Portfolio of Compositions

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Abstract

The essay briefly contextualizes the field of my compositional interest and accordingly proceeds to examine sound, space, and time from different grounds. The intention of this preliminary exercise is to derive a revised notion of onkyō (sound) in relation to time, which will be useful to comment on my works.

The compositional approaches presented here do not only involve the use of computers, but also the acoustic and physical shaping of sound and attempts at incorporating yet more complex historical and cultural aspects of sound in composition. Where necessary, hard- and software technologies specific to the works have been devised and research papers published. These are also discussed.

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List of Works

Practice in instrumental music

acamar	2010	aluminum cello & electronics	10’
snr	2011	snare drum & electronics	10’
klangle	2011	ensemble klang	0.5’
vortextures	2011	ensemble vortex	10’
128	2012	ensemble project 128	5-8’
textures±	2012	ensemble plus-minus	8’

Practice in electronic music

recitative	2010	electronic	1’
8ound	2011	eight laptop performers	5’
BEASTest	2011	electronic	5’
the tattooer	2010	music, dance, visual art & olfactory art	15’
white night flower	2011	music, dance & olfactory art	15’
hoto	2012	audio-visual	6’

Other practice

xy	2012	audio-visual	16’
matrix	2014	audio-visual	9’
spray	2014	sound installation	n/a
infrasonics	2014	sound installation	n/a

DVD Contents

Practice in instrumental music

acamar	video recording (2 sessions)	10’
	SuperCollider classes *Pcml, Pgcm, Pca1, Pca2*	
snr	score & audio recording	10’
klangle	score & audio recording	0.5’
vortextures	score & audio recording	10’
128	score, audio file (software synthesizer demo)	5-8’
	& audio recording	
	(a version with bass flute, bass clarinet and recorder)	
textures±	score & audio recording	8’

Practice in electronic music

recitative	audio file	1’
8ound	score, audio recording	5’
	& SuperCollider classes *SC8ound, Music*	
BEASTest	audio file (binaural simulation)	5’
the tattooer	video recording, video preview	15’
	& SuperCollider classes	
	MicKeyMouse, MicKeyWindow, MickeySynth	
white night flower	audio recording & video preview	15’

Other practice

hoto	video file	6’
xy	video recording	16’
matrix	video recording	9’
spray	video documentation	1’
infrasonics	video documentation	1’

1. Preliminaries

Introduction

> *A sound exists but nowhere since it is a memory rather than a physical event. A sound arises and disappears at every instant. When a sound arises, space arises, and time too. Space and time are mental frames. They are renewed at every instant together with the sound.*
>
> —Yuji Takahashi, 1998

For a long time, listening to music meant for me to listen to the sound. Without a conscious effort, my ears tend to bypass the structural and formal aspects of music and pay more attention to the momentary impressions of timbre (of a single sound, chord or orchestration). The potential of sound to invoke certain feelings and sensations appeared more valuable and I did not feel any need to problematize my ‘short-sighted’ listening.

I remember encountering Ryuichi Sakamoto’s music in my childhood. Back then his works were marked by an extensive use of analogue synthesizers and sequencers, combined with elements of ethnic music. It was surprizing how this music felt both new and strangely familiar. There is a great deal of attention to the details of sound — from the tuning to the design of overtone structure, modes of articulation, choice of musical scale and harmony. These sonic components evidence his effort in combining essences of Western and non-Western music, but more importantly, through sound it was possible to experience and understand it intuitively even though I had little knowledge of music at that time. Often sound in Sakamoto's music manifests such coexistance or collision of distant musical elements (The album, *Left-Handed Dream* and the collaborative single with David Sylvian, *Bamboo Houses/Bamboo Music* are good examples).

I started to learn the piano during my teenage years, to prepare for studying music in university. Because of my listening habit I did not enjoy playing classic music very much. Pieces like those of Beethoven did not appear particularly so meaningful as I had not attended to their musical form and dialectic. Debussy, Ravel and Toru Takemitsu's music instead taught me that timbre can set music in motion.

Later activities around sound art, especially Carsten Nicolai's installation works, interested me very much. His analytic approach to sound and aural perception sets an undertone to the compositional efforts documented here. Around the same time I also became interested in composer/pianist Yuji Takahashi's activities. His compositions and performances, underpinned by his political and philosophical writings, have since been a great source of inspiration. Particularlly, his observations concerning the corporeal state of musical performance and the corresponding concisousness of listening have been helpful to me in writing the following part of this chapter and in considering the performance of my electronic music *8ound* and *the tattooer*, discussed later.

After moving to Europe I started to implement sound generators to explore my interest in sound more fully and I was also introduced to compositional experiments by others in the similar vein. The music and theoretical writings of Karlheinz Stockhausen and Agostino Di Scipio were influential. I learned and experienced how compositional efforts can challenge the cognitive separation between sound and form in music. The comprehensive understanding of sound-form as a continuum was enlighting: musical form became no longer foreign to me and I gradulally learned strategies to derive the formal aspect of music through working with sound.

The following part of this chapter stems from my sustained interest in sound outlined above and serves as a preliminary to the following chapters of compositional practice. First, I examine sound and its relationship to space; sound and space's relationship to time; how sound exists in us; and the compoaitional relevance of these observations.

1.1 sound

Onkyō (音響) is a Japanese term for 'sound' having a somewhat more scientific tone (as it can also mean acoustics) than the commonly used *oto*. The word actually consists of two Chinese logograms (Kanji), which individually read oto (音 : sound) and *hibiki* (響 : resonance) in Japanese. While the phonetics of oto reflects its ancient origin where sound was tied to the cause of production (*ataru*, to hit against), hibiki (vibration, echo, reverberation and nuance) implies the quality of sound and an enveloping resonance. From the composite and ideographic nature of the word onkyō, one may see through both physical and psychological aspects of sound and an implied amalgam giving birth to the appearance of sound.

The invention of the phonograph and the development of recording technology thereafter (transducers, microphone techniques, etc.) enabled the storage of sound and thus the possibility of its reproduction in different contexts and locations. Although such a dislocation and disembodiment of sound seem to cause a rupture in the bond of sound and resonant space suggested by the notion of onkyō (in fact, the decontextualization is artistically explored in the practice of *acousmatic listening*), I maintain that even the most isolated sound is significantly a product of sound and space. And this will be evident when looking more closely at the materials of acousmatic music itself.

One may observe a tendency in acousmatic music towards favoring cleaner and well isolated sound materials. As it is expected that those materials will be subjected to further compositional manipulations both in terms of timbral and spatial processing, the favoring of this kind of quality seems a natural strategic choice (except for choices that value the particularity of an event or space). But is the spatial aspect of sound in such a case minimized or effectively cast aside? In actuality, a recording which reduces room acoustics (e.g. by moving the microphone closer to the sound object) places greater emphasis on object resonance than that of the room to be captured in the medium. The listening is, therefore, *directed* to a different space — the space of the object itself — and what becomes more apparent is the particular mode of vibration[1] which imprints the object's spatial and material characteristics. Acousmatic music, in this way, may favour the amplified object space as its musical material while still operating on the bond of sound and space. The use of various 'coloured' speakers in the practice of diffusion also attests to this; the quality of reproduction is varied according to the construction of transducers (different in size, shape and materials) and how they are installed in the performance space (location and orientation). Therefore, it is acceptable to think that sound, including its reproduction, exists fundamentally by its occupying a certain extent of space.

1.2 space/time

The right hand moves the bow up or down on the string.

Then arises the sound, conditioned and dependent.

And with the sound arises Time.

The continuous act of Origination.

—Yuji Takahashi, 1996
translator unknown

The Japanese term *ma* (間) denotes both an intervallic time and an empty space. When talking about a 'wrong ma' it is because the timing is awkward or unfortunate. Enumeration of the number of rooms is in ma, and when the same Kanji is pronounced as *ken*, it signifies a unit of length slightly less than two

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[1] a fluid or an elastic solid moving back and forth (oscillation) is what defines vibration and it is thus a spatial phenomenon *per se*.

meters. Apart from the etymology, it is interesting that time and space, two distinct ontological notions, are combined in one word[2]; thinking about the implication it may have on our conception of sound makes it even more interesting.

