Sound and Wearables

Johannes Birringer & Michèle Danjoux

Introduction

The idea of "wearing sound," and of designing sound to be worn on the body or on moving objects, is not an altogether new phenomenon in the arts. In a popular cultural sense, however, such an idea may pertain to many 21st century wearable technological gadgets in the music, fashion, sports and health markets. The many people we encounter on a daily basis walking the streets, traveling on trains, jogging, shopping or sitting at their laptops in cafés, with their earphone cables plugged into smart phones or iPods, reflect a changing culture, a process of internalization and privatization that is a symptom of media diffusion and electronic miniaturization, but also of the ever advancing digital technologies, platforms and shifts in distribution through streaming. The advance is also a shrinkage, reducing our sensorial relationship to the world, even as a technology and innovation-driven discourse in post-industrial societies suggests otherwise.

Sound is a critical environmental phenomenon of common experience – we are all "ensounded" and perceive material realities through hearing and listening, in the lively and life-long manner in which we communicate with others and with the environment, moving through, and existing in, the realm of the senses.[1] Music has played a vital cultural role in our civilizations throughout the history of evolution where sound, organized and performed in song and instrumental-percussive modes of accompaniment, became distinguished, patterned and rhythmicized as musical form for spiritual and communal rituals. These were, in the modern age, gradually superseded by entertainment and the consumption of products in a functional design or functional artistic realm where the distance between metaphysical and instrumental values had diminished or disappeared.

The decisive break with the performance of music arrived through the invention of recording technologies that transformed the idea of being ensounded, through a growing industrialization, marketing and distribution of music, sound and voice through records and mass media (radio, film, television) and, in the later decades of the 20th century, through individualized home audio systems and portable media, including access now to wifi networks and streaming. The notion of embedding sound on the wearer and into the wearer's behavior is therefore owed to sound's portability, accessibility to transmission, replayability and reproducibility.

In this chapter, we examine some conceptual proposals for "sonic bodies," in the sense that we are interested in introjective, generative and projective aspects of wearable sound, thus in the embedding of sound into clothes – costumes more properly speaking – or onto the body. Embedding may not be the precise term, since we are less concerned with sending sound to a wearer and making it inhabit the wearer, than we probe the creation, the making of sound through wearing, and thus the becoming of sounding bodies. Through historical example or contemporary case study – some referencing our own experience working with the Design and Performance Lab (DAP-Lab)[2] – we focus not on commercial consumer sectors but on diverse creative arts productions revealing intricate relationships between aesthetic design (fashion, scenography), sonic art (sound design for wearables), and performance (theatre, dance, installation, film).

As we define them more specifically in these artistic performance contexts, "wearables" are performative costumes or accoutrements, which to an extent are *sound instruments* (encompassing body-worn technologies and wired or wireless sensors). Yet they are also more than that. Developing the notion of "design-in-motion" coupled with audiophonic wearable concepts (Danjoux) points to a collaborative design fashioning process method, where along with the dancer or performer the designer creates a rehearsal series for constructing the "sound characters"[3] through movement and gestural expression. The choreographic and scenographic side (Birringer) of this process implies the creation of kinetic environments for wearable improvisation, for a "scoring" of their narrative and interactive physical-material potentials in expanded theatrical, architectural, fashion and performance contexts. Finally, in a larger political sense, sounding wearables can have a conductive social dimension that (at least subliminally) reconnects ensoundedness to the kind of cultural ritual and healing endeavors mentioned in the beginning.

Sound instruments as body instruments

As Marshall McLuhan argues in *The Medium is the Massage: An Inventory of Effects*, "all media are extensions of some human faculty – psychic or physical" (1967: 26). This includes clothes which he posits as extensions of the skin. In addition, he posits "electric circuitry" as an extension of the "central nervous system" (38-40).[4] More recently, Donna Haraway, Anna Munster, Susan Kozel, Don Ihde, Mark Hansen and others have written on issues concerning the body's shifting relation to technology and scientific advancement. On the question of how technology transforms our perception, Ihde for example explains in the context of astronomy and the telescope that the latter becomes an amplifier of perception. Thus, "instrumentally mediated observation," as he calls it in this case, enables extended viewing beyond the limits of normal human perceptual range (Ihde 2002). Furthermore, he adds, the computer can then transform image into data and data into image in a form of reversibility. While we are not focussing on optical technologies and visual techniques here, the data from a performer's body movements – being transmitted to and transformed by the computer – can of course be utilized both for sonic and visual output.

It is the motivation for movement that interests us, and movement's relationship to sound: perhaps we can speak of instrumentally mediated and modulated conduits. Sound, in our experience, can not only be an extension of movement but also work as "intension" or intensification of movement, with the body – and what is worn – as a source for sonic material (and breath sound is a of course a fundamental conduit). With today's digital technologies, in a mediatised world, the various media extensions to the human faculties facilitate an expanded reach (optically, sonically, kinetically, haptically). The technologically equipped body can traverse realms, moving between near and far, real and virtual – its reach stretched through its interactions and mediating tools and through the internet. Furthermore, media extensions offer the experience of remote forms of touching via technological instruments such as virtual reality (VR) headsets and haptic devices. The process of embodiment of new media technologies, argues Anna Munster, has the potential to become both sensate and virtual – beyond pure engagement on a material and corporeal level (2006: 17). As

intension, however, the sound generated or processed by the wearer, can also become a highly affective catalyst or stimulus for movement and a range of expressive and interactional gesture.

"The visual and the tactile, distance and proximity, play a part in shaping our aesthetic perception," writes Ingrid Loschek in *When Clothes Become Fashion: Design and Innovation Systems* (2009: 57). She is acknowledging the impacts of design on the "aestheticizing of the subconscious," referring particularly to the materiality of one of the dresses from Alexander McQueen's *Voss* collection (Spring/Summer 2001), a dress which utilized glass microscope slides, "blood plasma slides," and ostrich feathers in its construction (fig. 1). For fashion theorist Caroline Evans, the clothes in McQueen's 2001 collection "almost fetishized materials: feathers, brocade, shells, a wooden bodice, an outfit made from a jigsaw puzzle of a castle..." (2003: 95) which she identified communicated a certain dysfunctional and psychotic look in the models. Yet, what Loschek describes is more relevant here as it shifts the emphasis away from the visual to the sonic dimensions of the dress-in-motion, a form of body-worn instrument that is animated through a dynamic act of wearing. Worn in a one-off performance by the musician Björk, Loschek explains:

> Her dancing movements caused the glass slides to rattle against each other, and this gentle jingling was integrated as a component of Björk's music: The 'blood plasma slides' mutated into percussion instruments. (Loschek 2009: 57)

Figure 1. Glass medical slides with ostrich feathers dress (modelled by Erin O'Connor), *Voss*, SS 2001, Alexander McQueen. Photo courtesy Alexander McQueen.

