Composing Circuits, Systems and Interaction

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INTRODUCTION

From instrument design towards composed systems and interaction

In 2015, I completed my Bachelor studies at The Institute of Sonology, graduating with a thesis titled “Instrument design for live electronics”. My main motivation at that time was to create instruments that would allow me to perform and improvise with electronics, especially with computer models. The core of this research focused on developing two main approaches for instrument design and resulted in the construction of two instruments, both of which used midi interfaces as their control devices. The first instrument (Fig. 1.1), used a traditional instrumental paradigm, namely a one-to-one correspondence of physical gestures with individual sound events (Bolzman, 2015 pp. 02).

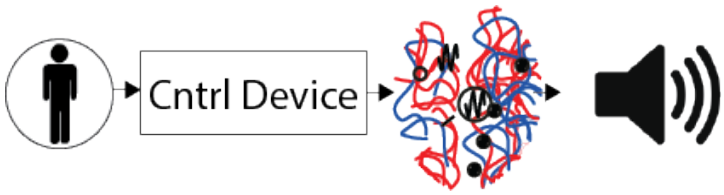


Figure 1. 1 Linear module

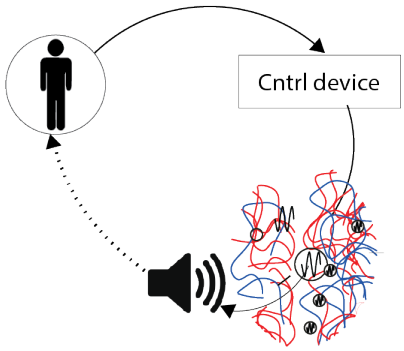


Figure 1. 2 Interactive module

The second instrument (Fig. 1.2) was based on the reactive approach and resulted in the realisation of a model inspired by the work David Tudor. It was my own digital interpretation in response to the Tudor’s ‘rainforest’ concept and aesthetics. The sound model used within the instrument featured a non-linear and semi-chaotic type of musical behaviour. Additionally, this type of semi-chaotic musical behaviour resulted from a feedback network of oscillators (that were also based on feedback loops). The difference between the models was not only technical; a reactive model - like the Tudor Machine or a No Input Mixer - with a certain musical independence

invites the performer to play differently than with a regular instrument. The interaction invites listening and collaboration. Toshimaru Nakamura, a pioneer in the field of No Input:

> *I think I find an equal relationship with no-input mixing board, which I didn't see with the guitar. When I played the guitar, I had to play the guitar. But with the mixing board, the machine would play me and the music would play the other two, and I would do something or maybe nothing. I would think some people would play the guitar and create their music with this kind of attitude, but for me, no-input mixing board gives me this equal relationship between the music, including the space, the instrument and me.* (Meyer, 2003)

Nakamura points to a very fundamental shift in electronic music, a conceptual shift from the instrument paradigm of control towards collaborative interaction with an electronic-system. Tudor emphasises this idea when saying: *"I try to find out what's there –not to make it do what I want, but to release what's there. The object should teach you what it wants to hear."* (Schonfeld, 1972). The object itself, the electronic setup – the design of its behaviour becomes the heart of the composition. The performer's "work" is to interact with it and reveal the musical potential of the system, "where music is revealed from 'inside', rather than from 'outside'." (Tudor quoted in Dewar, 2009, pp. 134)

System and Interaction

The model described in the last paragraph presents the fundamentals of electronic systems music (Nyman footnote). A musical system could be understood as a "network of connected components whose emergent behaviour in sound one calls music". (Di Scipio, xxxx). The components that ensemble a system could be conductors, resistors and transistors (as in the case of Tudor), but also a Pure-Data

patch, a microphone and a room (in the case of Di Scipio). The interaction between the components, as well as the design of the system musical behaviour over time, become the cornerstone of the piece, *"a shift from creating wanted sounds via interactive means* [instrumental paradigm]*, towards creating wanted interactions having audible traces* [composed system] (Di Scipio, xxxx)".

The title of that thesis was *Composing circuits, systems and interaction*. It refers to all parts of the performative system, the performer, the DSP model (circuit) and their mutual interaction. The aim of this research is to explore what kinds of musical behaviours occur from establishing certain rules of interaction between a performer and electronics, and how this behaviour could be formalised into a piece.

My personal artistic ambition in this research was to expand the interaction model by including myself inside the system, as a performer, a physical body in space and an identity with history. I wanted to resonate and reflect human/machine music relationship, making it audible (Fig. 1.3).

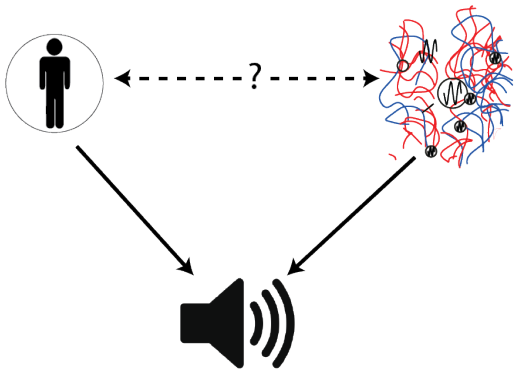


Figure 1. 3.