As I have argued, sound is inherently a spatial phenomenon. Since the physics of sound, vibration, is a change, and that change occurs as a function of time, sound exists as a form of variation which interrelates space and time. When sound travels a greater distance, it entrains audible traces of the environment — the architectural form and material characteristics of the interior reshape the sound in a particular manner. The time scale of the process is thus proportional to the size of the space, and a simple experiment can confirm this: when a recording of an object (or room resonance) is transposed down, an impression of a larger object (or room) arises; the spatiality engraved in time is preserved only relatively and locally, but the longer time that the resulting sound occupies perceptually suggests a larger space. Hearing is to sense the spatial characteristics (of vibrating surface and room acoustics) entangled in the 'tapestry of time' (Ganchrow, 2009) and sound is our experience of time as a quality (as opposed to the more normative, quantitative understanding of time).

[2]a more differentiated use of time and space, *jikan* (時間) and *kūkan* (空間) are also common but the origins are not as old as the word discussed.

1.3 materialism

> *Let the pupil learn by this example to recognize what is eternal: change, and what is temporal: being (das Bestehen).*
>
> —Arnold Schoenberg, 1978

By way of approaching the materiality of sound in which time and space interrelate, a common tangent to the philosophical domain may be drawn. A line of ontological projects, from Friedrich Nietzsche and Henri Bergson to Gilles Deleuze is read by Christoph Cox as accounting for a major change that the sonic arts underwent (Cox, 2006).

John Cage's opening of music to the *entire field of sound* is described as a key shift in music akin to the philosophical shift prompted by this lineage of ontological materialists. Nietzsche's emancipation of the transcendental 'being' to the flux of 'becoming' is explained by Bergson's qualitative experience of time (*ibid.*). There, becoming is to live an experiential flow of 'a self in which succeeding each other means melting into one another and forming an organic whole' (Bergson, 1910, pp.127–128). This permeating temporality (a continuous process of past events fusing into forming the particular quality of the present) closely resembles how aural spatiality folds in time and how we experience time as a quality of sound. Further, Cox introduces Deleuze's account of 'being', a temporal contraction or slowing down of fluidity and mobility, in relation to 'the virtual', the reservoir of matter-energy and becomings. He then describes the

Cagean musical shift as to opening an aural window onto the repository of sonic flux, the becoming of music.

Such striking parallels between ontological philosophy and music can be made but what is important here is to emphasize, from an ontological viewpoint, that sound is a becoming, an on-going process which forms an organic existential whole in us.

1.4 composition

That sound (onkyō) is a spatial phenomenon ascribed to time is perhaps not a new idea. Music has long been a praxis around acoustic instruments and voices, and with the help of an acoustic instrument's sonic and tactile intimacy, a careful ear cannot but notice the spatiotemporal dynamics with which sound is charged. For instance, one can find a deliberate setting of *fluctuating space* in ensemble playing of traditional Japanese music. As the majority of this music is heterophonic, and the ensemble co-ordination does not follow an exact, measured timing, instruments tracing the same formula create a widened spatial image as an ensemble of differences in micro timing.

Over centuries, the technology of acoustic instruments (designs and playing techniques) developed, and approaches to composition have been accordingly shaped by a number of factors, including observations of the spatiality activated by the instruments. The reason for revisiting the perhaps time-honoured idea of spatiality in sound is to deal with the problem posed by new technologies.

The dislocation and disembodiment of sound through recording and reproduction, as I touched previously, is a problem and challenge that must be tackled artistically. Without knowing its implications, the use of such technologies may turn out to be of minor musical significance. Whether to rehabilitate sonic spatiality into the mechanism of composition, or to explore the otherwise unattainable sonic quality or compositional relevance is a matter of choice.

The literal meaning of composition in Japanese (作曲 *sakkyoku*) would be 'making of curvature,' which I would like to read as a hint for my compositional effort. The curvature would be that of a temporal flux which propagates, folds different spaces, and immerses our ears. By delving into the materiality of sound which interweaves time and space, a compositional strategy aware of the spatiality in sound would concern itself with the *how to* of designing this sonic flux which manifests different spaces.

The following chapters comment on my portfolio of compositions in light of the discussion above. They are organized around different types of work: ones with acoustic instruments, pieces of electronic music, collaborative works, audio-visual and installation works. Within each chapter I follow more or less a chronological order of composition (the overview of chronology is given in the *List of Works*) as the trajectories correspond to my increased awareness of the spatiality and materialistic reality of sound.

2. Practice in instrumental music

Introduction

First, two pieces for solo acoustic instrument accompanied by live-electronics are discussed in relation to the practice of acousmatic diffusion and to the possibility of composition through the articulation of instrumental space. These are followed by three ensemble pieces (with or without electronics) which deal with sound and space in a more subjective manner. The chapter ends with an ensemble piece whose relevance to composition and acousmatic diffusion is explored.

2.1 sound composition and diffusion

My project *acamar* with cellist/composer Frances-Marie Uitti was a challenge in working with many speakers in a live situation. Comprising of 192 horizontally-arrayed speakers and two audio servers, the system with which we worked was designed for implementing wave field synthesis, a spatial sound field reproduction technique which uses speaker arrays to recreate wavefronts of virtual sources (Boone, 2001). It was primarily built for playing back tape pieces (no live input), so in order to explore its potential in a live situation, we had to use the speakers individually without the software system for wave field synthesis. Naturally, to make the full use of all the speakers in a live situation, it was necessary to devise a system to use them collectively (some kind of panning, or algorithms to distribute the input signal) because of the large number of speakers.

In one of our early experiments, I simply amplified the cello in combination with an automated panning procedure. While controlling the speed of panning (up to ca. 16Hz), we noticed that an interesting artifact, a kind of sonic moire became audible. As the moving sound played over the speakers is almost identical to that of the natural acoustic sound of the instrument, it is no wonder that such an interference occurs (due to the changing phase relationship between the original cello sound and the amplified rotating sound). Nonetheless, the spatial depth of the effect was intriguing and the fact that both of us were, to a certain extent, able to control this phenomenon (via panning speed and choice of pitch) was musically important. Thus, I experienced how the number of speakers and the consequent spatial extent of the system are significant in turning simple pieces of technology (amplification and panning) into interesting tools to explore the conditions of space. Furthermore, I realized that there is a shared interest between our attempt and the practice of *diffusion*, namely exploring spatiality, both of and with the given sound. Both in acousmatic diffusion and in our project, the sound is largely determined (composed tape music or a cello sound) but one of the challenges of diffusion lies in how to engage with the spatiality which arises from the particular set of conditions (the resonance characteristics of the sound itself, the architectonic feature of the space and the deployment of speaker system therein) of that sound (Harrison, 1998). In this regard I was fortunate to have a rich musical input from the cellist who is not only a dedicatee of esteemed composers (György Kurtág, Luigi Nono, Giacinto Scelsi, among others) but also one who radically extends the possibility of the instrument (for example, the *two-bows* technique discussed later).

After the experiment, I made implementations of two approaches found in the literature of complex dynamical systems. The first of these is cellular automata, a class of state machines which generates intricate patterns of state dynamics following fairly simple rules (Wolfram, 2002). The second is the 'coupled-maps' approach proposed by Kaneko and Tsuda, which combines many chaotic elements to construct dynamics that may explain complex spatiotemporal phenomena (Kaneko & Tsuda, 2001). These are implemented as extensions to *Pattern,* a SuperCollider class that specifies templates for streams of values (or more precisely, as subclasses of the *ListPattern*). Given a list of an arbitrary number of elements (floating-point values), the systems produce as many streams of values as the number of elements (source code, help file and examples are included in the accompanying DVD: folder name *1_acamar*). Apart from the technical details, what is most relevant here is the kind of autonomy these classes of system possess. Although they only define local interaction among the many elements, they also produce observable higher-order structures. Such characteristics can be useful in designing organic control over a system; one need not attend to each behaviour of every component but concentrate on the recognizable system dynamics and study empirically how to handle that autonomy.

From the sessions we recorded, two are selected, edited and included here. Although they provide contrasting musical contents, the technical setup is identical. In both cases, complex systems are used to organize the dynamic routing of the instrumental sound to a particular speaker. Each such system holds as many elements as the number of speakers (192), and the state of an element determines the projection of sound from the corresponding speaker. In this way, my control focuses on a more meaningful level (parameters and rules) rather than specification of each speaker projection. In the first recording, the instrumental sound is recorded and transformed in realtime according to the state of the element in the system. When I chose to run the complex system diffusion at a faster pace to follow the rapid instrumental gestures, the result became a kind of spatial granular synthesis.