Loschek also discusses briefly the sounding creations – garments embellished with hundreds of tiny brass bells of differing sizes – in Viktor and Rolf's couture collection *Bells* (2000/2001) and the challenges their sonorous effect posed aurally for a fashion audience (seated in the dark) accustomed to focusing on the visual. In this particular instance, the sounding activated by the movement of the models in the garments adorned in bells is the main focus. Subtle aural irritations and shimmering sonic textures (in the absence of the visual) suffuse the air, offering new sensory stimuli and raising questions for those attuned to a certain sensibility and consciousness of the performing body on the fashion catwalk. The fashion designers mentioned here are not interested in sound creation per se, but it is significant to imagine the sound potential related to movement in the fashioned garment and how that can be experienced, as musician Deniz Peters explains with regard to instrument sounding, as "direct result of a bodily act" (Peters 2012: 1), the garment in this case becoming extended as an instrument.

The sculpting of new body shapes through costumes or wearable architectures could be traced back to Oskar Schlemmer's Bauhaus figurines and stage experiments in the early 1920s. Working on the *Triadic Ballet*, a key aspect of Schlemmer's construction of spatial dynamics was the function of the costume. While his later Bauhaus dances have been called "gestural" or "spatial" performances (also involving a strong emphasis on light projection), the *Triadic Ballet* – its full version comprising three acts, three performers (2 male, 1 female), twelve dances and eighteen costumes, with each act displaying a different color and mood – displays a predominantly sculptural leitmotif, but it is important to realize that materials (e.g. metal) chosen for the design often imply sonic effects. With exaggerated headdresses and masks, bulbous padded torsos and outfits built with wiring and concentric hoops, extended prop-like limbs and conic or spherical appendages, the *Triadic* "figurines" are constructed to impede movement or shape it in very particular ways, drawing attention to the constructedness of the costumes as well their materials. The stylized motion required to move the costume across the stage would impel arhythmic, animated steps, intercut with stillness, or a spinning motion that allows the performer to show off the entire 360 degrees of the shape.

Schlemmer's abstraction – perhaps similar to Loïe Fuller's vivid *Serpentine Dance* (1896) during which she whirled voluminous expanses of silk cloth, manipulating the enveloping materials through movement and colored light projected onto them –figuralizes spatial organization. One could almost describe Fuller's and Schlemmer's work (and parallels could be found in Russian constructivist and futurist performances, for example in Malevich's and Lissitzky designs for the opera *Victory of the Sun*) as a wearing-into-space, thus inevitably creating an acoulogical, psychoacoustic dimension. These kinaesthetic and choreosonic potentials have inspired contemporary choreographers (e.g. William Forsythe) but also composers, from Stockhausen and Xenakis to Kagel and Goebbels. Forsythe has coined the expression "choreographic object," and *The Fact of Matter, White Bouncy Castle, Scattered Crowd, The Defenders,* and the online research project *Synchronous Objects* (http://synchronousobjects.osu.edu), transpose dance from the stage into other manifestations – participatory installations, architectural environments, soundings, cartographies, digital platforms with animated graphic materials, generative data and algorithms.

Our conceptual proposition for understanding *wearable sound*, therefore, is meant to be complex, open to such transpositions and hybridities. There is no single definition or established practice, much as it is now unnecessary to worry about spurious distinctions between sound and noise. The idea of an instrumental or sonic body is of course primarily owed to music and the many ways in which musicians/sound artists have experimented with forms of electro-acoustic or electronic improvisation, with wearable technologies, sensors, and actuators as ways of controlling sound (and video) through gesture. This enabled them to move away from the more static synthesizer or laptop scenarios of electronic music – turning their entire bodies into performing instruments through the exploration of the sensory aspects of interaction. The sensorial dimension, which is owed to fashion, is taken even more literally (and also scientifically) in cases where sound is probed through *physiological instrumentation*, where physical and physiological properties of the performers' bodies become interlaced with the material and computational qualities of the electronic instruments. Recent works by Atau Tanaka, Heidi Boisvert, Pamela Z or Marco Donnarumma are good examples of such interactions with audio, video, and motion capture modalities, used alongside bio-signal based modalities such as muscle-tension (electromyogram or EMG), heart rate (EKG), or even electroencephalography (EEG). These modes can form a complex system for capturing input modalities from the expressive bodily gestures of a performer. Stelarc had used such interfaces in his work over several decades, when he began experimenting with prosthetic augmentation and robotics (third arm, ear on arm, etc.) and what he calls "extended operational architectures" of the body (2016: 93). Even though Stelarc (fig. 2) may be an extreme case of a body/media artist exploring bio-signals that amplify and intensify internal sounds of the human body, he is of course not alone in the project of attaching the cyborgian body to the network, enabling the physical body and its organs to transmit sound elsewhere, "performing beyond the boundaries of its skin and beyond the local space that it occupies."[5]
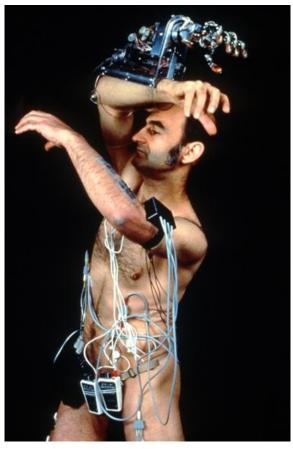
Figure 2. Stelarc, *The Third Hand*, Tokyo, Yokohama 1980. Photo: Simon Hunter © Stelarc.
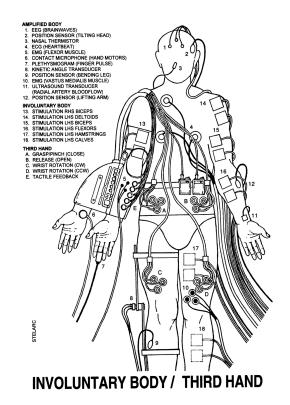
Figure 3. *Involuntary Arm/Third Hand*, Yokohama, Melbourne 1990. Diagram – Stelarc. © Stelarc.

The gestural dimension of this remains popular, linked to the desire amongst digital artists to move away from the prevailing disembodied performance models of the new media aesthetic of the 1980s and 90s. Fashion, theatre, dance and sonic theatricality easily intersect in the drive towards more sensory modes of engagement where corporeal activity sits at the heart of the technological system, where wearable and interactive technologies link to the phenomenology of sounding in staged performance.

