) notes, this development informs ‘how soundscape composition is listened to, but also how it is produced, sonically and philosophically’ (Drever 2002: 22). Consequently, soundscape presentation, aligning with Western electroacoustic tradition, became entangled with Pierre Schaeffer’s notion of ‘reduced listening’ to a ‘sonic object’ (Schaeffer [1966] 2017), removed from its environmental context. This approach led soundscape compositions to follow the Euclidian trajectory of multichannel compositions, or the conception of ‘time-space as an empty container wherein sounds can develop’ (Ouzounian 2015: 76).

From this perspective of ‘contained space’, soundscape composition is positioned within Western listening culture – the sit-still-and-listen paradigm (Bhagwati 2020), which filters out an

essential part of humans’ perceptual response to their environment: wayfaring and the ability to locate sounds and detect their sources (Clarke 2005). As Bennett Hogg (2013) observes, these realities have resulted in a soundscape tradition that is merely a ‘representation’ in sonic form, bypassing opportunities to deepen our acoustic or ecosystemic understanding. Even high-scale technological usage may do little to bridge this divide:

One could make a perfect recording of a forest in 32 channels and redistribute this material on the same number of loudspeakers, reproducing the experience of being in the forest very closely, and yet it would still be an objectification, a representation, a function of a listening subject who remains silent and attentive, not a listener who is a constitutive part of the soundscape they experience. (Ibid.: 262)

This raises the question if it is a prerequisite to leave the Western listening context to go beyond such a nature–culture or subject–object split. Importantly, it highlights the need for diversification of artistic methodologies to gain multiple entries into understanding of ecosystems and relations thereof. Such diversification can result in a wide range of approaches, from environmental performances that combine environmental and algorithmic/technological instrumentality (Peters 2016) to ethnographically driven methods that incorporate not only human voices but also alterity in their compositional approach (Lane 2017; Östersjö and Nguyễn 2020; Rennie 2020). These methodologies take seriously the idea that sensing forms ‘through a nascent world’ (Ingold 2011: 73) and recognising that sound exists in context, which invites us to consider the broader sociocultural and political entanglements of the sonic domain. In the following section, we will present a project designed to creatively explore the possibilities for interactive soundscape composition.

3. An Urban Archive as an English garden

The creation of *an Urban Archive* was initially instigated by Franzson and premiered at the SPOR festival in Aarhus, Denmark, in 2019. As presented in the programme notes, the audience was free to navigate at their own leisure, through an imaginary garden, existing in both time and space:

You enter a room. In front of you is a forest of speakers. From this forest you hear fragments of an urban archive . . .

Recordings taken at different times at the same location are placed successively through the space. As you walk through the forest, you walk through time, through the memory of what was – experiencing the archive as it was before – hearing what is, in the context of how things were before and how things will be after.

The instrument highlights the motion of time, its resonance extended, sound slowly moving from the instrument to the edges of the space, backwards and forward in time at a glacial pace. Sound becomes sculptural, seemingly hovering in the air, almost as if you could touch it. (Franzson 2019)

At SPOR, *an Urban Archive* was presented both as an installation and as a series of instrumental performances by Halla Steinunn Stefánsdóttir (baroque violin), Mattie Barbier (trombone) and Russell Greenberg (electronics) performed within the installation, which consisted of three differing soundscapes. As stated, the focus for this present article is the collaboration between Franzson and Stefánsdóttir, building on documentation of their work through all its stages. However, we also look towards later iterations of the work, within the Hljóðön series at Hafnarborg Museum, Iceland and wildUp’s Endless Season in Los Angeles.

3.1. Planning an urban garden

The work followed much of creative human–computer interaction (HCI) methodologies in that the initial planning and projections occurred on multiple non-linear planes (Suchman 2007). Such curatorial activity is essential to the design of experimental processes (Stefánsdóttir 2023), where the participants are to fluctuate between ‘known-knowns’ and ‘unknown-unknowns’, allowing for ‘established tools [to] acquire new functions in the process of their production’ (Rheinberger 1997: 32).