The second recording features the novel 'two-bows' technique of the cellist. She developed this technique of using two bows simultaneously in one hand (one on top and another from underneath the strings) which enables 'bowing the strings in any combination with a large and independent gamut of dynamic and expressive possibilities' (Uitti, n.d.). For example, she can play all the strings at the same time and the bows can access non-adjacent strings (e.g. one *sul tasto*, another *sul ponticello*). So the technique extends both possibilities of chordal and timbral articulations significantly. The electronics that accompany her are modest here: the captured instrumental sound is played back slowly in an overlapping manner without much transformation. The diffusion of instrumental sound thus follows the delicate chordal passages and provides them with an enveloping reverberant space whose shape also changes following the controlled dynamics of the complex system.

In addition to controlling the diffusion of the instrumental sound algorithmically, I have also used sound generators developed in my previous research to support and provide a counterpart to the cello. Because these sound generators actually implement the same dynamic systems, it was possible more or less to unify my control across the different task levels (sound generation, transformation/articulation and diffusion) involved in live performance.

2.1.1 Summary

The project was a valuable opportunity to experience how sound interacts and shapes itself in a space occupied by a large number of speakers, and to re-acknowledge the practice of diffusion as a strategy for composing sound. Therein, the autonomy present in complex systems turned out to be useful in designing a coherent control across different tasks involved in live electronics performance.

2.2 sound composition in bimanual space

On composing *snr,* for snare drum and electronics, I was interested in the active role of microphones in live electronic music. In works like *Cartridge Music* (1960) by Cage or *Mikrophonie I* (1964) by Stockhausen, microphones are more than a neutral observer or a faithful transducer of sound. They function similarly to musical instruments: they are not used but *played.* In the former piece unspecified small objects are inserted into and made audible by a phonograph cartridge (John Cage Trust, n.d.), and the latter piece articulates movements of two microphones around the surface of a tam-tam, thereby continuously transforming, along with modifications made with filters and potentiometers, the original sound (Stockhausen, 1989, p.80). The two pieces share the kind of (music) instrumental approach to microphones that is distant from standard usages.

Since my previous research in the Netherlands, I have gained experience in various recording projects (from a cathedral organ to ensembles of various sizes to an opera), and have always been interested in how the characteristics and set up of microphones result in different spatial images. Even when recording with two microphones, there are options of spatial microphone techniques such as *XY*, *Blumlein Pair*, *A-B, NOS, ORTF* and so on, which one could contemplate. Therefore, I thought it would be interesting to fuse the two distant poles of microphonic strategies (the compositionally motivated use and the standard use from recording practice).

Our body presents noticeable symmetries — the pairwise construction of the eyes, ears, arms, legs, etc., and the geometric and proportionate relationship among them — and some of those symmetries play an important role in the perception of visual and aural space. This link between our corporeal symmetry and our perception of space became the key in binding the instrumental mechanism of the snare drum with our aural sense of space. The articulation of the snare drum is relatively more symmetrical than in the case of other percussion instruments, and more so than strings, woodwind instruments or the like. Thus, I have come to think that the *bimanual* articulation of the instrumental membrane can mirror our *binaural* perception of space.

Two miniature omnidirectional microphones are attached, one underneath each of the performer's hands. An additional contact microphone captures the direct sound of the *snare*. In the score, I divide the radius of the membrane into seven points from the edge to centre and articulate the transitions among these points. When both hands play the instrument in a similar way, continuous changes in bimanual distance are specified in the second system. These two articulations interrelate and together specify how the performer moves the drum sticks, brushes or hands across the instrumental space. This way, the omni-pair underneath the hands acts like a dynamic A-B microphone pair due to the widening and narrowing of the inter-manual distance, and accordingly, a dynamic spatial image and a fluctuating timbre emerge.

The first section is built around the continuity of the rolling technique and the accentuation of the metallic sound of the snare. The computer takes a modest role here, governing the balance between the microphone groups (no obvious electronic sound is heard). In the second section, the previous continuity is passed to a sustained electronic sound on top of which the performer plays discretely. At the close of the section, the sustained sound reveals itself as a mass of sonic grains while the discrete instrumental articulation tries to converge. Sections three and four use the rolling technique again, accompanied by a more active electronic counterpart.

From the second half of the piece (section five), the hands start to act individually and the direct sound of the vibrating snare, which previously functioned as accents, becomes more audible. And the closing sections (seven and eight) echo or provide a residual recapitulation of the continuity-against-accentuation of the opening section.

2.2.1 Summary

The piece draws from techniques of spatial microphone setups in the more flexible and creative light hinted at by extraordinary historical works. And by doing so, it amplifies elastic instrumental space and exemplifies my attempt at embedding the audible spatiality of acoustic instruments into the mechanics of composition.

2.3 sound composition as collective instrumental activities

When composing for ensembles of acoustic instruments, I am interested in the aggregate instrumental activities which give rise to particular kinds of sound textures. Rather than approaching sound composition in terms of each instrument's extended articulatory possibilities or introducing technology extraneous to them, I employ more conventional instrumental techniques and try to find compositional mechanisms which generate the macroscopic level of ensemble.

2.3.1 *klangle*

The first ensemble piece included is the miniature work, *klangle,* one of the forty jingles composed for the Ensemble Klang (hence the title) for a concert in The Hague. Except for the use of electric guitar, there are no electronics involved in this piece. However, there are a few remarks that I would like to make regarding my approach to sound composition in chamber music.

In the first half of the piece (up to the tempo change), the instrumental group which provides the background (trombone, vibraphone, electric guitar and piano) starts rhythmically in unison, slows down individually and briefly coincides again before the change. Through this process, I aimed to create a sustained yet internally articulated sound, somewhat similar to the ‘phase-shifting’ textures heard in minimal music. Because I worked rather intuitively on this piece, how the shifting happens is a little arbitrary, but it presents a germination of ideas found in later works.

Aside from the above compositional interest, it was my intention to design metric changes through simple ratios. The rhythmic ambiguity and tension built up by the above mentioned shifting texture are released by the abrupt entrance to the more rhythmic second half. The glue to the change is the tempo ratio of 1:1.5 (M.M. 120:180) in which a triplet crotchet equals a crotchet after the change, a common yet useful bridge to metric modulation[3]. Within the second half, there are also alternations between duple and triple metres.

[3] To emphasize the metric relationship, the bar before the change has been streched to fit the triplets but the recording provided was made before the revision.

2.3.2 *vortextures*

The next ensemble piece I composed was for the Ensemble Vortex in Geneva. In this piece, I approached the composition of instrumental textures both from the individual articulatory level and the macroscopic level of organization, and I chose to keep the electronic part simple in order to contrast it with the instrumental textures.

The piece consists of six distinct sections which are played without a pause. The electronic sounds are all generated and do not depend on the instruments. They function as references to the activities of the instrumental part. By limiting the sound to either tones or noise, I have tried to contrast the tireless and somewhat flat characteristics of raw electronic sound with the delicate instrumental textures. Admittedly, that contrast might have been sharper had I not amplified the instrumental part and had only the electronics coming out of the speakers. In any case, it was my intention to establish a distance or perspective by drawing objective lines of electronic sound onto the more organic instrumental sound.

The first section is a process of divergence. The instruments begin with sharing the pitch class E repeated by the electronic reference tone, and gradually proceed to diverge around that pitch class. This heterophonic route of bifurcation prepares the full-blown noise of the next section. Starting in *tutti*, the thick texture of the opening of the second section breaks apart both in terms of the increasingly fragmented phrases and the asynchronous entrance of each instrument. The articulation of the instruments also grows milder while the referential electronic noise becomes lower and lower in pitch until it lurks in the background. The disintegration of the instrumental part also functions as a bridge to the vertical independence of the next section.

In the third section, I kept the instrumental techniques simple in order to focus on the mechanism of ensemble co-ordination. Instrumental parts proceed through the independent repetition of blocks, and the time-bracket specifies two choices of duration (twelve or eight seconds), left to individual decision. The number of repetitions of each block differs and at each repeat the duration is halved (e.g. 12, 6, and 3 seconds for three repetitions). This way, the mechanism and conditions for form are provided and the resulting interwoven texture reflects the choices of players. The low frequency electronic noise remains in the background throughout the section.

The fourth and the fifth sections are residual recapitulations of the first and second, emerging out of the drone of low frequency noise. While tracing the formal contour of the opening sections, extended techniques are explored by the instruments. Here, I sought ways to work with the instruments within the continuum of noisy sound. The ending section, made of one downward slope, mixes fragments of previously heard elements.

In summary, I did not deal with any particular spatial strategy but instead tried to give the electronics a referential role, and by doing so, I explored the flexible distance between the acoustic instruments and the electronic part.

2.3.3 *128*

A joint project by two ensembles in Amsterdam asked composers to write music in a fixed tempo: *128 BPM*. Their intention was to remix the pieces in concerts as a DJ would do (connect pieces in an overlapping manner). Thus, a common tempo and an additional techno-like kick (bass-drum) were required.

