

Sonic Wings: A Wearable Live Electronics Device for Performing Mixed Music

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ABSTRACT

This paper introduces the Sonic Wings, a wearable device that can capture audio, apply computational processes, and output new audio data in real time. This study covers the device's construction and the composition and performance of a stochastic solo piece of mixed music for flute and live electronics using the device. The Sonic Wings were developed using found speakers inside cardboard-made acoustic waveguides, a microcomputer accessed remotely, and a portable audio interface connected to a clippable microphone. Mounted to the performer's body, this system allows the performer to move freely while playing and interacting with the device across a performance space in which audiences stand and move spontaneously. This study's approach to interactions with body-mounted interfaces in musical performance challenges notions of control introducing notions of companionship. Engaging with the figure of the cyborg as proposed by Haraway, this paper discusses how the development of such device unfolds the embodiment of hybrid ontologies through musical performance enabling interactions with audiences through movement across an acoustically evolving space.

Author Keywords

Audience-performer interaction, new materialism, wearable speakers, performer-technology interaction, mixed music with live electronics

CCS Concepts

•Applied computing → Sound and music computing; Performing arts;

1. STATE OF PLAY AND AIMS

Throughout the history of mixed music, the integration of live electronics devices and processes within musical performance traditions has been problematic, mainly because physicality is central to sound production and meaning making in these traditions. From early live electronics works using analogue systems such as Kagel's *Transición II* (1959)

and Stockhausen's *Mikrofonie I* (1964), to the later introduction of digital signal processing leading to the development of real time audio processing [5], the body has been consistently displaced from sound production and display. When electronic sounds are diffused through speakers placed at a physical distance from the performer's body, listeners' perception symbolically and aesthetically separates electronic sound production from the body.

This study presents a practice-based artistic exploration of a live electronics device called Sonic Wings mounted to the performer's body. This wearable system runs a live electronics process from capturing and computing an audio signal to outputting a new audio signal and is designed to be used with an acoustic instrument in mixed chamber music performance. It has been studied that when performing mixed music with live electronics using standard sound diffusion systems, instrumentalists perceive electronic sounds as an expansion of their performance placed outside their body that they can control up to a certain extent with embodied gestures and instrumental timbres [2]. Bahn and Trueman addressed this issue of body disintegration when developing the SSpeaPer interface (a wireless MIDI controller and arm-mounted speakers) engaging with embodied musical gesture as well as with Haraway's figure of the cyborg enacted as a female persona that gains control over technologies [1]. However, the case of practice here examined engages with Haraway's cyborg metaphor interrogating a wearable interactive device as companion rather than as the subject of control strategies [4].

This paper considers technical and aesthetic aspects relating to: (1) the construction of the Sonic Wings, (2) the composition and notation of a mixed music piece for flute and live electronics using this interface, and (3) the performance of that piece, titled *The Agent*.



Figure 1: *The Agent* performed with the Sonic Wings

This study addresses questions relevant to the project of body reintegration in mixed music performance: first, whether a wearable live electronics system can foster aural intimacy and timbre subtleties characteristic of acoustic music traditions. Second, how may a performer become a companion of a live electronics interface rather than its master, which leads to interrogating which compositional



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and notation strategies may promote such notions of companionship between performer and technology and whether developing such musical dialogue can facilitate experienced notions of companionship between performer and audiences.

2. THE MAKING

2.1 Hardware and Software Components

The hardware components of the Sonic Wings are reduced in size and weight (1.2kg.). The acoustic audio input is captured by a clipable condenser microphone facilitating movement. The microphone is plugged into and phantom-powered by a portable audio interface connected to a microcomputer, powered by a portable bank. The microcomputer used is a Raspberry Pi 4. A DAC amplifier board is pinned to the computer board to output audio to a pair of 3W stereo speakers. The boards (inside a sealed case) are placed inside a backpack with the audio interface.



Figure 2: Hardware Components of the Sonic Wings

Raspberry Pi OS is based on Debian and thus the ARMv7 version of Reaper (Cockos 2006) was installed and used for processing audio in real time. During the performance, Reaper is operated remotely through a RMDT protocol from a device connected to the same wireless network as the Raspberry Pi.

2.2 Handcrafted Components

The choice to build acoustic waveguides with cardboard emerged as a means to both amplify the speakers' volume and attach them to the arms in a fixed position (Figure 3). Velcro straps were glued to each waveguide to fasten them around the arms. The volume of the sounds diffused with the Sonic Wings is considerably quiet compared with standard electronic sound practices described above and equals a chamber music ensemble member, fostering the notions of companionship aimed at in this study.

The lengthened shape of the waveguides combined with the risen arms position needed to play the flute suggests the Sonic Wings's name and informs the movement quality explored. This position places the acoustic source in the same physical location as the electronic sound source emanating from the wing-arms opening aside. Sound production becomes a broader poetic action in which meaning is communicated through musical gesture. These gestures also offer particular aural experiences to audiences as sound display shifts in proximity to their ears.

The use of arm-mounted speakers draws connections with the SSpeaPer device used in the *Pikapika* performance [1]. Though the Sonic Wings share the aesthetic and acoustic concept of electronic sounds emitted by a human body, they differentiate in that they integrate a live electronics system for real-time audio processing within mixed music performance, as opposed to operating a midi controller, and in that they conceal the technologies processing sound using black waveguides and a black backpack, as opposed to exhibiting them to evoke a *high-tech look* [1]. This approach

engages with Haraway's views on fascination around technology as dystopian [4] to creatively explore connections with technologies through listening and playing rather than visually enunciating the technologies in use.