Franzson’s initial idea was grounded in exploring the WFS hologram as an extension of reality rather than a substitute. This was to be done by embedding field recordings from urban environments within the system. His initial formulation of these recordings as data mapping is mirrored in the possibility offered by the WFS system to address the inherent problem of the discrepancy between ‘artificial’ and ‘real-world’ sound (Barrett 2022). Franzson’s overall compositional idea was for the work to evolve around a performer’s perceptual engagement with a sonic environment, while allowing the audience a multimodal engagement with the performance. This was accomplished by placing evolving resonant nodes across the soundscape. These resonances then unlocked delay chains through other positions, resulting in a blossoming of sonic activity at different points across the space.

Franzson conceptualised the WFS space from the perspective of landscape architecture, allowing him to construct a ‘holophonic garden’. Continued consideration of design methods found within landscape architecture were applied, such as where differing textures among trees in autumn may work to enhance one’s spatial perception. This resulted in the introduction of the resonances into the system design as a way of introducing spatial motion into the composition. The resonances’ role was explained by Franzson in an email:

It is a bit like a tree in autumn, where one tree is in front of another. The one that is closer has nearly lost all its leaves, but the one behind it is blood red but you get an extra depth by seeing the skeleton of the naked tree in front, or like one component is withered while the other is full with life. The same sound can be heard at different times and trigger these different states. (Franzson, personal communication, 7 January 2019)

The resonances were then configured into varying temporal and spatial positions, activated by a sound signal from the performer. The spatial nature of the performer’s instrument was reconfigured, and turned into a hybrid instrument, existing within the holophonic environment. This aligns with Barrett’s claim about how ‘a synthesised sound field ... can inform the composition of a real-world acoustic allusion to fold back into the work’ (Barrett 2022: 188–9). Stefánsdóttir’s playing was used to structure the resonances in both space and time, adapting their spatial and sonic response to her playing, using pitch content derived from analysis of the field recordings embedded in the WFS. Fragments from the very same recordings were later used to work as a substitute for her when the work lived as an installation, sent through the system to activate the gate triggers and alter the sonic field.

This iterative process between ideation, score and performance sent the project on a trajectory akin to methods in machine learning within new digital musical instrument (DMI) design, wherein a system may evolve with the performer as they train the system to adapt to their playing (Magnusson 2019). This results in an ergodynamic materiality ‘established through a relationship of playing that is unique to each performer’ (ibid.: 177). These methods have since developed to include machine learning

techniques and real-time generation of resonances in response to Stefánsdóttir’s playing in later collaborations. Methods that correspond with the shift that is occurring in music-making, where the focus shifts from the linear models located ‘in the symbolic writing of the musical score and the signal writing of the phonographic recording’ (Magnusson 2018: 48), to evolve around modern media technologies, which ‘support the ergodynamic potential of sensing, learning, reacting, conversing, evolving in tune with our play and performance practice’ (ibid.: 52). As a result, the actual ‘score’ of *an Urban Archive* emerges from the interplay between the pre-constructed and dynamic materials through the performer’s listening and response.

At the same time, if viewed from a design perspective, creatives working in HCI have highlighted that the focus on so-called ‘task-artifact cycle’ or ‘iterative’ processes in design falls outside what they find meaningful (Waters 2021). As John Bowers puts it: ‘A rationalist notion of convergence towards an ideal ... does not correspond to the exuberant explorative making that excites me’ (Bowers in Waters 2021: 138). When such experimentation involves human cooperation, performers may participate in prototyping through personalised training of DMIs. However, when DMIs function as both composition and instrument, or when they are part of a larger installation or composition, performers’ creative contributions may be limited to an ‘advisory’ role (Gorton and Östersjö 2016; Torrence 2018). This means they participate in the workshoping process but have little influence on creative design choices. However, *an Urban Archive* works against this both by welcoming the tailoring of the piece to a specific performer through the iterative creative process, as well as through the inclusion of ethnographic field recordings and the emergent nature of the ‘score’. This prompted Franzson to invite performers to contribute urban sounds from their near environment to be the basis of each garden within the hologram, giving the performers increased agency in the prototyping process, allowing them to co-curate and contribute additional data for system coding.