I chose to write for the three bass Paetzold recorders (great-, contra- and sub-contrabass) and a drum machine. The recorders were chosen on the basis of their articulatory possibilities: the rumbling low tones; the somewhat resonant key clicks; and the rich harmonics when overblown. What came to mind after learning about the project was to contrast the regular pulse ticked by the drum machine with the drifting instrumental part of Paetzolds. In addition, the phrase-to-phrase transitions are delegated to the instrumentalists, extending the idea of remix proposed by the ensembles to the domain of composition.

Each instrumentalist is given 17 blocks of repetition in which s/he can stay for as long as 60 seconds or as briefly as two or three repetitions (a mechanism, in principle, similar to *In C* [1964] by Terry Riley). The time signature of the blocks changes and it differs among parts ensuring on-going variation in terms of rhythmic relationship. Further, some repeating phrases follow a metric change such that they become progressively shorter (e.g. block number 3 to 6 of the contrabass).

At the opening of the piece, I used elements of ethnic musics: the *tabla* and *kalimba* of the drum machine matched by the key clicks played in cross-rhythm (triplets against duplets). My challenge was to compose something that has the atmosphere of ethnic music, but which does not refer to any particular ethnic origin. If it is acceptable to consider such *feeling* of musical identity as part of space perceived aurally, I would like to address the approach in light of sound composition inasmuch as one might be able to compose it through sound (choices of instruments, playing techniques, rhythmic and pitch structures).

The piece is basically in two parts: the first half till block 11, where the instruments drift individually while the cross-rhythmic relation runs throughout; and from 13 onwards, where a much more techno-like duple rhythm dominates. Here, the instruments align for the first time and play, together, the contracting metric structure derived from the first half.

To summarize, the piece is built around a mechanism which generates variations of rhythmic relationship. In comparison to the previous ensemble pieces, it presents a similar but more thorough application of compositional conditions which result in on-going formal changes. It was also a challenge to tap into a mental space formed by aural memories of different musics.

2.4 sound composition and diffusion ii

Over the course of my research, I have become increasingly aware of the difference between electronic and acoustic sound. By electronic sound, I mean sound heard through speakers or similar means, no matter what the content. Acoustic sound, by contrast, is any sound heard without transducers. It may seem contradictory to my stating that any sound (including ones reproduced by transducers) is spatial and thus *acoustic* in nature, but as I have also touched on, the difference is generated by the decontextualization of sound: even when an acoustic instrument is performed live, I feel that amplification alters the sound significantly and introduces a similar remoteness to the original acoustic quality. I do not undervalue the technology of transducers *per se* but increasingly feel the necessity to counterbalance the difference so caused. To tackle the lack of spatial depth or intimacy, one may deploy a large number of speakers in space, as in acousmatic diffusion, thereby triggering complex physical resonances characteristic of that space. The work discussed below, however, approaches the problem differently.

The last ensemble piece included is *textures±* composed for the Plus-Minus Ensemble in London. In composing this piece I wanted the electronic sounds to be as close as possible to those of the acoustic ensemble. There may be many ways to achieve such togetherness, perhaps as many as there are different compositional views. To name just a few possibilities: one may elaborate the sound itself such that it feels as realistic as the acoustic instruments; others would compose in such coherent ways that both parts sound musically together; or design interactivity adaptive to the acoustic circumstances including those of the musical instruments. To derive the approach presented here, I have examined the sounding mechanism in relation to my compositional idea, which will be discussed below.

Written for a trio of acoustic instruments (violin, piano and bass clarinet) and monaural electronics, the piece involves perhaps the least technical complexity or minimum extent of electronics in comparison to the works with acoustic instrument(s) so far discussed. Although the piece is technically quite the opposite of the project with cellist (i.e. mono as opposed to many channels), it will be discussed under the same major heading (*sound composition and diffusion*), as both pieces draw upon insights into the practice of diffusion.

The monaural sound of the electronics is fed to a speaker placed atop the sound-board of the piano pointing downwards and towards a sub-woofer underneath. Most of the electronic sounds are therefore diffused and heard only *indirectly* — an approach found in the practice of diffusion where a number of speakers point towards walls to create a diffused sound field. Furthermore, the sustain pedal actions of the piano as well as the choice of electronic sounds are made such that the electronics resonate the piano strings and become part of the instrument (similar approaches can be found in works such as *...sofferte onde serene...* [1976] by Nono or *Sequenza X* [1984] by Berio). The fact that all the acoustic instruments play without amplification also contributes to making the ensemble sound close together.

There are two movements in the piece, played without a pause. The first is built around diatonic clusters played by the piano, which naturally decay, but are extended by the other instruments including the electronics. The cluster chord heard at the opening of the piece is distributed to the other parts (towards bar 11) while the electronics gradually fade in. With the succeeding general pause (except for the piano pedal), the piano resonance is revealed. After the short soloistic passages for the bass clarinet (rehearsal letter B) and violin (letter C), the piece modulates and recapitulates the opening with some variations (letters D and E).

In the following contrasting movement, the electronics part not only uses sine tones, as it did previously, but also different types of noise and pulses to resonate the piano in a more active manner. The articulation of the electronics is very point-like so that the difference among tail resonances thus produced are clearly audible. The instrumental part is also pointillistic — at times providing contrast or support to the electronics' resonances, and at other times being combined rhythmically.

2.4.1 Summary

The piece uses fairly simple electronics but draws upon the complexity of physical instrumental resonance. The approach thus interrelates the motivic interest of the composition (diatonic clusters shared and distributed among parts) with the mechanism of sonic production (electronics through piano resonance co-ordinated with the actions of the damper pedal) in order that both the acoustic and electronic parts function musically together and appear sonically proximate.

3. Practice in electronic music

Introduction

> *Some company recently was interested in buying my "aura." They didn't want my product.*
>
> —Andy Warhol, 1975

In this chapter, three pieces of electronic music (ones without acoustic instruments) and three collaborative works, in which my role is focused on the electronic part, are discussed. Through my concentration on this particular task area as a composer and/or performer of the electronic part, I have reflected on my compositional tendencies and their validity in working with others. The following paragraphs initiate this undertaking by considering further my problematization of transducer technologies and the consequent disembodiment of sound.

In the 1936 essay "The Work of Art in the Age of Mechanical Reproduction," Walter Benjamin argues that *aura,* the authority of original work, is dissolved by modern techniques of mass reproduction (Benjamin, 1968, pp. 217–251). He writes, "Even the most perfect reproduction of a work of art is lacking in one element: its presence in time and space, its unique existence at the place where it happens to be." Although Benjamin's essay encompasses a broader critique of authenticity grounded on historical and institutional contexts, it still provides a clue to the problems of sonic reproduction on which I have repeatedly touched.

In the realm of sound the loss of authentic ground in replication or reproduction is a tangible issue. It is not only caused by the lack of a visible causality of sonic production (such as a hammer striking an object) but also arises from the altered sonic physicality which bundles the particularity of time and space. With our eyes closed, we are still able to tell whether that sound is produced (the object being hit here and now) or reproduced (captured elsewhere and played back). It is of course reasonable to ignore the above effect and use microphones and speakers simply for the purpose of amplification or as an effective tool of reproduction. But it can also be an interesting compositional challenge to acknowledge the significance of the mediating technology and Benjamin's philosophical critique may become relevant at this point: being a Marxist, he seeks a revolutionary opportunity in the radical accessibility that technologies of reproduction offer; "for the first time in world history, mechanical reproduction emancipates the work of art from its parasitical dependence on ritual" and electronic music, existing fundamentally on reproductive technologies and the consequent disembodiment of sound, can likewise explore the liberating potential of the medium. Transducing technologies can reproduce almost any sound without much prejudice (in contrast to the our selective listening habits) but at the same time alter the material reality of sound. And knowing that, the composer can draw upon their emancipatory potential.

3.1 electronic music

Three pieces of electronic music different in output format (stereo, laptop ensemble and multichannel) are documented and a shared approach to the materials as well as the underlying motivation for that approach are discussed.

3.1.1 *recitative*

I do not work much with materials derived from field recordings but often carry a handheld PCM recorder when traveling for any distance. These recordings are generally imperfect and kept purposelessly along with sound files collected elsewhere or captured by different means. This momentary piece, one of the first I composed during my research, uses a few of those othewise forgotten sounds: field recordings of religious verses and generated noise materials. Although I enjoy listening to electronic music whose sounds are elaborate and designed meticulously, the majority of my sounds are raw (as is also the case here) because I am more interested in the nature of sound (the materiality in its bare state) than in how I can transform it well according to compositional needs. In composing this piece I sought a formal binding of the two distant materials and I conceived of the acute noise materials as providing simple accompaniment to the essentially monodic vocal line, a strangely unreligious *recitativo*.