Experimental sound artists such as Laetitia Sonami[6] have built an entire performance
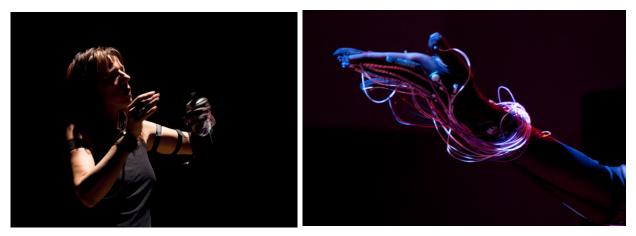
Figure 4. Laetitia Sonami with *lady's glove*, Stuttgart 2005. Photo: Bernd Wendt/falschnehmung [left].
Figure 5.The *lady's glove*, 2005. Photo: Bernd Wendt/falschnehmung [right].

practice around this notion, using interactive sensor-packed gloves – wearable apparatus – as interface for musical composition. The *lady's glove*[7], as she named it, is for Sonami first and foremost designed as a controller - the sensors and actuators all highly visible on the surface of the glove (figs. 3 & 4). She reflects on its unfolding as functional instrument relationally to the software and her musical sensibility:

> I think it becomes an instrument when the software starts reflecting and adapting the limitations and possibilities of the controller and your musical thinking ideas are more a symbiosis between the controller, the software and the hardware. (Sonami 2010: 229)

Sonami's notion of a mutuality of becoming through a process of inter-action reflects our experience of sounding through movement in the DAP-Lab performances with dancers and wearable instruments, except that Danjoux does not refer to her prototypes as controllers but positions the costumes and accoutrements as fashion as well as interfacial, aesthetic media that generate a form of distributed agency, as opposed to a form of control. Wearing-into scenographic space, especially when more than one performer is active and when their costumes are inter-referential, necessarily also makes perception and affect of singular gestures (say, an arm or hand movement) more difficult to discern, and yet also clearer, in a call-and-response sense. Such ensemble scenarios are choric and dialogic, and owe more to the lyrical improvisatory blues and jazz of the black avant-garde than to the cool conceptual European tradition evoked by sound theorists obliged to acousmatics (*musique concrète*). Wearing sound, as we understand it, is telling a story.

Composer Tara Rodgers, author of *Pink Noises: Women on electronic music and sound* (a series of interviews with female composers), comments on the physicality and multilayered aspects of Sonami's performances with the glove: "Her compositions have been described as 'performance novels,' because musical form and textual narrative unfold and are transformed through her physical motions" (Rodgers 2010: 226). In a similar vein, DAP-Lab stagings of *Suna no Onna* (inspired by Hiroshi Teshigahara's film), *UKIYO* (based on Hokusai woodblock prints and a collage of sources including Russian engineering and a novel by Christian Kracht), and *for the time being,* our version of *Victory over the Sun,* are designed to link wearables to the sensorium and an unfolding of narrative in performance through multi-dimensional and intertwined sounding-movement characters (see below).

The notion of activating sound through wearing and simple gestures or everyday motions was explored by Ellen Fullman in her *Metal Skirt Sound Sculpture* (1980). Fullman designed and built this pleated skirt, constructed out of metal as the name suggests, as performance wearable with an integrated system: sound was activated through the simple act of walking, the resultant noise simultaneously generating a soundtrack for her performance. Fullman expands on her motivations and her particular technique of sounding:

> In 1979, during my senior year studying sculpture at the Kansas City Art Institute, I became interested in working with sound in a concrete way using tape-recording techniques. This work functioned as soundtracks for my performance art. I also created a metal skirt sound sculpture, a costume that I wore in which guitar strings attached to the toes and heels of my platform shoes and to the edges of the 'skirt' automatically produced rising and falling glissandi as they were stretched and released as I walked. A contact microphone on the skirt amplified the sound through a Pignose portable amp I carried over my shoulder like a purse. I was fascinated by the aesthetics of the Judson Dance Theater in their incorporation of everyday movements into performance, and this piece was an expression of that idea; the only thing required for me to do was walk. (Fullman 2012: 3)

Fullman used the wearable sound sculpture skirt in a street performance in Downtown Minneapolis during the 1980 New Music America Festival, and a documentary video that exists of the event demonstrates the simple and straightforward execution she had imagined; yet the unexpected sound of the garment created perplexed reactions from the passers-by.[8] Her experience demonstrates how

body-worn wearables, responding directly to bodily motion, potentially challenge performers and audiences alike when the focus of a work's aesthetic design is directed at the creation of a particular character of sound or sound character that subtly redefines the idea of the "instrument" as well as movement's temporal affects – especially the latter's gestural and narrative characteristics that we find critical for DAP-Lab's theatrical installations.

The conventions of music-theatre and dance position the instrument as both an object (a device created or adapted to produce musical sounds) and a body. The performers engage their instrument and invite the audience to observe, listen to and experience the sonorous body. Just as Fullman arrived at this from a background in sculpture, so did Carolee Schneemann (who began performing around the time of the early 1960s Judson Church Dance Theatre) venture into kinetic body art with an intention of painting-into-space – her earliest choreographic works such as *Glass Environment for Sound and Motion* (1962) and *Newspaper Event, Chromelodeon* or *Lateral Splay* (1963) incorporated both performers and audiences as part of the work and led her to develop her conception of a multi-dimensional, moving-image "kinetic theatre," already at this early point incorporating film as a component of performance. Scheemann's pieces (including her notoriously messy, orgiastic *Meat Joy* happening in 1964) involved scores or task instructions for her fellow performers. With composer James Tenney she performed *Noise Bodies* in 1965 (fig. 6), a duet with everyday objects draped around the bodies, reflecting some of the typical Judson Church and Fluxus attitudes towards the mundane and the outrageous (as Schneemann demonstrated in her erotic work, and Charlotte Moorman in her "TV Bra for Living Sculpture" cello performances with Nam June Paik). But it also revealed a keen sense of noise-making acoustics. Asked about the "sound-producing debris" she wore, Schneemann responded to the interviewer:

> It was a noisy collage. We improvised together regarding what made sound and what gestures would produce varieties of sound. The way my kinetic theatre pieces developed was that parameters were set in terms of certain kinds of duration, position and action and then from studying those we would improvise. So each performance was different. *Meat Joy* has a score and units of specific active improvisation, and then within that motions change and are fluid. (Qtd. in Enright 2014)

Figure 6. Peter Moore, Performance view of Carolee Schneemann's *Noise Bodies*, with James Tenney, 3rd annual Avant-Garde Festival, Judson Hall, NYC, August 28, 1965 © Barbara Moore/Licensed by VAGA, New York, NY. Courtesy Paula Cooper Gallery, New York.