3.2. Field recording for a holophonic environment

Field recording can take various forms depending on the context. It can, for example, transform devices into instruments and note-taking tools, or provide access to hard-to-hear sounds. In *an Urban Archive*, Stefánsdóttir employed the recording device in a manner similar to Steven Feld’s ethnographic technique of tracing a body’s engagement with space – in this case, urban navigation. The act was also linked to system coding, requiring the recording to be conducted along a rectangular path.¹ Importantly, it differed from many soundscape projects in that the field recording was not a solitary endeavour. Rather, it was a cooperative undertaking, with the location choice also being made through an iterative process. This was made possible by the fact that the material allows for playback, or repeated listening and even a stimulated recall thereof (Stefánsdóttir and Östersjö 2022; Östersjö et al. 2023). Through this, the material became a source for ‘shared listenings’ essential to the prototyping.

In line with the autoethnographic approach, Stefánsdóttir initially selected two locations that were ‘Malmö to her’, eventually choosing a part of the harbour area by the closed-down Kockums shipyard and the Kungsgatan alley and the neighbouring canals. These recordings sparked discussions about sonic features,

¹ Each archive presented a different spatial pattern for the field recording to follow – dot, line, triangle, rectangle. Only the first three were presented at the first performance at the SPOR festival.



Figure 1. Final layout of the square for field recording.

rhythms and timbre as well as the socio-political realities of Malmö. Malmö is a diverse city with inhabitants from over 180 countries and nearly 150 different languages (Malmö stad n.d.). The city is undergoing a significant urban transformation, with old industrial buildings being replaced by high-tech architecture particularly in the harbour area. These considerations influenced the final choice of site, as shown in Figure 1.

Map-making has a long history intertwined with colonisation and surveillance. Field recording shares a similar past rooted in military applications (Wright 2022). Therefore, these practices demand a critical listening positionality. As part of the planning, Franzson consulted a lawyer specialising in privacy legislation for how to handle any incidental conversations that might be captured during the recording process. However, legal compliance does not necessarily ensure ethical practice. Therefore, although humans are poor at voice recognition (Latinus and Belin 2011), it became evident that ethical editing of the material might be necessary later. Thankfully, only sentence fragments appeared in the final recordings somewhat sidestepping this ethical issue.

The act of cooperative prototyping should be understood as a listening approach driven by phenomenological variation. In this context, recording technology and micro-sonic or monitored listening via headphones generate specific affordances for listening (Östersjö 2020; Stefánsdóttir and Östersjö 2022). As highlighted by Don Ihde (1990) in his explanation of the hermeneutic relations between humans, technologies and the world, the recorder has a different intentionality for sound than humans. For instance, it records background noise at a higher level than perceived by the human ear. Yet, recording technology also affords an ‘insider’ stance in relation to the environment, allowing for a partial engagement with how it is to navigate ‘through a nascent world’ (Ingold 2011: 73). In this way, technologies may provide a sensory ethnographic perspective (Pink 2015) – in this case, on wayfaring through Malmö’s urban environment.

Importantly, as the recording was to be configured within a future event, it also enacts a ‘staging’ (Böhme 2017) of urban ambiance through walking-as-mapping. An awareness of this, accumulated through years of field recording, influenced Stefánsdóttir’s choice of equipment: a couple of 4061 DPAs in a DIY setup, selected for their ambient qualities. She also carefully chose her clothing and controlled her movements to minimise her physical presence, avoiding the staging of her ‘persona’. Instead,

her aim was to create a situation for future sensorial engagement with urban sonic geographies.

We identify the shared listening to this material as an act of stimulated recall. Originally, stimulated recall was seen as a method allowing a subject to ‘relive an original situation’ (Bloom 1953: 161) and is closely connected to micro-phenomenology (Petitmengin 2006). However, as Stefánsdóttir and Östersjö (2022) point out, it is a convoluted practice where the mode of reduction cannot be separated from the perspectives provided by post-phenomenology, as unpacked in the preceding example.

3.3. Continued prototyping

The continued work on *an Urban Archive* unfolded through remote collaboration across the participants’ home studios and through three occasions of in-person explorations, at IRCAM in Paris, France, Center for Art and Media (ZKM) in Karlsruhe, Germany and finally during the premiere at the SPOR festival.