The piece's duration of 60 seconds was predetermined by the conditions of a compilation of signature works for a Canadian radio broadcast. The first verse is of Islamic *adhan,* a recited call for prayer and often amplified by a rather low quality speaker system. It was recorded at a mountaintop in Cappadocia, the historical region of Central Anatolia in Turkey. The wind noise, usually an undesired artifacts and consistently present in the recording, is intentionally kept for its contribution in the low frequency range. Following a short section of noise bursts, a repeating fragment of the above mentioned recording prepares a modulation to another recited vocal line (presumably from the *Koran*) recorded at one of the largest mosques in Istanbul. The very wet acoustic of the mosque contrasts with the open air quality of the previous recitation. The continuity maintained by the vocal line makes possible such a rapid exchange of spatial situations, an approach I found promising in exploring the decontextualizing force of the medium.

3.1.2 *8ound*

This piece was composed for the eight laptop performers of Electric Monster Laptop Ensemble at Montana State University. In this work I examined how human agency can create pseudo-randomness within the very limited interface of laptop computers. It would of course have been possible to incorporate other sophisticated interfacing devices which the performers could provide (e.g. MIDI faders, buttons, or the like) but I wanted to challenge this particular form of ensemble that is emerging and increasing in number but is not explored thoroughly. Only what is essential in operating a computer is kept (i.e.

the keyboard) in the hope that the constraints would manifest the autonomy and the consequent contingency of collective human activity.

Tha alpha-numeric space of the keyboard, the common interface for all the performers, is mapped onto a certain portion of a sound file unique to each player (SuperCollider source code, sound materials and instructions are included in the DVD: folder name *8_8ound*). The mapping is done in such a way that when a performer strikes the keys from the top-left (which is number '1') down to bottom-right (alphabet 'm') in an order, s/he will hear portions of the sound file in a sequential order. From the essentially dualistic interface (the on/off states of keys) what generates variety is the measured time difference between the on and off. The interval between the states is mapped to the duration and the playback rate of the triggered sonic portion. If one wishes to initiate a longer event (correspondingly lower in pitch), s/he needs to hold the key longer before releasing it. Although very rudimentary, I found it interesting that the previously passive interface started to hold a kind of instrumental *resistance* in response to the applied human action[4].

Commencing together, all the players follow the four sheets of graphic score (which can be arranged in any order, agreed beforehand and the same for all the performers). Each performer proceeds through a page at a varying pace of 45 to 90 seconds decided individually. In the graphic score the dots are interpreted roughly as representing the alpha-numeric keys and the lines (as an extention of dots) indicating the durations for which performers should

[4] An extensive discussion of embodied intstrumentality can be found in *An Enactive Approach to Digital Musical Instrument Design* by Newton Armstrong, especially pp.37–39, where the laptop's (mis)use in a potential embodied activity is discussed.

hold the keys. Three sheets (*drops, windchime* and *thunderous*) present certain regulated dynamics through the addition of a flowchart-like schematic, while *rain* is more aleatoric, leaving space for interpretation.

The choice of eight sounds for the players is based on the musical instrument taxonomy of the ancient Chinese which was brought over to Japan (*hachi-on*: the eight sounds). Where the auditorium is small enough, the performers are asked to play *unplugged* (using the laptop's built-in speakers) surrounding or in between the audience (otherwise circling around the audience with one speaker for each performer).

3.1.3 *BEASTest*

This is a study piece composed for *BEAST* (Birmingham ElectroAcoustic Sound Theatre) on the occasion of a concert at the CBSO Centre. I was concerned with examining the heterogenous spatial characteristics of the system deployed over the large space of the hall and was also very excited about the potential significance of the high elevation possible in the hall. Using signals characteristic to electronics (tones and noise), a series of *tests* are conducted. These are guided by and subsequently incorporated into the narrative of the historical recording of spacecraft ignition sequences.

Admittedly, I wish I had had time to adjust the piece in the actual setup of the Centre and to provide a recording of that instead of the binaural simulation included, which presents only a portion of the variety of acoustic impressions possible in the full setup. That said, the musical discourse described below is present in the recording.

The piece opens with a series of synthesised speech events announcing the kinds of test signals following it. The robotic tone of the announcements helps with setting the clinical atmosphere of conducted experiments. Here I have intentionally omitted the word *noise* which actually should follow the pronounced contents (*brown*, *pink* and *white*) to emphasize the somewhat poetic analogy drawn from the visual domain in naming those types of noise (except for *brown noise* named after a botanist).

While the test pattern continues over one of the main groups of speakers at floor level, the nicely low-fi historical recording starts counting the time left before the launch and commences the sequence of checks of the space craft equipment. The speech synthesis then pronounces the corrresponding spatial functions of the speakers (*very distant/close, high/low-elevation/frequency* etc.) some of which are taken from the naming conventions of the BEAST system. Thereafter, the stopwatch ticks the time and an association between the speakers and a spacecraft is introduced (57” onwards).

Meanwhile, some of speakers start to function as a system, beginning from the groups forming the rings; first horizontally rotational motions at different heights are tested individually followed by the first vertical motion test which groups further those rings of different height (1’34”).

Blinking impulses sounding somewhat spatially aleatoric (1’44”) are the result of playing all the speakers in sequence following the index convention of the system. I found this test most significantly manifested the heterogeneity of the BEAST system coupled with the large space of the CBSO Centre (within my piece) in that it does not only attest to the responses characteristic of different speaker types but also to the responses of the particular space and the manner in which each speaker is installed (although not present in the simulation).

A percussive and rhythmic section seeded by the previous impulse test follows, the *countdown* sequence proceeds and the piece continues to draw different asscociations (high/low, elevations/frequencies etc.) until a general pause (1’52”–2’41”).

Shortly after this, the recapitulated test signal pattern commences the ignition. The engines (speakers) now fire up in sequence and the generated low frequency noise gradually elevates both in frequency and height. To emphasize the effect of the first and only *tutti* of the speakers at the very ending of the piece, I randomly gave each speaker a slightly different delay.

3.1.4 Summary

To summarize, the three pieces of electronic music present rather different compositional interests: in *recitative* it was the exploration of the alienating impact of recording through rapid exchanges of spatial situations; in *8ound,* it was human agency as a source of variation in a laptop ensemble; and in *BEASTest*, it was the heterogeneity of the system and its large vertical extent. Retrospectively, however, I consider them as manifestations of my general interest in media, namely the critical role of the particular medium or a collection of mediating technologies involved in shaping the sound: *recitative* draws upon the spatial richness of concrete sounds; *8ound* explores the stripped-down potential of a laptop ensemble; and *BEASTest* most obviously is about the system itself (comprising unmatched speakers and a large space).

This common interest explains why I work with unprocessed sound and little transformation. Through raw sound as recorded it is possible to hear the characteristics of the equipment, techniques employed or artifacts left since sound itself carries traces of the processes it underwent. In other words, we hear how sound is made (hitting, bowing, speaker membrane etc.), from where and how it traveled before arriving at our ears (the spatial characteristics imprinted in sound). Similarly, by means of bare electronic signals, the characteristics of the speaker system and how it functions in a space become audible because of the even and marked characteristics of these sounds. Perhaps I have learnt this from pieces like *Chambers* (1968) or *I am sitting in a room* (1970) by Alvin Lucier: in the former piece the composer asks performers to 'collect or make large and small resonant environments' and to find a way to make these chambers sound; and the latter work, which repeatedly records and plays back a speech, reveals a gradual process where room resonance and artefacts of recording take over the initial content of the recording. Works like these reveal important aspects of sound which I found particularly relevant to my interest in the materiality of sound.

3.2 sound composition in collaborative works

Throughout my research period I have had opportunities to work with others. From such collaborative works, three pieces from *project sukebeningen* are included on the basis of their sound compositional relevance.

3.2.1 *the tattooer*

With two other Japanese artists, I started the project sukebeningen[5] in 2010. Its objective is to explore sensuality in various forms and to accommodate the different views on eroticism each invited artist possesses. We have so far created six pieces with five artists and the first of these is *the tattooer,* an interdisciplinary work with dance, music, visual art and olfactory art, based on a sadomasochistic tale by Jun'ichirō Tanizaki.

