OtoKin: Mapping for Sound Space Exploration through Dance Improvisation

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ABSTRACT

We present a work where a space of realtime synthesized sounds is explored through ear (Oto) and movement (Kinesis) by one or two dancers. Movement is tracked and mapped through extensive pre-processing to a high-dimensional acoustic space, using a many-to-many mapping, so that every small body movement matters. Designed for improvised exploration, it works as both performance and installation. Through this re-translation of bodily action, position, and posture into infinite-dimensional sound texture and timbre, the performers are invited to re-think and re-learn position and posture as sound, effort as gesture, and timbre as a bodily construction. The sound space can be shared by two people, with added modes of presence, proximity and interaction. The aesthetic background and technical implementation of the system are described, and the system is evaluated based on a number of performances, workshops and installation exhibits. Finally, the aesthetic and choreographic motivations behind the performance narrative are explained, and discussed in the light of the design of the sonification.

Author Keywords

movement sonification, interactive dance, mapping

CCS Concepts

•Human-centered computing → Gestural input; •Applied computing → Performing arts; Sound and music computing;

1. INTRODUCTION

Oto means sound in Japanese, and ear in Latin, while **Kin** is short for *kinesis*, meaning motion in Greek. Motion through the ear, music and movement, or music and dance are intimately connected as embodied human expressions. The addition of technology makes the combination of the two both easier and more difficult. The path from electronic music to dance is easy to see, while the other direction is harder to tame. Electronic music is sometimes far removed from embodied performance, maybe because the path from the body to the actual sound sources is long and winding, where the directness of traditional instruments may be lost.

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In this paper, we describe a project where an electronic musician (PD) with a strong focus on embodied musicianship collaborates with a choreographer and dancer (ASD) with a thorough background within both Western and Japanese dance traditions. Together, we have created a performance space extended by a layer of realtime synthesis, where each subtle movement is sonified, and where we can perform as musician-dancers. In focus is a discussion about the aesthetics behind the mapping from movement to sound, and how the sound engines together form a rich landscape for improvised exploration, including mediated interaction between the performers. The work has been performed several times by the authors, and also been shown as participatory interactive installation/workshop in several places (including NIME 2018 in Blacksburg, VA, USA), with visitors moving and dancing in the space, and very positive response.[1]

The paper also describes the chosen narrative framework and performance constraints, where our shared background in classical Japanese performing arts is combined with the special constraints of moving in an experimental sonified space, together shaping a performance narrative.

2. AESTHETIC DEPARTURE POINTS

The departure point of OtoKin was a commission from the art and science AHA Festival in Gothenburg, Sweden.

Our main idea is to augment a performance space with sound, adding new dimensions and hidden layers, which would enrich the performance from both the performers' and the spectators' perspective. The addition of a new layer transforms the space into something else, and in an improvisatory context, it changes the way you move. Each movement acquires sonic properties, and movement and musical gestures inform each other – none can take place without the other, and it will be impossible to tell if you make a movement to cause a sound, or if you make a sound that requires you to move. They become entangled, and the space is experienced as a multi-modal space, not as sound in a 3-dimensional physical space.

Dahlstedt has previously developed mapping algorithms based on spatial metaphors (e.g., [3, 6]), primarily based on vectorization of the output from high-dimensional controllers to navigate and explore similarly high-dimensional synthesis parameter spaces. The idea to apply this to precise tracking in a physical space has been a recurring thought, and this is the first step in that direction.

The idea is to perform in in a physical space of potential sounds, with a strong correspondence between movement and sound gestures. This requires that the mapping is sufficiently good, retaining subtle dynamics and a rich flow

[1] A video of the premiere: https://youtu.be/HB0AX4NSs38 Videos of workshops: https://youtu.be/HB0AX4NSs38, https://youtu.be/cJ50sBA9NvY

of information from motion tracking to synthesis. From a perspective of number of dimensions and amount of information, it is a good match. Sound synthesis usually have a large number of parameters, but space is only three-dimensional. However, a dancer's body has many more degrees of freedom than its position in space. With existing, affordable and accessible technology, we can measure the coordinates of all major points/joints of the body over time, enabling the capturing of:

Position Location on the floor in absolute coordinate space

Posture The characteristic configuration of body parts

Movement of the whole body, and of each joint as measured relative to some central point on the body

In this space, each movement causes a sound, and they together can be used as a medium for expression combining choreography and musicianship. From a performer's point of view, the sonic dimensions should feel so rich that it would almost be possible to dance blind-folded. This served as a good design criterion during the implementation.