Among the most well-known practitioners working with wearables in sound art and street performance contexts is Benoît Maubrey and his Audio Gruppe. Enacted in public spaces, the costumes Maubrey created for characters such as the *Audio Ballerinas* (1990), *Audio Geishas* (1997) and *Audio Peacock* (2003) were worn by Audio Gruppe members who developed solos with a particular instrument-costume (with built-in amplification). Certain costumes have mutated into highly individualistic and self-contained sound units or "phonic" bodies producing sounds and movements in intimate, close-to-the-spectator performances (fig. 7).[9]

Figure 7. Benoît Maubrey, *Audioballerinas*, dancers with electroacoustic tutus and digital samplers and motion sensors allowing them to trigger their sounds via their choreography. 2000 Photo courtesy of Benoît Maubrey.

Vocalists have also experimented with interactive sensor suits and accessories, e.g. composer/performer Pamela Z with BodySynth®[10] featuring wearable electrode sensors enabling muscle movement to control how her voice is processed, and Julie Wilson-Bokowiec with the Bodycoder System.[11] Rodgers' book features an interview with Pamela Z where she explains her choices for incorporating various technologies into her work stating: "In every piece I do, I incorporate technologies in a certain way. I have kind of a love affair with modern high-tech objects, but I also like the simplicity and directness of mechanical things" (2010: 220). Thus, she highlights her interest in both the digital (e.g. cell phone) and the analog (e.g. typewriter) to the compositional processes of her electronic music. Furthermore, works that integrate the glitch as compositional tool, such as Stanley Ruiz' *Barong Analog* wearable synth built into a cheap plastic poncho – a trashy performable noisemaker (exhibited at The Osage Gallery, Hong Kong in 2005 as part of Futura Manila), are pertinent to the exploration of wearable sound we conducted in the DAP-Lab early on, when we compared analog and digital options. Glitch aesthetic, known for the exploitation of

dysfunctionalities or accidents in sound and noise music, implied an aesthetic we were keen to explore for its disruptive and affective potentials.

In the remainder of this chapter, we shall focus on such noise aesthetics and the particular subtleties of the poetic dress as sounding instrument in the "expanded choreographic" field which for us indicates various cross-overs between design, theatre, art, fashion and music. The wearables described here reflect a historical, critical and reflective sensibility which makes them less assimilable and commodifiable. They suggest generative performative behavior – each sounding-out affecting a subjective, often quite intimate process of noise making that does not comply to any ready-made ideologies of *interactive technology* (the "garments of paradise" Susan Elizabeth Ryan has written about) but seeks to crawl underneath the skin. The wearable instruments we use often tend to be encumbrances, sly inhibitors and misfits, instruments gesturing towards uninstrumentation, thus also questioning the interactive imperative (the contemporary swiping of screens and pressing of buttons) as such.

Ensounded Wearing

For the types of mediated performance environments in which wearables are most often performed, the short manifesto "After Choreography" proposes that in addition to there being no set choreography, one also cannot speak of free improvisation, but only of the freedom for dancers to move within the technological parameters of the system (Birringer 2008: 119-120). Interactive sensor and capture systems, as we learnt during the dance performance *Suna no* Onna (2007), where the dancers' movements "controlled" the digital and auditory space via motion and heat sensor technologies integrated into their garments, tend to be limiting (if accelerometers, for example, actuate simple pitch bends) or disorienting (when delay, feedback, doppler effects, granular synthesis, etc., are involved). The wearable interfaces enabled the dancers to become embedded in the world they created, but the dancers could not necessarily hear (nor see) the kinetic shape-shifting. In encounters with "wearable space" in interactive performance, the dancer will most likely either prefer to learn and internalize what motion sensors do, in order to adopt behavior, or not know or

repeat her movements, if the interactive system algorithms are more random, generative and unpredictable.

Figure. 8. Anne Laure Misme as WorkerWoman (Act I), performing in *UKIYO*, Sadler's Wells, London, 2010. Video still © DAP-lab.

In *UKIYO* (2010), dancer Anne-Laure Misme, equipped with various clunky sound generating accoutrements (metal cage/mini crinoline [incorporating curved speaker grills], speakers, contact microphone with transmitter and 12" vinyl disc), actively explored the technologies that extended her body physically and sonically (fig. 8). She was immersed in the long process of making *UKIYO,* and therefore understood the interconnectivity and enfolding of her sounding movement-character within the larger hybrid narrative and sonic landscape, i.e. her historic reference, abstract representation of dynamic change – past to future, revolution and mutability. In creating "WorkerWoman" Danjoux had a loose concept for the distorted and dysfunctional sound desired for this character, involving interferences and elements of analog and digital hacker culture, to pull up new sounds and compositional strategies. For her garment instrument design, electronic processes and software coding needed to be known, as well as the basic tools involved in making custom-built interface instruments which could be small and flexible enough to be worn or integrated into the garments.[12]

The materiality of this prototype connected elements of the old with the new in terms of technologies thus looking back, whilst simultaneously looking forward in a retro-futuristic fashion. The wireless portable speakers with unstable Bluetooth transmission became motivational worker tools for Misme, offering unpredictability of performance and flow. The two inverted dysfunctional speakers worn provocatively on the body (as speaker breasts integrated into bra design) intentionally and paradoxically emitted no sound at all – cracked media taken to its most extreme (cf. Kelly 2009). Unexpected sounds were forced by Misme's energetic actions flexing a 12″ vinyl LP – accentuating its materiality – as her motion shifted sound production from standard playback methods of recorded sound on vinyl, through sonic rhymes of air displacement, to detecting and amplifying hidden vibrational sounds. This was made possible using the clip-on radio microphone attached to one of Misme's fingers, with wireless transmitter mounted on her arm. The result was grungy; when she dragged the mike over the vinyl, as one would a stylus across the grooves, the sounds were amplified. Getting down to her knees, pushing the vinyl across her white *hanamichi* strip – generating the sounds of friction of a laborious task – Misme became visibly stimulated by her capabilities to manipulate the sonic landscape. Her movements became more forceful, vigorous and energetic, generating a dark booming crescendo of low frequency sound and hum. She became a noise turntablist – without stylus to delicately traverse the grooves – scratching and applying forceful pressure to the vinyl disc, flexing it in a manner that would eventually cause it to crack.[13]

Helenna Ren's "SpeakerWoman" is another sound character in this installation; she is dressed in an all-white costume that is modeled after early 60s Cold War fashion (protective spacesuits) but also alludes to workers in rice fields, as she carries a wooden bo across her shoulders from which dangle two spherical speakers , the conical forms swaying gently as she walks across the *hanamichi*, dropping rice grains onto the floor. For a few moments, all we hear are the grains falling, then high frequency sounds begin to sound from her speakers as she moves forward and backward, the wires stretching to the end of the runway and the amp. She begins to swing the speakers, and as they rotate, the sound travels in various directions, growing softer and more intimate, now resembling spectral echoes of bells and percussive music used in Kabuki performances. Her sound travels from her directional speakers outward along the lines she moves, whereas Misme's amplified, distorted noise is diffused from the surround speaker system and subwoofers. Composers Oded Ben-Tal and Sandy Finlayson, who worked with the dancers on these scenes, added a "postdigital" effect at the end of

Misme's cacophonous noise performance by letting the volume of her amplified live recording fade to a bare minimum, at which point we hear a locked groove repeating ticks and clippings from an eerie "drum" pattern originally taken from bandoneon tones (an instrument played by another performer, Caroline Wilkins).