The choreography and dance are performed by a former NDT (Netherlands Dance Theatre) dancer and the music, performed on violin, frame drum and electronics, is a guided improvisation whose scheme I worked on with two other members of the project. The olfactory artist impregnated the traditional Japanese garment, *kimono,* with a distinctive fragrance (a common practice of *geisha*) and also diffused two different fragrances following the changes taking place during the performance.

For the electronics improvisation, I developed a set of SuperCollider classes based on the interface I made for the laptop ensemble (discussed in **3.1.2** *8ound*). In practical terms, the class *MicKeyWindow* catches key and mouse actions, stores them and prints information texts onto itself (which is a GUI window). And with *MicKeySynth* one can define a synthesis process and associate it with a particular key of the keyboard. When the defined synthesis process is triggered from the associated key, mouse position and wheel movements are passed into the process (in addition to the interval between key down-up actions as in *8ound*).

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[5] http://sukebeningen.org/

Fragments of concrete sound define the materials of the electronics: waterdrops, respiratory noise of the dancer, floor noise pertaining to the dance and a few others. The key down-up intervals control their rate of playback and wheel horizontal movement controls speed of panning (bi-directional). Because of the trackpad's inertial effect of scrolling, interesting controls became possible: with gentle left/right swipe I could move the sound in the corresponding direction; with more abrupt gestures, automated panning with decaying speed; with several rapid gestures, amplitude modulation varying in speed.

Subtle instrumental nuances (e.g. brush strokes on the frame drum, *col legno battuto/tratto* on the violin etc.) are amplified by contact microphones. An important distinction between the amplified instrumental sound and electronics is made: while using a quadraphonic system, two frontal speakers are placed close to each of the players and only the two behind the audience are used by the electronics. In this way I located the instrumental sound with the performers and contrasted this with the somewhat ghostly and disembodied quality of moving electronic sound projected from behind.

Following the narrative of the tale, the tattooed woman acquires a demonic and compelling beauty and this abrupt transition is prepared by a blackout accompanied by a precomposed white noise section. While the visual aspect of the performance is silenced by the blackout (nothing visible), as a counterbalance, the white noise covering the entire frequency range of audibility presents the opposite aural equivalent (everything audible).

3.2.2 *white night flower*

The concept of the work is an installation of *kehai* (気配), a Japanese notion of a vague sense of the presence of something. When one becomes aware that something exists around oneself without actually seeing it, perception arises from non-visual sensory faculties. In this work we have attempted to engage the audience with a multi-sensorial mode of experience.

The completely dark auditorium suppresses the sense of sight, thereby boosting the sensitivity of other modalities. The seats are arranged in a random manner through which the dancer moves while keeping an intimate proximity to the audience. She wears a perfume, developed by the olfactory artist to emphasize her kehai (where she is and what she does in the dark). She dances, breathes and touches softly around the audience with her hands, legs, and so on.

I composed the music to consist of a cyclical transition through 29 sustained chords corresponding to the phasing of the moon and the biorhythm of women. The materials are prolonged resonances of the piano. Miniature microphones are attached to the dancer's body and she listens to her own sound and reacts according to the music. It is also important that, while the dancer moves, she causes sonic interferences in the quadraphonic soundfield, changing the listening perspective of the audience (one's sense of space is modified especially when her hands are close to one's ears).

As the performance proceeds, the audience experience an increasing awareness of their non-visual senses. And, finally, when she presents herself visually for the first time, the light is extremely dim and the details remain veiled by a curtain.

3.2.3 *hoto*

In working with the stamp/graphic artist, the project chose symbolism and eroticism as the exhibition themes. On the one hand the artist designs digital graphics for corporates, and on the other hand interviews people and makes personalized hand-curved stamps. Seemingly he balances his creative motivation through working for these quite different types of client. As we found this antagonism between his outputs (digital/analogue, industrial/personal, etc.) interesting, we decided to emphasize it to create a contrasting female/male and digital/analogue diptych. The ‘male’, ‘analogue’ work for live-stamping and acoustic instruments was composed by the other member of the project and I have composed the ‘female’, ‘digital’ work documented here.

All the graphics in this work, be it symbolic or concrete, derive from the female genitals. Each presents a Freudian, semiotic, or mythological symbol shared or echoed among different cultures. At first I collected the symbolic items and started to draw formal connections among them. I then worked out the timeline defining the functions of sounds in relation to the symbolic images.

The sound materials divide into two extremes: concrete recorded sounds and characteristically electronic tones and noise. Together, they function as a ‘time glue’ for the otherwise static illustrations. It was also my first attempt at working extensively with binaural recording. And while keeping the sonic events intact I carefully cut the tail resonances of the recordings in order to emphasize their objective or clinical quality and symbolic functions.

The title of the work means female genitals in ancient Japanese. In addition, *H* informally means ‘naughty,’ and *oto* means ‘sound’ in present day Japanese.

3.2.4 Summary

Through collaborations I experienced how my compositional interest can challenge or be shared by other artistic views: the distinction between instrumental and electronic sound in *the tattooer* stems from my persistent attention to the effect of transducer technology, and it played a significant role in establishing connections between sonic quality (tied closely to human performance or floating in an other-worldly manner) and the subject matter of the tale (transformation process of the leading character); in *white night flower* I re-evaluated the dancer’s ability as an ‘instrumentalist’ to shape audience’s sonic experience of space through her moving in close proximity and in the abscence of light; and in *hoto* I developed my sensitivity to attend to a small but important trimming of resonance, which became instrumental in achieving the sober sonic impression necessitated by the visual materials.

4. Other practice

Introduction

The four works documented here form a substantial part of a project started at the time of my previous research at the Institute of Sonology. At that time I was interested in the possibility of sound synthesis using models of nonlinear dynamical systems. The utility class for SuperCollider *transnd* was a byproduct of my interest in sound synthesis: it was a simple tool for sonification. The class provides functionality to convert arbitrary digital data into multichannel interleaved audio. Using this utility I experimented with sonifying various data but had not previously been able to find a use for them in my compositions. Gradually, however, sonification gained increased significance in my compositional interest and has become the key means to explore the materiality of sound in digital media (Morimoto & Aoki, 2012) (Morimoto, 2012). The sound generators I developed at Sonology could even be understood in retrospect as instances of the sonification of complex systems. In any case I started collectively to call my solo works *transnd* after the above utility, as these works most directly reflect my compositional interest in examining and experimenting with sonic materiality.

4.1 sound (de)composition

I have a continuing interest in the audio-visual format, primarily because of its analytical potential. As in an oscilloscope, a spectrum analyzer or any other device for sound analysis, the understanding of certain aspects of sound may be enhanced through visualization. In addition, the difference between aural and visual perceptions can be explored, such that the combined effect brings about experiences which neither alone can achieve. Like their sonic materials, the two works discussed below use little (visual) abstraction and derive the images very directly from the dynamics of sound, namely from the *time-series*. Therefore, visual diversity is achieved entirely through the activities and forms of sound and not in terms of manipulations in the visual domain, and this brings about a healthy relationship in which my focus always remains within the realm of sound and composition.

4.1.1 *xy*

The major material of this work is sonified machine code (i.e., executables, object code, shared libraries, dynamically-loaded code, and core dumps) obtained by the utility described. Such binaries describe instructions performed directly by computer's CPU (as opposed to binary files that are parsed as texts/images/sound) and thus mark the dynamics of machine language. Using the x/y plot of oscilloscope, the characteristics of the material is examined in phase space.

Significant factors which determine the sonic features of binaries are the targeted CPU architecture, its instruction set architecture, and the way in which files are interpreted as interleaved audio. I have improved the utility to provide options for interpreting consecutive chunks of a file in different block sizes (8-, 16-, and 32-bit). For example, different executables compiled for an identical target may somewhat resemble each other sonically, or a similar header-like structure may be heard at the beginning of the generated sound file.

Structural features commonly observed across different binaries are the frequent presence of DC components, repetitions, oscillations, and abrupt transitions among different localised patterns. When heard at higher playback rates (above 10,000 samples per second), they present a highly noisy quality, yet different in kind from common noise generators (white, pink, brown noise, etc.), and at lower rates, the irregularity and asymmetric structures in stereo space become progressively apparent. In both cases, the observed dynamics are quite remote from those which have a physical root (i.e, various dynamical systems whose energy propagates in an elastic medium having a wave-like structure).

The performance of the work alternates between the above-mentioned raw sonified materials and sections that are built with those materials. In the ‘raw’ sections, materials are often transposed down to about three octaves below the original rate, where changes in the left/right phasing can be followed individually and perceived as semi-formal dynamics. By doing so, the detailed phase space structure of audible programs are revealed both sonically and visually. The more ‘composed’ sections respond to each proceeding exposition by using those materials as audible sonorities (rendered at higher rates) rather than for the sake of their formal structures.