Throughout the process, the system underwent a number of developments, stabilising as a low-density wavefield of 24 speakers with 40 sound sources. The low speaker density is a workable solution for a mobile system, and in accordance with Wilson and Harrison’s claim about how artistic and musical criteria may downplay the importance of precise localisation (Wilson and Harrison 2010). The absolute positioning of sounds in the field is not pivotal in an aesthetic work where the general location or direction of sound is more important than absolute location. During this development phase, the importance of musical phrasing of sound as it moves through space, giving the listener cues of when the sound is beginning, holding and ending, became apparent.

These developments were shared with Stefánsdóttir through videos, set to convey to a further extent the workings of the system and its sounding results. The next round of data that Stefánsdóttir produced for the prototyping were pitches corresponding to those found via a listening analysis that Franzson had completed of the field recordings within the WFS. This stage moved from only exploring pitch materials to experimentation with sound production and, later, work with a rough reference render of the field recordings. This initial testing revealed that sending certain sounds too far out of the expected range of possibilities could potentially disturb and unbalance the system. However, it was not until in-

person experiments during a two-day workshop with Franzson at The Sound Dome of ZKM in Karlsruhe, Germany that Stefánsdóttir was able to experience the performance's 'otherness'.

As her violin was integrated with the system at ZKM, it seemed to adapt a tentacle-like form, through which the resonances shifted and shaped a virtual hologram. De Souza (2017) notes that as instruments move from analogue to digital, players lose touch with the location of sound production. This applies to the tentacle violin. However, the signal configuration not only alters the player's usual relationship to her instrument, but also that of the speakers. They no longer merely transmit sound into acoustical space: performer → (violin–DPA–speaker → world), but become part of a performer → (violin–gateways–hologram/speaker → world) configuration.² Continued experimentation at ZKM evolved around gaining further understanding of how sound best travelled within the hologram and how the performance should unfold in terms of timbre, articulation and level of playback. Through such testing, Stefánsdóttir started to work with what she calls a 'pulsation polyphony'. An approach that allowed her to creatively work with length and articulation of notes and as a result, create a texture that felt meaningful in relation to the resonances.

Initially, Franzson had intended for performers to stand at the edge of the holophonic garden, performing into it rather than within it. Through Stefánsdóttir's development of a performance practice for *an Urban Archive*, she proposed to alter the relationship and instead of translating the navigation during field recording into a performance method, to open up to a wayfaring attunement within the holophonic garden. Stefánsdóttir's memorisation of the 45 minute pitch score, combined with the violin's affordance in terms of walkability while playing, alongside wireless amplification and a wearable stopwatch, made this possible. As a result, the work at ZKM also led to discussion regarding clothing and possible traversing strategies. The hows of such a performance was not to be realised until the premiere, where all entities would gather at the interface, audience and weather included. An augmentation that would push at what performance may become in terms of expressivity and communication.

3.4. Gathering in an urban garden

A presentation of *an Urban Archive* was organised by the curators of SPOR festival, Anna Berit Asp Christensen and Anne Marqvardsen in the Rå hal hall, situated in the Godsbanen venue, a former goods station in Aarhus. The hall is atmospheric and evokes thoughts of the city's industrial past. Throughout the day, pedestrians and cars pass its windows, and the light of the space shifts according to the weather outside. The speaker system was assembled in a hotel room in Aarhus from speaker elements flown in via a single suitcase, mailing tubes that had been previously sent to the festival office that functioned as the speaker bodies, and copper wire picked up from a local hobbyist store. The speakers were placed in a 4 × 6 grid with 4 m between each speaker, forming a 12 × 20 m performance space. Following a half day of rig-up and consequent sound check, the doors were opened to visitors.

Musical interfaces, as elaborated by Frisk, often push at the ontology of musical works. For, although they have often been labelled as 'instruments', 'in some cases these systems are as much a part of the score as the score is (if one at all exists)' (Frisk 2020: 35). In the case of *an Urban Archive*, we may see how the system takes

on the role of an installation (when running without performers), creator (when sound files were fed through the system by Franzson) and co-creator when a performer was hooked up with the system. Similarly, the length of its resonances may function as an aural score, as their length and spread impacts performative decisions on behalf of the performer.