The musical and conceptual framework of this research is rooted in the pioneering work of David Tudor. His work, ideas and aesthetics have influenced my work over the last years and echo in my compositions. Tudor, together with other members of the Sonic Art Union – Robert Ashley, Gordon Mumma, David Behrman and Alvin Lucier – layed the foundation for a unique approach in live electronics that is often called *system music*. Although the SAU's body of work is very rich and diverse, they all shared a common ground concerning the experimental approach towards composition; the idea that time-based behaviour of an electronic configuration [could

be understood] as the identity of a musical composition (Kuivila & Behrman 1998:14).

In the first chapter of this thesis that documents the accumulation of material from a two-year research, I will review ideas and concepts of the SAU that I found relevant to my current work. Furthermore, four different pieces of the SAU members that represent different models of interaction between a performer and circuitry will be examined.

The second chapter will discuss *ShuShu:* an etude series composed as part of the study on machine listening and composed interaction. In a third chapter, a currently developing work, titled *"The Visit of the Iraqi Delegation"*, will be presented and discussed.

1. Sonic Art Union as a Case Study

1.1. Background motivation

This research started with an intention to yield new models of composing and performing with electronics. Models of live electronic music that would combine compositional aspects within the design of electronic systems. Through previous research on the work of David Tudor, I was introduced to the pioneering works of the Sonic Art Union. Innovative at their time of activity, the group's approach to live electronic music performance was a mixture of post-Cagean compositional ideas and radical conceptions about the "nature" of electronics in music.

In the following paragraphs, specific ideas, that relate to the intentions of this research, are examined by investigating on the background of individual works of the group's members. The pieces to be mentioned reveal interesting idioms of musical expression, in a context where the electronics and the performers operate in a real-time collaboration, composing systems that function as the cores of each piece's development.

1.2. Origins of the union

The Sonic Art Union (SAU) was an American experimental live electronic music group formed in 1966 by composers Robert Ashley, Gordon Mumma, David Behrman and Alvin Lucier (Dewar, 2009). Tudor himself was not an official member of the "union", nevertheless his late career as a composer was deeply connected to the group. The word "group" might be misleading in the case of SAU, as Ashley explains:

> *I thought we weren't really a group. I mean, we didn't have an ensemble, we were just four guys, and so I suggested that the word 'Union' might be a better description of what we did than 'group'. I mean, we didn't*

actually rehearse, you know? We played. (Dewar, 2009,pp 54).

Ashley's statement is reflected in the diverse body of work performed by the SAU members, with each member maintaining his own aesthetics and compositional ideas. Nevertheless, SAU expressed some common guidelines that could be found in almost all of their work. Gordon Momma described their common ground of collaboration as follows:

"…more important is their attitude about using electronic technology in their work. Rather than ***impose the formalities of non-electronic and European concert traditions*** *upon it, they develop their art from their* ***experiences with electronics*** *and the diversity of the culture in which they live". (Mumma 1974, pp 75)*

Compared to the established European electronic music at that time, that was mainly based on studio work, SAU composers were working mainly in the field of live electronic music. Furthermore, with limited access to commercial electronic equipment or studios, SAU and Tudor based their work on DIY (do it yourself) circuits design,modified found electronic equipment, or with means of amplification itself. Their intimate experience with electronics consequently shaped their composition approach, as music that derive from the sound properties of the circuitry itself. In the following quote, Holzer links between the technological aspect of their work with the compositional one:

When creating electronic music instruments, the builder is in fact simultaneously acting as post-Cagean composer by simultaneously constructing a highly restrictive collection of limitations and an indeterministic set of performance possibilities, each full of as much potential and risk as the builder/composer wishes to allow the performer. (Holzer, 2011)

The dichotomy of 'music from inside and outside' could be understood as the second mutual character in the work of SAU, influenced by John Cage's compositional and philosophical ideas, namely indeterminacy and the "liberation of sound". The following quote describe this relationship:

In the context of this research, I will examine the following relevant subjects, with respect to the work of SAU: the concept of collaboration with electronics, models of interaction with systems and cybernetic approach towards composition.

1.3. From an Object to a Collaborator

In the following inspiring quote of David Tudor we can find the fundamentals to his unique approach towards composing inside electronics. Electronic systems as collaborators, and composing as an act of designing potentials. His approach had an important influence on the work of SAU, yet, as a composer, he too was influenced by the interaction with the group.