We were also interested in exploring how to allow for mediated interactions in this space, with performers and perhaps agents. Mediated interaction between dancers did indeed become an integral part of the work, but the virtual agents in the direct sense in not yet implemented. Still, some of the sound engines have complex, unpredictable behavior, which can make it feel like you are trying to control an unruly puppet.

The space is designed for improvisation, which for us means that it is not made for one single piece. No exact choreography should be needed, and there should be no score for the music. One may create a predetermined framework for the improvisation, but it must be possible to improvise details, and most importantly, to respond to what is happening in the moment, like on a musical instrument.

The space should not be based on any presets or stored states, but the dancers should interact with a system that is always on, and that makes them a part of the system. If the humans do nothing, the machines do nothing. When humans act, the machine response shapes further human behavior, etc.. This is a very important feedback loop, which requires high resolution in time and space, and the translation between the two worlds is crucial. Transformations must occur, but a significant portion of the information is lost, problems appear.

The space should be designed based on rich potentials to be probed, explored and harnessed for artistic expression. Navigational strategies for the exploration of such complex (non-physical) sound spaces has previously been discussed by Dahlstedt [4].

2.1 Interaction design, aesthetics of mapping

The interaction design of the project involves choices for how the space is set up, what can be done in it, which actions should be detected and have sonic consequences, aesthetic ideas about movement repertoire, how computer-mediated interactions between the dancers happen, the desired qualities of the interaction, and maybe most importantly, how the mapping from movement to sound is to be implemented.

Sonification of movements can be approached in different ways. We want to avoid triggering notes and events, and instead prefer the fluidity and continuity of body movements to translate into the sounds. This can be done either by mapping to parameters of continuously ongoing synthesis, or by mapping to continuous parameters for generative sound structures, which can be varied and gesturally controlled based on realtime feedback [4]. Both approaches are used in OtoKin, for different sound engines.

2.2 Effort-based mappings

A design ideal of ours is that mappings for physical embodied playing should be based on effort. Moving in the space should feel like playing an instrument – a rich space of possibilities, with repeatability, learnability and intimate control over the sound, to borrow a term from David Wessel [15].The output sound energy should be in some way proportional to the amount of movement, momentum, or acceleration. This also implies that the system should be silent when you are still. This principle was applied to a large extent in OtoKin, by letting the amount of acceleration map to volume and core filters in some of the sound engines. However, an approach focusing only on motion misses the idea of potential energy, which is also effort. And it does not allow for high-energy still states. For this reason, we also included possibilities where either lifting a leg (a temporary effort that takes some energy and cannot be done for ever) or raising your arm either is generates sound or has a profound impact on the sound contents.

There are many reasons that we use physical metaphors for the effort-based mapping. We think this is extra important when translating bodily movement to sound, because the body lives in a Newtonian physics space, and our patterns of movement are so much shaped, both evolutionarily and on a more short term scale, by these constraints. For example, a constant movement can be considered a state because it does not involve a change of energy. Neither does a free fall – it is in fact a very still state. The active use of energy to change motion path is perceived by a spectator as an event. A well-known example is conducting: it is the very bottom point of the beating hand pattern that is perceived as the beat, exactly when the conductor's hand changes direction and starts upwards. This movement is both prepared and have an extended decay, so that its timing and impact can be predicted and experienced by a spectator, as part of a partly known dynamic system. For us, it was important to think in these terms also when designing the mapping, to keep a correspondence between movements gestures and sound gestures, and a correspondence between the feel of both of them. This discussion on empathetic experience of movement in electronic music is developed further in [5].