Importantly, the installation enacts a virtual environment, which was envisioned by Franzson, to function together with the resonances as an open-ended situation, wherein the performer's performance was the path of discovery. Similarly, the visitor's experience would be steered not only towards an encounter with the holophonic garden, but also towards their experience of the performer experiencing it. From this, we may see how the only traditional score, or the pitch score that includes the information as to which pitches could open the resonance gates, is just one element in the organisation of *an Urban Archive*, which is as much a definitive text as what would traditionally be called the score.

To further grasp its hybridity, we need to turn our eyes towards the materialities and their mediating effect for not only did the speaker setup (Figure 2; Stefánsdóttir and Franzson 2024) function as sound source, but it can also be seen to carve out a field, or garden, for navigation. This was different from experiments done at ZKM where the speaker dome placement, high above the ground, did nothing to enact such staging. Neither did the explorations at IRCAM, where the speakers were placed on the floor, perhaps both due to the number of speakers used and consequent size of the area. At SPOR, through both the area size and Franzson's 'queering' of what a speaker may look like, the speakers become scenographic materials that can send the imagination flying. This in return affords the performer and visitor another layer with which they can experientially engage.

The urban environment unfolding outside the windows of the venue becomes another element in this shared space. Given the materiality of the work, the sound in the installation, at times, conflated with noises from outside, confusing the discrimination between which sounds were 'real' and which were not. This also occurred in subsequent performances at the Hafnarborg Museum in Hafnarfjörður, Iceland and Frankie in Los Angeles, United States, where the movements of cars outside made it hard to know what was real and what belonged to the work. Thus, the staging creates a porosity between the outside and inside, contributing to its overall atmosphere (Böhme 2017).

To further understand how 'staging' unfolds within *an Urban Archive*, we choose to look towards a gestural analytical framework proposed by Jaana Parviainen, Kai Tuuri and Antti Pirhonen (2013). Developed in relation to their investigation into movement within HCI design, it puts forth the choreographic grid of 'micro', 'local' and 'macro' movements. The micro involves real and imagined movements, the local has focus on the intentionality of movements, and the macro links to broader interconnections with other milieus. Of importance is that through such an analysis 'the focus of this bodily engagement shifts to the intentional, environment-oriented and social aspects of interaction, and how the micro-level (actual and imagined) movements connect to the choreographic continuum of the user's actions' (ibid.: 110).

An example of local level engagement by the performer during performance is when a sound of a traffic light within the hologram prompts a rhythmical response in her playing. Equally, cars driving by outside the hall triggered a local response, functioning as an incidental visual performance score. Similarly, her playing 'made present' that which she otherwise would have perceived as a background sound within the WFS. Such as when resonance

²The schematic depiction builds on Peter-Paul Verbeek's (2008) expansion of Don Ihde's hermeneutic relations between humans and technology, set to be further detailed in section 4.



Figure 2. Still from documentation of the premiere of *an Urban Archive*, at the SPOR festival.

strophes, triggered by her, blended and dissolved with other sounds of the hologram, making it ‘audibly appear’ to her in the process. The beauty of such morphing prompts listening while traversing, rather than responding through more playing. Gernot Böhme describes such sensing as an experience where ‘[w]hat is first and immediately perceived is neither sensations nor shapes or objects or their constellations . . . but atmospheres, against whose background the analytic regard distinguishes such things as objects, forms, colours etc.’ (Böhme 1993: 125). Another instance of such an act, wherein atmospheric relations invite retrospection, occurs when Stefánsdóttir comes to a halt, immersed in sunrays. This prompts her to linger in the sensation and incorporate her contemplation of such an ‘outside’ effect into the performance.

The performer is also affected by the movements and positioning of visitors. A notable instance is when Stefánsdóttir decides to stay and play near a person who is lying on the ground, listening. Through their participation, visitors become performers and rewrite parts of the holophonic garden, its atmosphere alike. This brings to mind how technical innovation may result in the reconfiguration of persons, roles and practices (Suchman 2007), which we will further address in the concluding discussions.