Kinaesthetically and proprioceptively, gestural interaction with real-time environments (sonic or visual) can deflect both from the physical virtuosity or embodied expressiveness of the performer and from the unpredictable qualities and metaphoric richness of immersive aurality and moving scenographies (films, layered animations, networked video streams). The audience for *UKIYO* was to experience "moveability" as a concrete virtuality that was not overdetermined or correlated, in the sense in which software mappings determine, for example, the principal directions and speed of images (forwards, backwards, slow, fast, freeze) or the pitch, amplitude, wave shape, and granulation of sound. Our spatial and lighting design aimed at a space both polyphonic and limitless, able to surprise the visitors through unexpected intimacies as the dancers moved with – and through – the audible micro-sounds they generated.

Our interest in noise and analog/digital sounding characters guided our next production, *for the time being* (2012-14). Danjoux's new prototypes of choreosonic wearables were built to stimulate dialogical partnering between dancers in costumes, affecting both the sound and movement choreography mutually. Rather than solely characterizing the wearables as choreosonic, then, the term now applies to a particular type of *audible improvisation*: costumes and characters in *for the time being* are meant to enter into dialogue, creating a more amalgamated sonic architecture of *relational/transitional* entities. Our re-versioning of the Russian futurist opera *Victory over the Sun* provoked a new dimension of questions about how one garment worn by one dancer can influence the sounding and movement of another in performance. The RedMicro Dress and Futurian ChestPlate prototypes specifically aim to explore such contiguous relations between dancers in wearables, where the dynamics of proximity and distance and the interconnectedness of performers' movements generate sound (figs. 11 & 14). Designed for both solo and duet performance, the final version of ChestPlate, first tested in rehearsal with flautist Emi Watanabe (fig. 11), then performed by dancer Angeliki Margeti (fig. 14) in 2014, had evolved into a fully functional electro-acoustic instrument integrating interactive circuitry – incorporating proximity, bend and light sensors to effect sounding

of the instrument, and two small amplified wearable speakers into its makeup (fig. 12). When partnered with RedMicro Dress, sonic responses from the chestplate can be explored synergistically between the two dancers, their relational movements emerging concurrently, as the sensors respond to their movements and proximity.

Whilst questions relating to the amplification of analog and electro-acoustic wearable instruments in a digital theatre realm had been raised by our earlier research, intensified collaboration with musicians and electronics engineers over the past five years opened up further possibilities for technology-enabled designs and explorations of conductivity.[14] For example, RedMicro Dress, whilst devoid of its own sounding capabilities, can act as a transceiver – a receiver and transmitter – simultaneously detecting and relaying sounds, picked up in close proximity by its small integrated shoulder microphone, to a larger amplifying system operated by musicians. In the case of this duet, the small speaker system of the Futurian ChestPlate with its limited amplification is enlarged sonically and thus also aurally through improvised partnering.
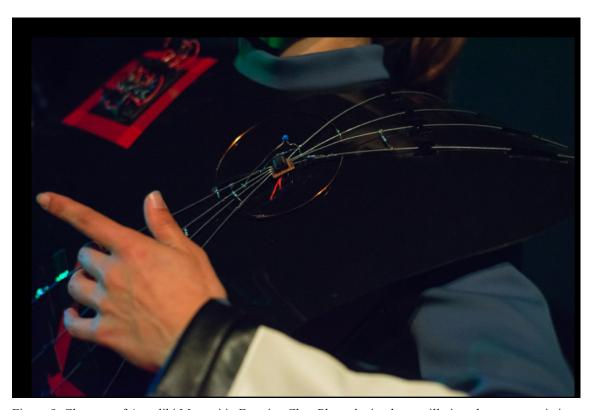

Figure 9. Close-up of Angeliki Margeti in Futurian ChestPlate playing her oscillating electro-acoustic instrument – completing the electronic circuit through touch, 2014. Photo © Hans Staartjes.

Act II, Scene VI is in fact a quintet, involving Vanessa Michielon, Angeliki Margeti, Yoko Ishiguro and Rosella Galindo: all partners move relationally but the central duet emerges from the intimate dynamics of Margeti's and Michielon's conjoined improvised performance (fig. 11). The Futurian character enters into a proximal relationship with the RedMicro Dress to commence their dance.
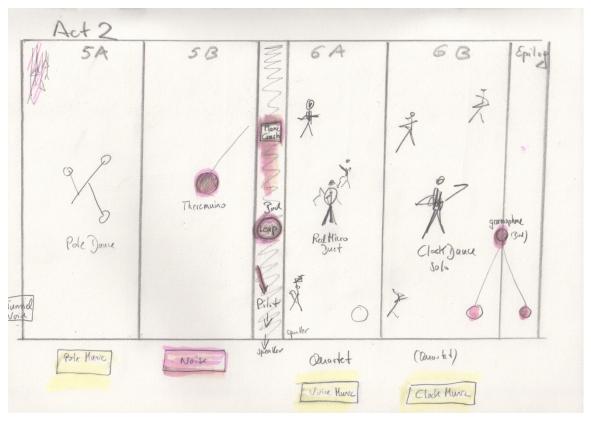

Figure 10. *for the time being [Victory over the Sun]* – dramaturgical sketch highlighting the positioning and choreographic sequencing of the four prototypes: TatlinTower; GraveDigger; RedMicro Dress and Futurian ChestPlate, 2014. © Johannes Birringer.