2.3 Interactions

An overview of the interactions possible in OtoKin:

Musical alarm sounds are heard when you are too close to the border of the bounding box. It fades in the last 0.3m (adjustable), when any skeleton coordinate is too close. This can be exploited musically by the dancers, but is also there for pragmatic reasons.

The head (x,z) coordinates are used as the center point position, and allow for choice of sound engine to play. There are three main sound engines, and there are crossfades between them, controlled by the floor coordinates.

Height matters. The floor is silent, so when sitting or lying down, you stop making sounds. There has to be a way to rest. When the highest point goes above a certain threshold, it fades into a special sound engine, which we call *The bells in the sky*.

Coordinates of the joints of the upper body and arms are used to control synthesis parameters, according to a complex mapping engine. Primarily, the coordinates of the shoulders, arms and hand joints are used, because they are our most expressive of the larger limbs.

OtoKin is made for two dancers. Each one generates music based on his/her position, posture and movement. Here, it is perfectly possible to interact, in a similar manner to two musicians who play similar instruments. But there is a special mode entered when dancers touch each other. Then they instead make a shared sound, completely different, stronger and shimmering. It is a separate sound engine, and the sound is shaped by both dancers' posture and movement. The possibility of such mediated interactions was an important part of the initial concept.

3. RELATED WORK

Music and dance have symbiotically coexisted throughout history, and probably long before that. A philosophical perspective on their relationship is given by Hodgins [9], based on the analysis of 20th century dance works. An early example of technological mediation between movement and sound is Leon Theremin's invention of the Theremin instrument around 1920, and its dance-based cousin, the Terpsitone (1932). They allowed for pure gesture, with no physical contact with the instrument, to produce sound. The same technology was used in John Cage's and Merce Cunningham's collaboration Variation V (1965), where large theremin antennae (built by Bob Moog) were placed on the dance floor, sonifying the dancers' movements.

From a NIME perspective, the sound-movement relationship has been analyzed thoroughly. In a broad overview, Winkler [16] provides an analysis of the physical conditions of motion in different contexts, including dance, and its implications for the design of good mappings from motion to sound. He emphasizes the importance of understanding the physical parameters and constraints of movement to see how they can be translated to sound. Other significant reviews have been given by Siegel and Jacobsen [13], again stressing the importance of the physical constraints, effort, and resistance in musical instruments, which in dance are primarily contributed by gravity and inertia. In a later overview, Siegel [12] discusses the distinction between natural and unnatural mappings, where the former "complies with our common experience of the real world". He also mentions the lack of helpful audience expectations in the field of art and technology, since there are no general conventions about how to do things. We agree that the audience do not need to understand how the sonification works, but we think there needs to be cues that help them empathetically perceive effort (physical and motorical-cognitive), direction and intention. This has been further discussed by Dahlstedt in [5].

Both Winkler and Siegel emphasize Ryan's [10] thoughts on the importance of effort for musical expression, and to include this aspect when designing musical interfaces. Ryan have also been a major inspiration for us, and has influenced the design of our previous instruments, as well as OtoKin.

Mapping is a key problem in this field, and rich mappings are hard to design. Skogstad et al [14] writes: "We soon discovered that it was challenging to design a single instrument, or one synthesizer state, that would be interesting enough to listen to and watch for a whole performance. The performer needed to be able to change between different mappings."

An broad discussion of the problem of mapping is provided by Schacher [11], even though he arrives at different conclusions than we do. He argues that there is an insurmountable difference between how we perceive musical gestures and dance movements. He quotes interactive artist Marc Coniglio, stating that in order to make music and for the audience to understand that the dancers produce the music, they need to move like musicians. This is very different from how dance movements are perceived. "We really see energy." Schacher concludes that "a straight parametric linking between the phenomena of each domain seems impossible", and that we may have to translate movement to "meta-gesture", perhaps by a detour to emotion and affect, "instead of focusing on physiology and physics." This meta-layer is then translated into music.