4. Discussion

One of the aims with *an Urban Archive* was to create a situation that would enable experiential engagement, so often lacking in soundscape compositions, all the while creatively exploring the possibilities of the WFS technology. This was done through curatorial conceptualisation, which considered the holophonic field as an extension of reality rather than substitute. As this was done through cooperative means, it opened up for an analysis of what such approaches afford an artistic collaboration across the practices of performer and composer.

As an entry into discussion thereof, we turn to Peter-Paul Verbeek’s post-phenomenological theorising, which entails an

expansion of Ihde’s hermeneutic relations between humans and technology, towards the category of ‘composite intentionality’. It entails a double intentionality:

one of technology toward ‘its’ world, and one of human beings toward the result of this technological intentionality. In other words: humans are directed here at the ways in which a technology is directed at the world. This implies that, to conceptualize the basis for composite intentionality, the dash in Ihde’s schematic depiction of the hermeneutic relation human → (technology–world) should be replaced with an arrow. This gives the following scheme: composite relation human → (technology → world). (Verbeek 2008: 393)

We are here reminded that human intentionality may be entangled with a sociomaterial tradition of ‘usage’. For example, as mentioned earlier, the history of field recording is interlinked with usage where technology is directed at the world in a way reminiscent of its military origins as a tool of capture and surveillance. Such ‘ways of hearing’ may then transform into work that becomes a mere representation, hindering our exploration of environmental relations. If, however, the field recordist takes seriously the anthropological intrigue of field recording (Voegelin 2014), it may be understood along Ingold’s reasoning as an ‘art of inquiry’, which ‘is not to describe the world or to represent it, but to open up our perception to what is going on there so that we, in turn, can respond to it’ (Ingold 2015: 8).

In this context, technological intentionality due to its possibility of ‘multistable variation’ (Ihde 2007) may offer new ways of doing, if approached from a critical positionality. This recalls ethnomusicologist Steven Feld’s experimental approach to field recording techniques that focused on the body’s tracing of space. His ongoing work, aimed at demystifying his equipment in relation to the Bosavi people he was recording, led him to engage in shared listening. This resulted in an approach he called ‘dialogic editing’, which gave the Bosavi people increased agency in the process (Feld in Lane and Carlyle 2013).

Similarly, in *an Urban Archive*, Franzson’s decision not to record the sounds of Malmö himself was an act of decolonisation wherein

the composer handed the technology over to Stefánsdóttir so that she could engage directly with the sounds of her hometown. This then became a material for shared listening and stimulated recall, which fed into the next round of recordings. However, such curation was intertwined with another set of technologies – the WFS. An explicit example is how Stefánsdóttir's choice of clothing and movements correlated with her projections of the future virtual performance space and Franzson's projections in relation to the material into the context of resonance design. This can be translated into Verbeek's schematic depiction of composite relations as follows:

human → (technology → technology → world)

Focusing on field recording as the primary technology, we see it aligns with Verbeek's subcategory of composite relations, or 'augmented intentionality' – the mildest form of composite intentionality (Verbeek 2008). This augmentation, building on Husserl's method of 'essential intuition', creates a framework for identifying a phenomenon's critical elements (*ibid.*). Had the recordings simply been embedded within the WFS technology, the work would not have progressed beyond this augmentation, despite WFS's potential for sensory navigation. However, Franzson's desire to explore the technique as an extension of reality, coupled with the introduction of resonances, shifted it to Verbeek's second subcategory of composite relations: constructive intentionality. This approach 'generate[s] a new reality which can only exist for human intentionality when it is complemented with technological intentionality' (*ibid.*: 394).

WFS is often presented as a technology that addresses or diminishes the rift between so-called artificial and real-world sounds. As unpacked in this article, the boundaries are however still in place, made even more apparent due to the resistance produced by its computational overhead. From this perspective, the project became a way of working creatively with WFS. This resulted in a prototyping process where the system adapts the agency of virtual environment, co-creator, archive and hybrid instrument: a soundscape composition that opens up to a novel experiential possibility.