Michielon in red executes a repeated series of revolutionary poses, arms held straight and elbows rotating, while Margeti as Futurian approaches in her blue and black garment – a science fiction instrument adorning her chest, its two small speakers attached to her lower back. The light and proximity sensors integrated into the circuitry and construction of the chestplate detect the presence of her partner – RedMicro Dress – and mobilize sounding. As bodies draw up close, closer, before retracting again, the sounding emitted from the two integrated speakers is actuated, intensified and distorted by the circuitry interactions (see fig.12). The Futurian's noise is picked up by the dynamic microphone worn by Michielon in the RedMicro Dress, transmitted and amplified – further distorting

the sonic textures of noise. Thus, the intimate entwinement of the body instrument is advanced in Act II through dynamic methods of co-creation for compositional purposes. The choreographic here is the choreosonic.[15]

Figure 11. Dancers Vanessa Michielon in RedMicro Dress and Angeliki Margeti in Futurian ChestPlate performing a duet in *for the time being [Victory over the Sun]*. Sadler's Wells, London, 2014. Video still © DAP-Lab.
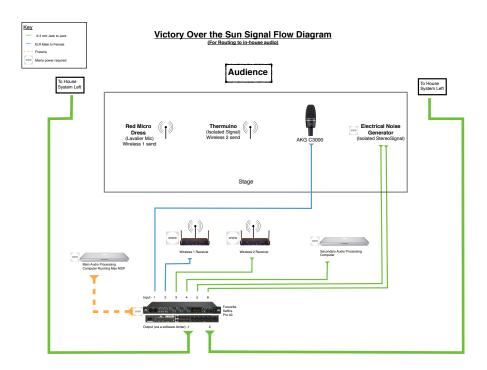
Victory Over the Sun Signal Flow Diagram
(For Routing to in-house audio)

Key

6.3 mm Jack to Jack
XLR Male to Female
Firewire
Mains power required

To House
System Left

To House
System Left

Audience

Red Micro
Dress
(Lavalier Mic)
Wireless 1 send

Thermuino
(Isolated Signal)
Wireless 2 send

AKG C3000

Electrical Noise
Generator
(Isolated StereoSignal)

Stage

Wireless 1 Receiver

Wireless 2 Receiver

Secondary Audio Processing
Computer

Main Audio Processing
Computer Running Max MSP

Input - 1   2   3   4   5   6

Focusrite
Saffire
Pro 40

Output (via a software limiter) -1   2

Figure 12. *for the time being [Victory over the Sun]*. Signal Flow Diagram (for routing to in-house audio) produced by sonic artist Oliver Doyle, 2014. Diagram © DAP-Lab.

In the opening Prolog and Scene 1 of *for the time being,* Helenna Ren initiates a quartet performing with a central icon of the Russian revolution as wearable sound. The TatlinTower (head)dress prototype was conceived as a wearable electro-acoustic instrument to be mounted on the head of the dancer (fig. 16), extending the body through a process of vibrating shivers moving through the body, subtly massaging from the inside-out, in a form of vibrational augmentation.

Figure 13. Conceptual design sketch for the TatlinTower head(dress) 2012. © Michèle Danjoux.

 The design for the (head)dress follows the double helix formation of Tatlin's famous unrealized tower and is constructed in spring metal. The main body of the instrument design integrates a metal coil attached to a small motor/vibrator at its apex to rotate the coil, a bend sensor for the dancer to control the speed of the motor and subsequent speed of coil rotation, thus altering sonic output, and a black box speaker-amplifier. A piezo contact mic sits within the main construction of the (head)dress; to pick up and amplify the vibrations of the rotating spring which beats the tower, translating the mechanical activity into electrical signals – volts that can then be sent via the small circuit and jack to jack connection mounted at the base of the (head)dress, to the black box speaker, worn on the

stomach area of the dancer, for amplification and portability of her minimal sound across the performance space.[16]

DAP-Lab's performance of *for the time being* opens with a double prolog, with Ren stage left wearing the TatlinTower (head)dress, sending out its signals. Across from her tower, downstage right, Khlebnikov's address to the futurians (from the original 1913 *Victory over the Sun)* is recited by actor Ross Jennings who wears a dark blue worker's overall and performs a repetitive transverse movement along a small triangle grid outlined on the floor. Picked up by a condenser mic, the words are processed to disintegrate into noise distortion, in order to demonstrate two points – both the visual relationship on stage between Ren wearing the Tatlin radio tower (and its subtle repetitive signal sounds) and the marching worker on the other side, and secondly their sonic relationship. Their kinaesonic prologs constitute a duet; the TatlinTower dancer operates the radio softly with her white gloved fingers, as the Announcer almost literally performs the function of a "loud speaker" (performing with megaphone) shouting out the bizarre address to the futurians, obliterating all else.

As Ren transitions from prolog to Scene I, the complex constraining presence and vibrational touch of the wearable instrument extending her body can be visibly sensed in her restricted movements. After Jennings utters the words "Never/will pass by/like a quiet dream," she rises slowly and skillfully to standing, her centre of gravity held low as she explores her body movements in relation to the instrument; head twisting, manipulating the sensor (fig. 14); stopping and starting her sound, shifting it into the space, moving the black box away from her body, arms outstretched. Ren wears a white productivist suit with the TatlinTower (head)dress, and is joined by two other women workers in white. In addition to the physical constraining effects placed on her movement habitus by the vibrating apparatus, a psychological dimension to the wearing might also be activated by these clinical if utilitarian suits.

Figure 14. Helenna Ren in TatlinTower, Scene I, *for the time being [Victory over the Sun]*, Sadler's Wells, 2014. Photo © Hans Staartjes.

Needles, Nails and Feathers

Reflecting on the expanded choreosonics elicited through such wearables as we have described them here, it is apparent that we have drawn close links between fashion and art, music and dance-theatre/opera, yet the contexts for the wearables moved from the catwalk to gallery and theatre environments. Portable and mobile media have also been used in urban contexts (locative media projects such as the roaming pieces by Blast Theory in England; Susan Kozel's *AffeXity* project with mobile devices in Sweden, or Canadian sound artist Janet Cardiff's audio walks). Our examples from Ellen Fullman and Audio Gruppe were meant to indicate how such works tend towards situationist and sound installation art – rather than involving participant audiences, the wearable sound is enacted

by the instrument builders and performers who develop more intimate knowledge of the emergent bahaviors of materials and prototypes.