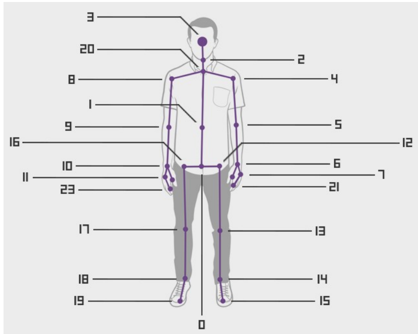

Figure 1: A map of the skeleton joints available from the Kinect 2 sensor. Most of these were used in OtoKin. Image from vvvv.org.

We do not agree. Rather, a thorough understanding and acceptance of the physics and physiology behind music-making (with traditional instruments, and electronic instruments based on similar principles) allows for bridging this gap. It is certainly possible to design mappings where the movement are not in service of the sound, but still integrated, stemming from the same underlying (mental, immaterial) gesture and intention. What we see when observing a musician is also to a large degree energy and effort, perceived empathetically through the mirror neuron system. Could a solution to this divide be the understanding that musical sound is also based on real or perceived change of energy states? Perhaps a simpler kind of meta-gestures is hidden in the transformations we introduce in our mappings, which preserves the contour and shape but maps the minute specifics of gestures in complex ways to synthesis, in a many-to-many mapping inspired by acoustic instruments. A detour via meta-layers of affect and emotion will inevitably lose the crucial synchrony between movement and sound gestures, so fundamental for perceived agency and for merging them into a combined expression.

Finally, an interesting perspective on mapping is presented by Bergsland and Wechsler [2]. They state that the important thing is not if the mapping is simple, complex, one-to-one or many-to-may, but that "[t]he critical issue in terms of user engagement is how the environment evolves over time, i.e. how the user is guided back and forth between 'causal-ordered-predictable' and 'intuitive-improvised' processes. This is to say that either, at exclusion of the other, can quickly lose interest."

4. DESIGN AND IMPLEMENTATION

OtoKin uses a 2nd-generation Microsoft Kinect sensor, produced 2013-2017. It has good precision, and tracks 25 skeleton joint coordinates each for several people (see Fig.1). The frame rate is 30fps, and the sensing area is a 84° cone, with a maximum depth of 4.5m.

The sensor is placed at stage front, ca 80cm above the floor, turned inwards towards the dancers. A laptop screen is discretely placed under it to provide visual feedback for the dancers. The system can be calibrated for different sensor height, dancer body height and active sensing area.

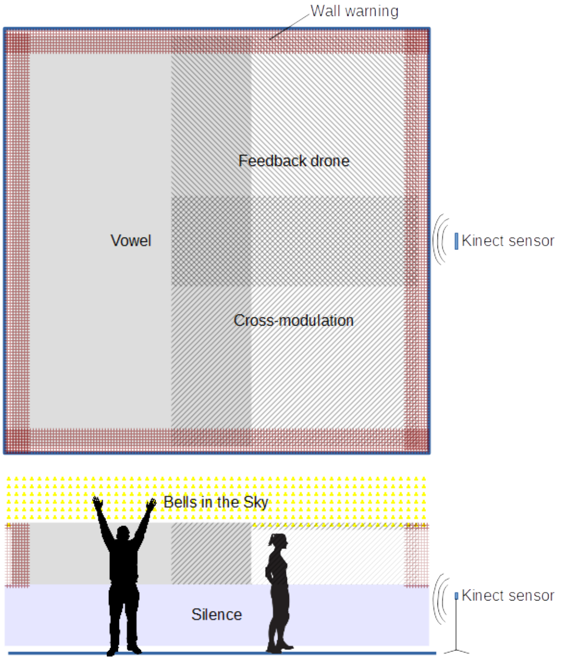

Figure 2: Map showing the zones for the sound engines, viewed from above and from the side. The audience is on the right side.

Tracking and mapping preprocessing implemented in *vvvv*[2], a data-flow programming environment specialized in interactive realtime graphics. The patch creates a simple visualization for debugging and stage monitoring, and performs extensive preprocessing as part of the mapping, such as coordinate scaling, coordinate comparisons, proximity calculations, smoothing, and sends the translated data off to two hardware Nord Modular G2 DSP farms for final mapping and synthesis, via MIDI.