Materials other than machine code are simple geometric forms (e.g. sine, triangle, and square wave), which were primarily associated with scientific measurements and electronics engineering instruments. Although they can serve as an architectonic basis of electronic music (additive and subtractive synthesis, FM and AM synthesis, etc.), in this audio-visual work, they are valued *per se* and used in their raw forms. Their simplicity and determined characteristics make these waveforms suitable for shaping the phase space (Figure 1, top row).

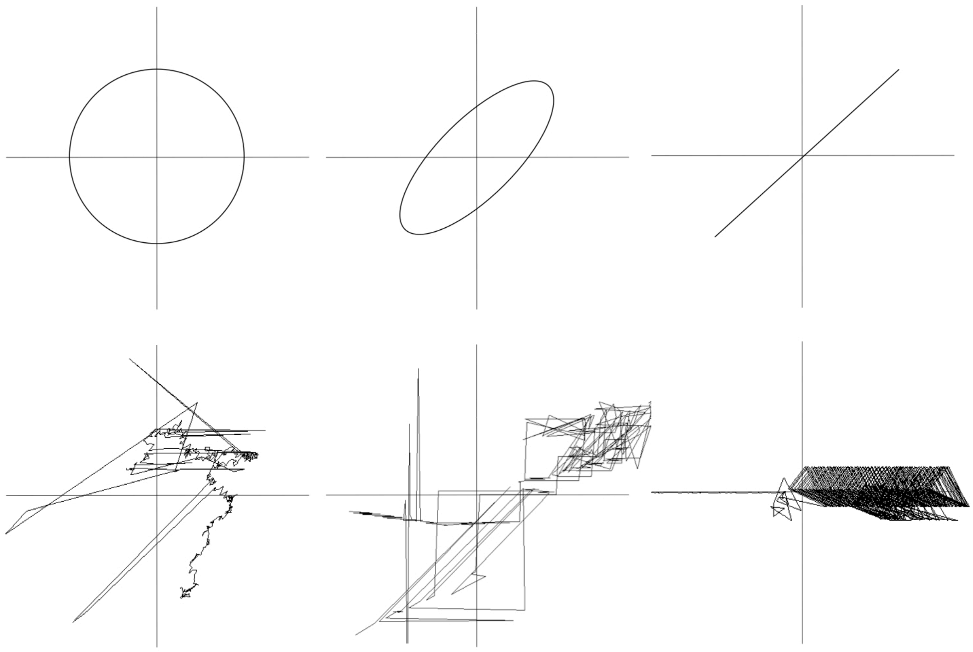

Figure 1. Examples of phase space dynamics in x/y plot. Three images in the top row are all two sine waves with identical frequency — left: inverse phase relationship; middle: 45˚ difference; right: in phase. The bottom row shows examples of sonified stereo machine code — left and middle: observable irregularity, asymmetry and DC component; right: fragment of machine code material projected along the sinewave at x-axis.

Importantly, the visually present phase space is also a sonic space defined by inter-aural time difference. The dynamic relationship created by two signals eventually shapes the space perceived. Notably this space is not something designed separately from the sound (i.e., via various panning algorithms, simulations of space or reverberations), but one that emerges from the dynamic relationship between the two sounds.

While the sonified machine code materials in *xy* present highly irregular phase dynamics, interestingly remote from those of physical origins, the geometric forms provide a means to shape accurately a dynamic inter-aural space. Furthermore, the work combines the two materials such that the geometric forms provide anatomical cuts to reveal the structures of machine code (Figure 1, bottom right).

4.1.2 *matrix*

Most recently I have presented three new works of the project *transnd* as a solo exhibition. The first of these is the audio-visual installation, *matrix*. The materials of the work are sonified machine code, electronic tones and noise, instrumental drones, and field recordings of environmental and wildlife sounds. The work seeks to explore differences/similarities between these materials, and as a compositional process, it was interesting to encounter unexpected differences/similarities between the seemingly close/distant materials. The first two groups of materials, sonification and raw electronic sound which are very common among other works of mine, play an important role in hinting at and navigating through such associations between the groups of materials.

Practically, the work renders the sonic materials visually in a difference matrix (*recurrence plot*) (Figure 2). Each of the two audio channels of the stereo corresponds to the vertical/horizontal lines: where sound is projected from one of the speakers alone, a grayscale pattern corresponding to the waveform is rendered either vertically or horizontally; a different signal in each channel results in a matrix of difference; and the same signal over both channels (i.e. monaural) represents the recurring periodicity of the signal.

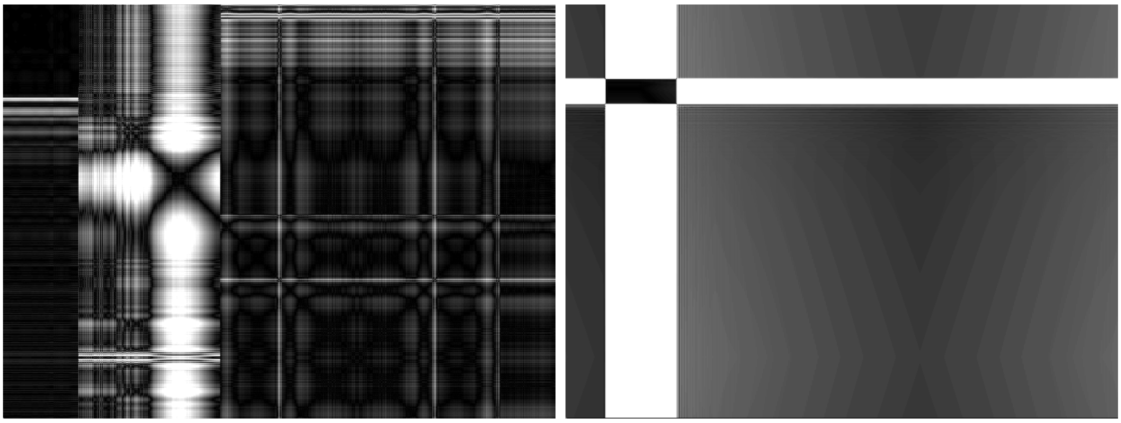

Figure 2. Examples of difference matrix of two signals — left: complex sound in both channels; right: two pulses with an identical frequency and different pulse width.

Not only are the images matrices of difference but also through sound the work attempts at extending this temporally: the successions of distant but somehow similar materials (electonic/environmental noise, machine/wildlife sonic patterns, electronic/instrumental clusters etc.) suggests a matrix in time. The work is a loop of about ten minutes.

4.1.3 Summary

Working with the very direct sound-to-image conversion systems of the two audio-visual works, I gained a better understanding of my materials: in *xy,* through the analytic potential of phase space dynamics I re-evaluated the compositional use of simple geometric waveforms in articulating space in terms of inter-aural time difference. In addition, the highly irregular and asymmetric structures of machine code dynamics became tangible, which helped me discover new uses of this material; in *matrix,* these oscillators and sonification materials, together with the common noise generators, played an important part in shaping the audio-visual matrix. I was able not only to contrast these synthetic materials with recordings of natural sound but also to find new relationships between them.

4.2 sound installation

The range of audible frequency is much greater than frequency range in the visual domain; whereas the wavelength of longest visible light (red) is only twice the shortest visible (violet), that of sound is a thousand times longer (20-20000 Hz ≒ 17 meters to 1.7 centimeters). The physical properties of sonic wave propagation thus differs greatly from light (diffraction, reflection, or other kinds of interference depend largely on wavelength). For my solo exhibition I have designed and developed a pair of sound installations which draw upon the extremes of audiblity, one for high frequency range and another for low.

4.2.1 *spray*

The directivity of sound is stronger in upper frequencies. In this sound installation I developed two motorized line arrays of tweeters in order to create kinetic and focused columns of sound. Where certain conditions are met[6], a line array can significantly narrow the directivity of sound. These line arrays are identical in construction and form sonic beams at around 2,000-10,000 Hz (inter-driver distance 1.6 cm, array width 16 cm).

[6] when the distances between adjacent speakers (inter-driver spacing) = ½ the wavelength and the array width is greater than the wavelength.

Figure 3. Sound installation, *spray.* Left: installation view with linearrays at ear-level and computers on the floor; top right: a pair of Raspberry Pi computers and battery-driven amplifiers; bottom right: linearrays in motion mounted on microphone stands.