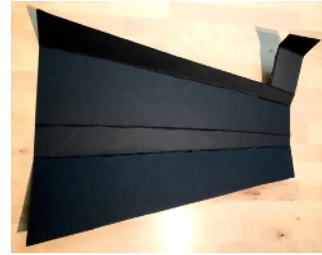


Figure 3: Cardboard-made attachable acoustic waveguides

3. THE AGENT

3.1 Scoring Performer-Machine Interactions

The Agent was composed and performed by the author with the aim of becoming a companion of a live electronics interface. Its text score articulates notions of companionship between acoustic flute sounds and electronic sounds fed back by the computer and is a new materialist response to Oliveros' text score *The Witness* [6]. Both scores elaborate detailed yet flexible performance indications and differentiate sections through changes in modes of interaction. While *The Agent* is a solo work for any instrument with live electronics accompaniment functioning as stochastic counterpoint, *The Witness*' instrumentation is variable including a solo version played with an imaginary partner. This aural and philosophical exercise draws connections with Oliveros' *auralization* practices which comprise listening to sounds made by external sources, making sounds, and imagining sounds [7]. Accordingly, *The Agent* enacts a hybrid flutist-bird exploring sound-making bodily co-presence with audiences.

The score of *The Witness* offers four-dimensional indications for each section: Sound, Movement, Theatre and Attention. *The Agent* focuses on Sound and Movement as the theatrical dimension of music-making is approached in a performative sense. The theatrical development of *The Agent* relies on movement and immediacy (see appendix for video recording) as opposed to on preconceived intentionality. There is an overall structure for the movement designed as an entering and exiting path which gives a narrative structure to the piece unfolding by its own process. There is no specific section for the end in *The Witness* but the indication to gradually become totally silent. *The Agent* also ends by becoming gradually silent, though this is achieved by the final section's mode of interaction. The performer's attention is not prescribed in the score of *The Agent*, but rather developed through co-presence with technology and audiences.

3.2 Live Electronics as Dialogic Counterpart

The live electronics system set in Reaper consists of two tracks. A track inputs audio from the microphone and sends it only to an effects track containing Reaper's ReaDelay plugin. Addressing the aims of this study, the plugin's parameters are set to create a dialogic counterpart. The plugin's Dry channel is set to zero to avoid amplifying the flute's input. The speakers display only the material created in real-time. The length indicated in milliseconds is

set to 1370.4 to ensure a temporal separation between the flute’s input and the system’s response avoiding an echo or late reverb effect (see Figure 4). Accordingly, no feedback was used. The musical length tab is linked to a randomised LFO modulation, the delay thus suddenly taps repeatedly or stops articulating contrasting rhythmic sequences and sound lengths.



Figure 4: Delay plugin settings in Reaper

This live electronics system draws connections with Oliveros’ Expanded Instrument System (controlled by the performer with foot pedals and switches in real-time) [3] and with NIME technologies developed by women across the categories of augment instruments and gestural controllers. While the Sonic Wings augment the sonic possibilities of the flute, they produce independent musical material and their system relates to microphone-speaker arrays described by Reid and Kapur as gestural controllers [8].

The stochastic configuration of *The Agent’s* live electronics examines agency in apparently static matter challenging notions of control usually present in technologically mediated performance practices and exploring mutual agency between acoustic and live electronics parts or even between human and technology. This approach differs from *The Witness’* oscillation between leading and following interactions with external sound sources. *The Agent’s* title indicates connections with *The Witness* while shifting philosophical conceptions through technological enquiry.

4. CONCLUSIONS

To conclude, this study approached interactive technology in music composition and performance practices effectively engaging with the new materialist proposal of companionship. When inquiring the application of new materialist ontological configurations to a piece of mixed music with live electronics, the development of an interactive device whose main features are portability, accessibility, and aural agency emerged. The physical dimensions of and the sounds displayed by the Sonic Wings meaningfully informed the performer’s movements and modes of playing. The stochastic nature of the score indications and the electronic sounds provided the freedom to subtly improvise responding to audiences’ bodily presences. It has been here demonstrated that the use of a body-mounted live electronics device enables the embodiment of hybrid ontologies through shifting modes of sound production and display. The cyborg-performer became a companion-performer by way of physically integrating into the audience space enabling music to unfold as a result of co-presence within a social context and reframing audience-performer interaction.

This study has contributed to NIME technologies developed by women and provided a framework and approaches that can be applied to further musical practices, replicating or further developing the technical design used (which may include controlling the effects through movement) as well as engaging with new materialist feminist enquiry when developing body-mounted interactive interfaces.

5. ACKNOWLEDGMENTS

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6. ETHICAL STANDARDS

To conduct this study, principles of ethical and professional conduct have been followed in accordance with the University of Portsmouth’s Ethics Standards, Protocols, and Processes. Winter Composer Festival is supported by Rea Charitable Trust, Texas Commission on the Arts, and Cultural Arts City of Austin. The hardware and software components used for developing the interface are presented as off-the-shelf products and their use is not supported by any form of endorsement whatsoever. The author has no conflicts of interest to declare.

7. REFERENCES

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APPENDIX

A. THE AGENT SCORE

<https://figshare.com/s/af895c65aae6d0273d81>

B. THE AGENT VIDEO RECORDING

<https://youtu.be/92-AtGuiEMo?feature=shared>