4.1 Mapping

The mapping in OtoKin consists of many different parts and mechanisms. The main idea, as already stated, is to do an effort-based translation from movement gestures to sound gestures, free from triggering, focusing on continuous modulation of ongoing synthesis systems.

The stage is divided into different sub-spaces in all dimensions, which correspond to different sound engines, crossfading into each other. Each has a somewhat different mapping mechanism. For example, only two of them use the concept of chromatic pitch, while others are based on non-linear synthesis techniques where pitch is not a parameter, but an emergent feature. The main implementation is centered around the three core properties of the dancer:

Position – of the dancer, in three dimensions, determine the crossfading between sound engines. Extreme positions of any joint near the edges of the bounding box, in all directions, cause special sonic responses. The "walls" have a bell-like warning sound. There is a silent zone near the floor to provide for rest, and the "ceiling" features a special sound engine, reached by raising any joint (usually a hand) very high. Position is also mapped to sound panning, so that the sound is co-located with the dancer.

Posture – the configuration of the limbs, primarily the arms, determine synthesis parameters, through a many-to-many translation engine based on linear transformations. Arm coordinates are measured relative to the shoulder. Lifting one leg is a special posture – this represent an effort, and is mapped to volume/intensity, just like movement.

Movement – the difference of a dancer's posture between two measured frames (1/30s) is used to calculate a rough measure of the total magnitude of movement and acceleration. This is in turn used to control volume and overall contour of the sonic gesture, when applicable. (A couple of sound engines have other dynamic control methods, to provide for variation in movement and sonic expression.)

This is not unrelated to Schacher's [11] approach of "multi-tiered" sensing, where camera-based global, "topographic" sensing gives information about position, and sensors on the dancers' bodies give data with "limited scope but expressive scale". However, with today's technology, we are able to do both with the same sensor.

In addition, the mapping looks at the proximity between the dancers, measured as the minimum of all possible pairwise distances of skeleton points. This means that we with surprisingly high reliability and precision can tell when they touch each other, with any body part against any other, which enables the *Together* sound engine.

4.1.1 Pitch

Pitch is a parameter different from all others. If mapped continuously, we end up in an undesirable "glissando hell". For the pitch-based engines, we had to design a mechanism that derives discrete pitch values. Simple quantization does not make sense. Instead, we perform six coordinate comparisons of arm joint positions, such as "is the x coordinate of the hand larger than x of the shoulder?" If true, this enables a specific musical interval, and all enabled intervals are added. This sum gives an offset from a fixed fundamental pitch, for that specific arm. The intervals are chosen to create a flexible yet characteristic melodic contour. In this way, the arm posture at any moment corresponds to a specific pitch. The two pitch values for the two arms are continuously sent to the sound engines. The actual pitch is only updated when the acceleration goes above a certain threshold, e.g., at the start of an arm movement or a change of direction. This additive pitch approach was inspired by earlier mechanisms Dahlstedt has designed for various musical interfaces with similar complications and no obvious pitch control [7, 6]. See the example video at time 4'30"-5'10" for an example of this mechanism in action.

4.1.2 Timbre

The word timbre is here used in the sense of all other synthesis parameters, and is controlled through a translation mechanism from essential arm coordinates, relative to the shoulder. The (x, y, z) coordinates of the hand and the elbow of both arms, relative to the shoulder, are sent to the sound engines, where they are subjected to a matrix-based linear transformation. In essence, each synthesis parameter is modulated by a weighted sum of all input values. The matrix coefficients were randomly generated at design time, within a range of (-1.0,1.0). This many-to-all mapping approach keeps the gestural contour and magnitude, but modulates all parameters in a coupled way – all parameters are affected by every movement. It is in no way random, but repeatable, and interesting directions of movement or postures can be further explored as they are found. Further discussions on playing through this kind of mapping transformations can be found in [3].

4.2 Sound engines

OtoKin contains a number of different sound engines, all running simultaneously. They are all implemented in the Nord Modular G2 signal processing development environ-

[2]https://vvvv.org/

ment[3], based around a number of hardware DSP processors using sample-by-sample processing, which means that there is minimal latency, and feedback can be used as a core sound design element, which is more difficult in buffer-based environments. Two of the OtoKin sound engines are based on feedback of different kinds, so this is crucial.