Two *Raspberry Pi* computers and battery driven amplifiers generate and amplify the sound and control the motors (Figure 3). The sonic material of one system is white noise with varied articulations, while the other is sustained drones of diatonic clusters of sine waves. These materials are chosen with a visual analogy in mind: one sprays with *white* and another with different *colours* (diatonic clusters of different compositions); and because of the strong directivity of the sounds, one experiences moving audible reflections from the walls which could seem almost visible: two sonic sprays that paint the space.

The sound generating patches are programmed with Pure Data and the motors are driven by programmes written in the Python language. In order to co-ordinate the sound with the motor, the Python programme controls both the parameters of the sound and the motions of the motors. Each of the two systems, the white- and colour-spray, runs at a fixed cycle but they differ from one another in duration, resulting in a shift at each cycle. Further, within each spray the cycle of motor controls (starting at maximum speed, followed by a *ritardando* and then intermittent motions) and that of sonic articulations (sustained, percussive, etc.) differ, which ensures determined (no randomization) but on-going internal variations between sonic articulations and kinetic motions — an approach to variations similar to those discussed in **2.3** (sound composition as collective instrumental activities).

4.2.2 *infrasonics*

The last work discussed is the second of the pair of installation works. It uses the so-called *structure-borne transducing* technology in order to resonate a polycarbonate surface. Three of these transducers designed for low frequencies (resonant frequency 25 Hz) are mounted on the surface, each playing a sine wave of slightly different frequencies (Figure 4).

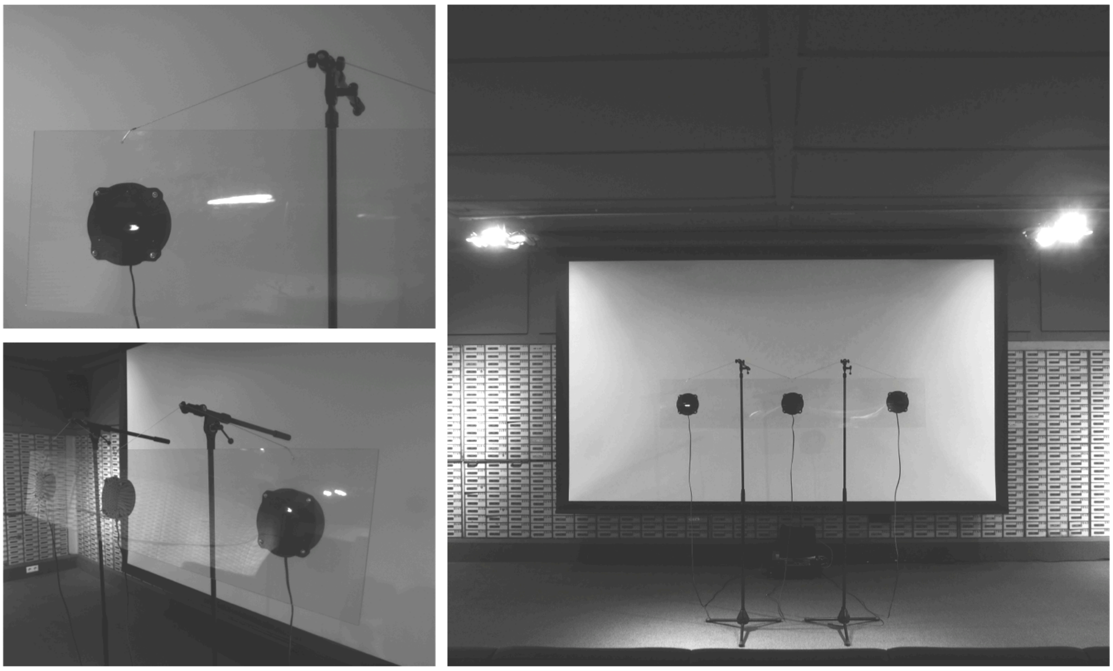

Figure 4. Sound installation, *infrasonics.* Right: installation view of three transducers lifted to ear-level and a computer on the floor; top left: close-up of a transducer attached to the polycarbonate surface; bottom left: sideview of the installation.

In principle, the slight differences between the three low frequency oscillations (in range of 30-35 Hz) create infrasonic beating patterns across the surface. Although the transducers resonate at a lower audible range, their amplitudes are kept small making the installation almost silent and inviting the audience’s physical contact with the surface. With both hands in contact with different locations it is possible to feel vibrations moving slowly on the plane, depending on the controlled interference. At close proximities (2-3 cm) one can also hear the sound which again differs from one place to another. There are some conditions (e.g. the material construction of the surface, its size in relationship to the wavelength etc.) which would contribute to a better control over the varying geometry of the surface, and I will continue investigations into this.

4.2.3 Summary

The above sound installations all draw upon the physicality of sound: in *spray,* the physical formation of sonic beams in the arrayed speaker constructions was instrumental in articulating the installation space in terms of audible reflections; and *infrasonics* attempted the translation of sonic dynamics into a tactile material experience through its use of structure-borne infrasonic beating patterns. Drawing upon the extreme conditions of sound (high frequency with tight focus and low frequency with tactile sensetion), I sought ways to present a possible re-embodied experience of sound in technologically mediated conditions — as audible reflections seeming almost visible and as materials’ tactile resonance patterns.

5. Concluding remarks

> *Art in its most primitive state is a simple imitation of nature. But it quickly becomes imitation of nature in the wider sense of this idea, that is, not merely imitation of outer but also of inner nature.*
>
> —Arnold Schoenberg, 1978

> *Art = imitation of nature in her manner of operation.*
>
> —John Cage, 1982

The material reality of sound has become increasingly important to me. If a sound posseses a certain existential reality (that it appears to us reasonably existing and appreciable) it is not because of its immutable identity. Sound exsits as a form of change and is a temporal flux. Constant change like a persistent background noise or a static tone (without any modulation, tone itself is still a change of a regular periodicity) quickly becomes insignificant because it is another form of fixity, and can only appear meaningful with one's sensitivity to or effort to listen to it. The Cagean silence does this precisely by setting up a time frame, a condition to plunge into the sea of noise. Many sound installations' use of static sound, too, like the standing-waves of *The Dream House* (1993) by La Monte Young, is instrumental in initiating the audience's discovery of sound in relation to space (since sound changes according to the listening location and fixed sound emphasizes this by providing a firm reference).

On the other hand, by being transient and with its temporal formal dynamics (begining, ending and the compositional logic bridging them), music more closely imitates the nature of sound (the applied kinetic force to a fluid or elastic solid bearing a particular mode of resonance until it settles back to equilibrium) and how we experience it in its quality (our ability not only to appreciate the sonic quality of the source, but also to decode the characteristics of the space it traveled through). Music is, like its material sound, a change, making it *a change of change*. The compsitional awareness of the material reality of sound, derived from the revised notion of onkyō and reading of ontological materialism, can help the composer with establishing connections between the two changes (*to imitate nature in her manner of operation, its inner nature*). Here, *time* is the key factor for the attempt at reverse-engineering the reality of sound: in *acamar,* we experienced how sound physically shapes itself in the large spatial extent defined by many speakers; in *snr,* through observations into how aural spatiality folds in time, it became possible to design space in terms of time: the bimanual *timing* difference articulating the spatial image of the snare drum; in ensemble pieces, I explored the use of compositional conditions which generate on-going ensemble *timing* difference (a shifting vertical co-ordination among instruments resulting in formal changes); in *textures±,* by rendering the simplistic electronics complex through the instrumental resonance of the piano, I brought closer the mechanics of sonic production (electro-acoustic resonance) and music composition (shared motivic interest co-ordinated with actions of the damper pedal); in the three pieces of electronic music, while trying to trace the impact of disembodiment and dislocation of sound brought about by technological mediations, the range of materials I used became progressively more limited and this tendency permeated other works of mine; collaborative works have been good opportunities to test the validity, and to a certain extent, the generality of my sound compositional interest; through audio-visual works, I gained a better understanding of the materials (oscillators and noise generators) which were increasing in significance in my works, and re-evaluated their possibility to shape certain sensations of space; and lastly through installation works, I tried to design time (specific behaviours of sound, highly focused or tactile) in terms of space (different spatial assembly of transducers).

As discussed in this document, my approaches to a possible materialism in sound manifest differently in each work, and in that sense, they do not comprise a compositional methodology, nor a development or refinement of a certain kind of technique. However, it was through such an enterprise that I fostered a sensitivity to attend to the material reality of sound, that I became aware of the compositional urgency to re-establish the sonic-music nexus, and it is in this sense that I increasingly appreciate the complexity of sonic matters as a significant impetus for my research and creation.

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