The project aimed to create a context for sonifying and embodying a person's perceptual engagement with the environment. Through several iterations of *an Urban Archive*, we were able to further assess elements essential to the constructive approach. The performer's physical presence – or lack thereof – created a new version of the work in each iteration. Unsurprisingly, when presented as an installation with resonances activated through playback, the focus shifts towards its machinic and archival agency. A telematic iteration with Stefánsdóttir playing into the installation from Sweden while it was presented in Iceland introduced an element of liveness. However, it is not until she is present in the space that the wayfaring element is fully activated. As a result, she not only lends physicality to the hybrid instrument but, through her navigation, also heightens the performative agency of the visitors within the work. Simultaneously, she expands the agencies at the interface through her reaction to environmental entities and atmosphere in the performance space.

The success of the constructed relations also stands in a direct relationship to spatial properties. Architectural space, much like sound, expresses a sociality and territoriality. Given the materiality of the archive, the choice of the Rå hal hall in Aarhus created a correspondence through the intricate environmental mediations in place – ranging from light to temperature, resonance, movement of passing cars, rundown industrialised materiality and other elements. Another interesting effect manifested in the performance

at Hafnarborg. Although the space had one side covered by a window onto the street, allowing for some augmented environmental mediation, the work still transferred at times into a performance 'for', rather than 'with' as the audience chose to gather outside the holophonic garden. This had also occurred at times in Aarhus, but there in Hafnarborg, when the audience stepped outside the garden, little space remained, and what was left did not fulfil the role of staging or stage design as it had at Rå hal hall. As a result, the 'fourth wall' appeared – a performance convention where the audience looks 'at' the event and perhaps goes no further than co-creating an atmosphere driven by intent listening rather than participating in it.

5. Conclusion

We conclude that working with the WFS as a soundscape composition mechanism can only be fully realised when the transcreation allows for staging that extends beyond the institutional constraints of space. This presents challenges, as event/festival organising often involves predetermined spaces, and expanding beyond these typically requires infrastructure not recognised by funding bodies. However, Franzson's DIY speaker construction exemplifies a direct response to these funding limitations, enabling the work's staging in the Rå hal hall without substantial speaker and installation costs. Our conclusion resonates with Ingold's critique of how acousmatic settings may deprive soundscape compositions of their potential to evoke multimodal environmental responses. Achieving an alternative scenario, however, depends on an iterative experimental process.

The second aim of this article was to explore how working with the WFS offers novel approaches to composition, performance and artistic collaboration across these practices. From our analysis it should be clear that a work such as *an Urban Archive* aligns with new musical practices that resist inherited practices of score writing or organisation through phonographic writing. Rather, this soundscape composition evolved around a musical-system design that could take on the role of virtual environment, co-creator, archive and hybrid instrument. From this we may see how some of the performative elements, essential to musical performance, or instrument and musical stage, are no longer steered by inherited aesthetic contexts, but rather become situations for experimentation and questioning of the possibilities of sense-making through music.

We have detailed how the collaborative prototyping process unfolded in part through shared listening and stimulated recall, facilitated by technological mediation. This allowed composer and performer alike to gain new insights while using these same approaches as methods for creative collaboration. Importantly, the onsite ethnographic engagement, and the shared experience thereof, gave Stefánsdóttir increased agency in the prototyping process. We have explained how this approach extends beyond the traditional interpretative or advisory role of performers in Western art music and the training found in the DMI tradition, resulting in ergodynamic material.

This shifted *an Urban Archive* towards a choreographic element, further reinforced in Aarhus by the curator's choice of site. This aligns with a trend in Western Art Music where non-dance or non-theatrical spatial organisation explores contemporary aesthetics and challenges hierarchies. However, performers may still find themselves relegated to an advisory role or, worse, engaged in works whose methods are designed to rob performers of performative agency. While this article will not delve into the

ethics of such practices, we emphasise how combining the preceding methods and critical stance with platforms enabling long-term collaborations can forge a path towards ‘otherwise’ co-creativity and facilitation.

Similarly, the distributed co-creativity in *an Urban Archive*, as it unfolds through environmental and technological mediations, pushes at the usual anthropocentrism inherent to musical creativity. This prompts us to conclude that the transcreation of sensory ethnographies may only acquire a transmodal effect if we come to embrace and critically engage with the co-constitutive possibilities of more-than-humans.

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Videography

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