This implies aesthetic criteria for the custom-built design of the wearable, the way it insinuates and/or encumbers movement gestures, the way sounds are placed (in the "score"), and how they unfold relationally and meaningfully. One conclusion to be drawn is that the mutual enfolding of movement and sound generation requires more careful attention to the scope and insistence of the aural – and in the case of DAP-Lab's adaptation of a futurist opera, attention to the music drama and its narrative threads. This is the reason why we speak of "sound characters," and although to some extent they are visual abstractions – and their gestures perceived as an important part of the visual aesthetic and kinetic atmosphere of the performance – they also carry art historical and musical dimensions that undergird the wearable through particular design and noise aesthetics (in their synergies with Japanese ukiyo-e prints, Kabuki, noise art such as KK Null, Otomo Yoshihide, Sachiko M, Toshi Nakamura, and Russian Futurism and Suprematism). The noise aesthetic is nowhere clearer than in the vibrational "radio" coil sonics of TatlinTower (head)dress and the heavy metal guitar associations of Futurian ChestPlate, the latter's visual electronic circuits a subtle allusion to Rodchenko and Stepanova's abstract *Tofts* graphics. In one scene we also hear operatic voices, but they come from an old gramophone record played by Caroline Wilkins' Motley Eye bird-character wearing a cone shaped beak. She uses her beak as a stilus, and the recorded voice becomes warped as the needle eventually gets stuck in the groove. If noise and crackling distortion are considered a form of interference, it is a pertinent index of a particular design aesthetic elaborated throughout some of our work, and the dancers' somatic and technical experiences of the wearables and their particular encumbrances (Danjoux 2017).

Our more recent work explores large-scale kinetic atmospheres (*kimospheres*) that invite the audience to become immersed in a multi-sensorial architecture of sonic, visual and tactile elements, "wearable design" here stretched to an overall construction of fabrics and gauzes (a meta-scenic dress) onto which light and film particles are projected. We have also tested the role of wearable virtual reality (VR) headsets within the kimospheres, inviting visitors to choose how they negotiate the organic and anorganic through the threshold of augmented virtuality. In such environments, narrative composition is weaker, as emphasis shifts to the experiential and what Danjoux's

experiments with conductivity promise to open up to audiophonic wearable performance design – namely heightening the sensory aural-auratic force of garments in the absence of a narrative theatrical frame.

NailFeathersDress (fig. 15) opts for a more fashionable design aesthetic than the ones drawn from historical text or cultural era, exploring the notion of sounding movement design from an essentially abstract point of view. Constructed using a multitude of nails interwoven into the main conductive mesh fabric of the dress, the idea of this garment was to amplify purely the sound of the wearer's movements stimulated by the dress and nothing more. This was achieved through integrating a series of piezo contact mics into the garment, to pick up the vibrational qualities of the nails – animated by the dancer – and then making these audible via a wearable amplifier-speaker carried like a camera on the dancer's body.[17] Elisabeth Sutherland, wearing this garment, confided how inspired she was to

Figure 15. NailFeathers Dress worn by Elisabeth Sutherland in rehearsal, *metakimosphere no.3*, Artaud Performance Centre, London, 2016. Video still © Michèle Danjoux.

use her body literally as an instrument, unencumbered by narrative or any additional factors, to generate sound through her individual steps, crouching and whole body torque. Her body expanded through wearable design to create a fused and intertwined sounding instrument-body, generating compositional elements of pure instrumental music kinetically in performance. Wearer sensation and interaction were the only motivations to movement-sounding.

Given the personal associations we all have with the clothes or accessories we wear, it is apparent that performers respond in individual ways to the challenges of the wearable structure and the "felt" presence of body-worn technologies. We can thus state a pertinent outcome of the emergent choreographies of real-time interaction and the amplification of physical presence through costume, namely particularised forms of performance specific to the *character of the wearable*. The dancers adopt or discover movement expressions which are not based on familiar technical vocabularies (ballet, modern dance, tanztheater, etc.) but inspired by the intricacies of the material and sonic design. The designs created by Danjoux for the DAP-Lab productions seek to be both visually highly distinctive yet also distinctively audible when activated through wearing by the dancer in motion.

The overarching emphasis of Danjoux's *design-in-motion* research was directed at what she calls the *sonic touch* (2017: 217), namely the contained, intimate, proximate movement expression of the dancer articulating her wearable dress as a transceiver instrument. The method used for discovering the sonic touch fundamentally stipulates a practice of designing that attaches electro-acoustic instruments onto the dancer's body and costume, testing emergent behaviors of materials, movement, and sound in the design process while conceptualizing them as relational, dynamic and active. A significant marker of transfer between this method and artistic movement practices concerned with emergent/improvisatory processes is the importance of initial design form (provided in stages, added on in the process). Each prototype is a kind of machine of its own kinetic and sonic poiesis.

Endnotes

[1] As anthropologist Tim Ingold reminds us, *being alive* is a matter of realizing how we move and change, and how we are always ensounded moving through the world, which is also a world of sonorities and auditory spaces (Ingold 2011: 138). Cf. Birringer 2017a.

[2] DAP-Lab is a cross-media lab exploring convergences between performance, telematics, textile/fashion design and movement, visual expression, film/photography, sound and interactive design, founded by Birringer and Danjoux in 2004: http://people.brunel.ac.uk/dap/.

[3] DAP-Lab productions have consistently used the notion of wearables as *sound characters* through the specific costumes Danjoux designed for the movement rehearsals out of which the particular choreosonics of a work emerged (for example in *Suna no Onna*, *UKIYO*, and *for the time being*). For a comprehensive delineation the design-in-motion method, see Danjoux 2017. Other publications on choreosonic wearables and kinetic atmospheres include Birringer 2013; 2017b; Birringer and Danjoux 2009a; 2009b; 2013; and Danjoux 2014.

[4] Earlier in the 1960s, and concerning the notion of media as extensions to the communication condition of the present body, sociologist Erving Goffman had discussed (analog) technologies such as microphones and other mechanical devices as "boosting devices" – to amplify and augment the naked senses (Goffman 1963: 14).

[5] See Stelarc's website for his description of engineering internet organs: http://stelarc.org/?catID=20242. Alongside the growth of net.art and telematic performance (in the current era of internet-based experimentation), collaborations using biosignal data transfers are part of the international new media arts and computer music circuits (which include festivals, conferences and journals). Donnarumma curated biophysical works for the 2015 Computer Music Journal's Sound and Video Anthology; the Brazilian collective Corpos Informáticos has explored the networked body for over two decades (see: https://anthology.rhizome.org/telepresence).

[6] http://sonami.net.

[7] Documentation of Laetitia Sonami in performance with "Lady Glove" available at: https://www.youtube.com/watch?v=C8GqbS2w_Lg.

[8] Available at: https://vimeo.com/channels/1017437/45207205.

[9] http://www.benoitmaubrey.com/.

[10] http://www.pamelaz.com/.

[11] http://www.bodycoder.com/.

[12] Nicolas Collins's *Handmade Electronic Music: The Art of Hardware Hacking* (2006) was helpful for the prototyping process; the book derives from his course (at the Department of Sound, School of the Art Institute, Chicago) for introducing students to some electronic alternatives to the computer, ways to bridge the gap between the sound world of a generation raised in an electronic culture and the "gestural tradition of the hand," as he calls it.