For a specific dancer, only one sound engine is generally heard at any one time, except in the cross-fades between them. Which sound engine is heard is dependent on the dancer's position, and on his/her maximum height over ground (see Fig.2):

Vowel The main melodic sound engine, covering the rear half of the stage. Using two wave shaping oscillators and formant filters, it uses the additive pitch mechanism, and sounds a bit like a pair of synthetic voices, one for each arm.

Cross-modulation Front right of the stage. More complex and intense sounds, but still gesturally controlled. The core is two cross-modulating oscillators, using frequency modulation. There is potential for chaotic behavior.

Feedback drone An oscillating feedback circuit based around a delay, a filter, a leveling waveshaper and a multistage phaser. It is not based on movement energy, but sounds continuously. This sound engine can be very intense.

Bells in the sky For when a dancer reaches up above the head level with any part of the body, usually the hand. It sounds continuously, and consists of a generative dual bell rhythmic structure, where the pitch, rhythm pattern and timbre parameters are modulated from dancer posture

Together Takes over as soon as the two dancers touch each other with any part of their bodies. It consists of two parts: a shimmering, pulsating tone cluster made from white noise through a tuned resonant filter bank, and a pitched granular scraping sound from pulse trains directly generated from dancers gestures (like bowing in the air), sent through a resonant multi-pole phaser filter. It uses the additive pitch mechanism, and has a vocal character.

The walls A warning sound which intentionally stands out, to signal that the dancer are too close to the borders. Similar to an alarm bell ringing.

Silence Near the floor is always silence.

5. PERFORMANCE

Given the aesthetic design choices behind the sonification system, the choreographer in parallel developed a narrative framework for a semi-improvised performance within the OtoKin sound space, where both authors act as dancers. We both have a long practice of collaboration and of improvisation, but also of traditional Japanese theater and dance. In a recent collaboration, commissioned by the *Noh Reimagined* festival in London, 2016, we created a deconstruction of Zeami's Noh drama *Atsumori*. In the piece, ASD wore the mask of *Chujo,* and performed relating to traditional body postures and movements from Noh and Nihon Buyo (the traditional Japanese dance, [8]), filtered through a contemporary dance practice. Also, traditional bodily constructions of gender and cross-gender were exploited to transform the classical narrative.

In the performance for OtoKin, we wanted to continue this work, and again worked with the masks. ASD wore the mask of *Chujo* once more, a young sensitive nobleman, while PD wore *Uba*, the mask of an aging melancholic woman. This became a constraint for our movements, by continuing a practice that we both value and respect and by attempting to find an expression for it inside the OtoKin space. We did not use explicit choreographed movements, but decided

Figure 3: From the premiere of OtoKin.

to move according to lived and performed knowledge, and allow for exploration of various movement patterns within the sound space. The Noh also adds the constraint of reduced vision – it is difficult to see where you are, where your performing partner is, and even where your own limbs are. This enforced a different spatial awareness, where movements needed to be precautious and precise. They needed to be felt in a different way, almost as if we performed with a blindfold. It also induced a particular sense of *ma*, a Japanese term denoting the sense of spacing, in any dimension (space or time).

We also decided to work with the classic formal dramaturgical concept of *jo-ha-kyu*, meaning "beginning, break, rapid". It is traditionally used on all levels to shape the flow of time, and can perhaps be described as slow prelude, steadily increase and breaking apart, with a swift ending, going back into silence.

So, we relate to Japanese and Chinese concepts such as *ma* and *jo-ha-kyu*, but we also go against this. The form helped us create a rhythmic constraint for playing the space. We put special emphasis on the *jo*. We wanted to meet the sounds slowly, not to over-represent the space. We also wanted to reach the powerful *ha* through a long-term build up, not using the more intense sonic possibilities of OtoKin until the second half. Having our faces covered also created a possibility of staying in an inner world, where sound (yet spatial) was the only interface between us.