[13] See: https://youtu.be/g2yfYrlvOLM.

[14] During preproduction and production phases of *UKIYO* (2009-11), all early tests in London and Tokyo focused on designs that explored elements of audiophonic cloth, sounding objects, portable sound, sensor interfaces and wearable speakers. Some of DAP-Lab's tests during *for the time being* (2012-14) were also staged at Interaktionslabor Göttelborn (Germany). Research for the METABODY (http://www.metabody.eu) project, a large-scale EU Culture Program collaboration between 11 partner organizations, enabled prototype testing during workshops and exhibitions in Madrid, Genova, Dresden, Amsterdam and London. Regarding investigations of conductivity, the

Studio for Electro-Instrumental Music (STEIM) invited Danjoux to a three-day research-creation laboratory on e-textiles, movement and sound (October 2014) bringing together experts in the divergent fields with the view to creating synergies through the convergence of these disciplines. Working teams consisted of textile experts, interaction designers, sound artists, choreographers, dancers and performers. The short but intensive residency was organized by Marije Baalman, an electronics engineer then based at STEIM, and it was during this residency that a new ConductiveCoat prototype was created, and the seeds for the NailFeathersDress (2016) were planted. For a brief film of latter, created for *metakimosphere no. 3,* see: https://www.youtube.com/watch?v=Iw4T-uM3n-U.

[15] See: https://www.youtube.com/watch?v=oXBW4oWyK0.

[16] Collaborating with Danjoux, electronic artist John Richards built the micro-circuitry, advised on materials for achieving the desired vibrational qualities and designed the quiet disruptive sound for this audiophonic prototype.

[17] Neal Spowage assisted in the electronic construction of this prototype design.

References

Birringer, Johannes (2017a) "Ensounded: An Introduction to Special Topic: Sound/Theatre: Sound in Performance," *Critical Stages/Scènes Critiques* (December/Décembre 2017) no. 16. Available at: http://www.critical-stages.org/16/special-topic/.

Birringer, Johannes (2017b) "Metakimospheres," in: Susan Broadhurst and Sara Price (eds.) *Digital Bodies: Creativity and Technology in the Arts and Humanities*, Palgrave Macmillan, pp. 27-48.

Birringer, Johannes (2008) "After Choreography," *Performance Research* 13 (1), 118-123.

Birringer, Johannes and Danjoux, Michèle (2013) "The Sound of Movement Wearables," *Leonardo* 46 (3), 232-240.

Birringer, Johannes and Danjoux, Michèle (2009a) "Wearable Performance," *Digital Creativity* 20 (1-2), 95-113.

Birringer, Johannes and Danjoux, Michèle (2009b) "Wearable technology for the performing arts*,"* in McCann, Jane and Bryson, David (eds.) *Smart Clothes and Wearable Technology*, Cambridge: Woodhead Publishing Ltd., pp. 308-419.

Collins, Nicolas ([2006] 2009) *Handmade Electronic Music: The Art of Hardware Hacking*, 2nd edition, London: Routledge.

Danjoux, Michèle (2017) *Design in Motion: Choreosonic Wearables in Performance*, Phd Thesis, London College of Fashion, University of the Arts London.

Danjoux, Michèle (2014) "Choreography and Sounding Wearables," Special Issue on 'Critical Costume', Scene 2 (1-2), 197-220.

Donnarumma, Marco, Caramiaux, Baptiste, Tanaka, Atau (2013) "Body and Space: Combining Modalities for Musical Expression," Paper presented at Conference on Tangible and Embedded Interaction (TEI), UPF: Barcelona. Available at: http://marcodonnarumma.com/publications/.

Enright, Robert (2014) "Notes on Fuseology: Carolee Schneemann remembers James Tenney," *Border Crossings* 132. Available at: http://bordercrossingsmag.com/article/notes-on-fuseology. [accessed 5 January 2018]

Evans, Caroline (2003) *Fashion at the Edge: Spectacle, Modernity and Deathliness*, New Haven: Yale University Press.

for the time being [Victory over the Sun] by DAP-Lab (2014) Directed by Johannes Birringer and Michèle Danjoux [Lilian Baylis Studio, Sadler's Wells, London. 3-4 April].

Fullman, Ellen (2012) "A Compositional Approach Derived from Material and Ephemeral Elements," *Leonardo Music Journal* 22, 3–10.

Goffman, Erving (1963) *Behavior in Public Places: Notes on the Social Organization of Gatherings*, London: Free Press.

Hansen, Mark (2006) *Bodies in Code. Interfaces with Digital Media*, New York: Routledge.

Ihde, Don (2002) *Bodies in Technology*, Minneapolis: University of Minnesota Press.

Ihde, Don (2010) *Embodied Technics*, Copenhagen: Automatic Press/VIP.

Ingold, Tim (2011) *Being Alive: Essays on Movement, Knowledge and Description*, London: Routledge.

Kelly, Caleb (2009) *Cracked Media: The Sound of Malfunction*, Cambridge, MA.: MIT Press.

Kozel, Susan (2007) *Closer: Performance, Technologies, Phenomenology,* Cambridge, MA.: MIT Press.

Loschek, Ingrid (2009) *When Clothes Become Fashion: Design and Innovation Systems*, Oxford: Berg.

McLuhan, Marshall ([1967] 1996) *The Medium is the Massage: An Inventory of Effects*, with illustrations by Quentin Fiore, Berkeley: Gingko Press Inc.

Munster, Anna (2006) *Materializing New Media: Embodiment in Information Aesthetics*, Hanover: Dartmouth College Press.

Peters, Deniz (2012) "Introduction," in: Peters, Deniz, Eckel, Gerhard, Dorschel, Andreas (eds.) *Bodily Expression in Electronic Music: Perspectives on Reclaiming Performativity*, New York: Routledge, pp. 1-14.

Ryan, Susan E. (2014) *Garments of Paradise*, Cambridge, MA: MIT Press.

Sonami, Laetitia (2010) "Laetitia Sonami," in: Rodgers, Tara (ed.) *Pink Noises: Women and Electronic Music & Sound,* Durham: Duke University Press, pp. 226-34.

Stelarc (2016) "Excess and Indifference," in Gardiner, Hazel and Gere, Charlie (eds.) *Art Practice in a Digital Culture*, London: Routledge, pp. 93-116.

Suna no Onna by DAP-Lab (2008) Directed by Johannes Birringer and Michèle Danjoux [Laban Studio Theatre, London. 8 December].

UKIYO [Moveable Worlds] by DAP-Lab (2010) Directed by Johannes Birringer and Michèle Danjoux [Lilian Baylis Studio, Sadler's Wells, London. 26 November].