Slow *suriashi* (walking with sliding feet) is used when actors and dancers enter and leave the Noh stage on the *hashigakari*, the bridge leading from the left side up to the stage. This represents the connection between the stage and the spiritual world, between the human and the *kami* (god/desses). The audience has plenty of time to experience the entrance. We walked in *suriashi* from upstage left and right, forming our individual *hashigakari*, and then sat down in *seiza* (kneeling position), which is quiet in OtoKin, because it is low.

The affective responses from the sound created an intensified space for us, where we were working with the limitations of codified movements, the masks, and also the fact that we needed to move as if in separate rooms. In a way it was as if we were continuing *seiza* but in movement. There is an intense build up after that slow start, and since the sound space is designed with greater sonic intensity and complexity towards the stage front, the progression and build up happens in a very organic way.

A considerable amount of energy is generated through consciously resisting speed, while performing high intensity on the inside, behind the mask. Actor and director Barba [1] describes how the performers in Japanese Noh theater

[3]https://www.nordkeyboards.com/products/nord-modular-g2

use the energy needed to move through space, but that they actually do not move much through space. He explains that the energy they would have expended in space is instead kept in their bodies, creating a certain intense atmosphere not easily discerned by the untrained eye, but certainly felt as a particularity. According to Japanese theater scholar Gunji [8], the smallness of the stage and the restricted movements of the dancers has a symbolic value, and it also reveals a specific interpretation of space. In some dances, the ideal is 'to dance without actually moving'. He also points out the characteristic restriction of the traditional Japanese dancer's movements in space, which differs from Western dance in that it is oriented towards the Earth, with little of the raised arms, lifted bodies and leaps of Western dance. The sound space we built challenges presumptions of space. In the ceiling there was indeed a kind of heavenly sound that we both loved to touch now and then, it represented another sound world with a more seductive tonality than the bounding walls. The different sub-spaces lent themselves very well to giving shape to the *jo-ha-kyu* development. In fact, they directly provided a spatial and sonic representation of this progression, including a resting position to depart from and return to.

As a part of the performance, thanks to the strong affordance for interaction through touch, which transforms the space completely, a parallel narrative developed around the themes of solitude, searching and belonging.

6. DISCUSSION

How is **kin**esis related to **oto**, or sound? In many dance traditions, kinesis is no more than a representation of oto, i. e. movements are created as exclamation marks next to a music piece. Even if the movements are composed as a dialogue with the existing music, the result is more a music visualization than an independent artistic piece. Kinesis is responsive to oto, and historically this has created a hierarchical imbalance. In Noh theater, even though the movements underline and amplify the narrative in abstract ways, movement and sound coexist independently, and the space in between creates the suspension and intensity we experience when watching Noh. During the 20th century, there has been a shift also in the West, towards letting kinesis and oto operate independently, mainly because art has become less Eurocentric.

In ASD's training as a dancer, she has both the experience of movement as a representation of or response to sound, where movement is composed as music visualization. In her own work, choreography is an independent artistic piece where movement and sound operate interdisciplinarily. What was different in working with OtoKin was the strong link between them in both directions, merging them into a responsive system we had to learn to exist in. A choreographic impulse immediately got a sonic response, sensitive to different intensities in the movement. As she expressed it: "The room around us became filled with strings and objects to pick up, to explore, of walls to touch and lean against. The sounds filled me with images, and created a transformed space to dance in."

7. CONCLUSIONS

We have presented the sonified performance space of OtoKin, based on a particular design ideal of embodied performance and effort-based mapping, true to physical gesture in both domains. It lends itself well for both improvisatory exploration, and for semi-prepared narratives. To be in it feels like playing an instrument and dancing at the same time, where movement and sound are equally guiding the development of the performance.

The aesthetic design decisions of the sound space, combined with the choreographer's background and interest in traditional Japanese performance, together shaped an emerging narrative. In this process, it was evident that the OtoKin sound space provided sonic richness, detail, and expressive potential, allowing for an extensive duet performance, and that the movement-to-sound mapping in a meaningful way merged sonic and choreographic expression.

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