> *"The view from inside – The realm of electronics, entered into in the spirit of discovery, can give the musician a new world.* ***Electronic components and circuitry, observed as individual and unique****, rather than* ***as servo-mechanisms****, more and more reveal their* ***personalities****, directly related to the particular musician involved with them. The deeper this process of observation, the more the components seem to require and* ***suggest their own musical ideas****, arriving at that point of discovery, always incredible,* ***where music is revealed from 'inside', rather than from 'outside'"*** *(Dewar, 2009: pg. xxx)*

Tudor's conceptual shift from circuitry used as an **object**: a servo-mechanism (i.e., "servants" or "slaves"), to a **semi-subject**: individual and unique, could be understood as the crucial point where Tudor established his own compositional idiom developed from Cage's indeterminate compositional ideas.

The idea that an object can have a sound identity or personality that should be revealed, could be located in Cage's piece *Cartridge Music*. The piece is based on the amplification of everyday objects, manually making them sound and resonate, hence revealing their sonic character. A very poetic quote shows a spiritual aspect in Cage(and perhaps Tudor's) motivation behind the piece:

> [Oskar Fischinger, movie director]… began to talk with me about the spirit which is inside each of the objects of this world. So, he told me, all we need to do to liberate that spirit is to brush past the object, and to draw forth its sound. In all the many years which followed… I never stopped touching things, making them sound and resound, to discover what sounds they could produce (Cage 1981, pp 73) .

In *Rainforest IV*, Tudor approaches the same idea, revealing sonic characteristics of everyday objects, with a different method. Rather than playing manually on the object as an instrument, then amplifying it and projecting the sound through a speaker, Tudor uses the object itself as speakers (using transducers) that resonate according to the signal routed to it. The performer needs to choose a sound material that will trigger the resonant behaviour of the object, to communicate with it until he/she finds the right frequency that makes it move. *To realise the piece, you must collaborate with the object you chose. As a composition, all that must be stipulated are the basic terms of that collaboration, the rest will unfold as 'nature'.* (Kuivila, 2001) Opposite to Cage, Tudor uses amplification as a method of interaction, letting the object itself reveal its own sonic character, rather than manually "forcing" it.

1.4. Life in the Machine

In the early versions of *Rainforest* – and in most of his other compositions – the physical resonating object was replaced with handmade circuitry. In both cases the motivation is the same: to reveal the own unique voice of the object. Although the object that Tudor used was electronic, the design of the circuits themselves was based on amplifiers and self-feedback, a design that resembles a physical model that can resonate (Tudor never mentioned his intention to model a circuit, but from my own experiments in feedback models, they are always comparable to an equivalent scientific physical model). The reason that Tudor used a feedback model is explained well in the following quote:

> He treated each collection of components as though it had a distinct personality and he was discovering its authentic nature. He accomplished this through feedback oscillation – the machines' spontaneous response to given conditions. For Tudor, feedback was not noise, but rather the **expression of the machine's persona** (...). He'd set the knobs in such a way that when he increased the gain a very unpredictable thing would occur, that he'd react to. (Bischoff, in Manousakis, 2010, pp. 3–4).

For Tudor, internal feedback is used to reveal the unique features of the circuit, its own personality. Without any outside manipulation, the circuit itself can perform and suggest unique musical ideas, a method of emancipation of the object and convert it to a **semi-subject -** a collaborator. In compositional terms, Tudor frees himself from the need to use traditional music tools such as pitch, amplitude and duration, and bases his compositions on the design of the circuit's behaviour. Tudor expressed this feeling when saying: *Well, I don't like to tell the machines what to do. It's when they do something that I don't know about, and I can help it along, then all of a sudden I know the piece is mine. Otherwise, you set out to make a scale of pitches or a scale of dynamics; anybody can do that. (Fullemann, 1984)*

1.5. Acoustic Feedback – Conductive Performer

Lucier, referring to his work on *Vespers* (1968) reveals a similar approach to Tudor, only in his case the object of exploration is space rather than electronic circuitry:

> I am satisfied not to compose terribly much but to let the space and the situation take over. I don't intrude my personality on a space, I don't bring an idea of mine about composition into a space and superimpose it on that space, I just bring a very simple idea about a task that players can do and let the space push the players around. (Lucier, 1995, pp 78)

In Lucier's feedback piece *Bird and Person Dyning* (1975), **listening** is the most fundamental rule of the score, *listening to itself becomes a performative act* (Van Eck, 2017, pp. 103). The text score of the piece is divided in two. The first part describes how to setup the electronic system (Fig. xx). Lucier uses a very simple acoustic feedback loop: two binaural microphones (placed inside the performer's ear), compressor, two speakers and a space. To this setup Lucier adds a ready-made object, an electric singing bird that "sings" endless repetitions of a downward glissando. The second part of the text score describes simple instructions for the performer:

> Stand anywhere facing the bird. Listen to it […] Walk in very slow motion, pawing the bird and/or loudspeakers, mapping the acoustic characteristics of the space in terms of the pitches. intensities, and shapes of the encountered strands of feedback. Turn, dip and tilt your head to make corrections and fine adjustments and to move the sounds of the twittering bird from loudspeaker to loudspeaker. […] Search for phantom twitters, including mirror images above and below the originals

> caused by heterodyning. Use the directional properties of the binaural system to localize these phenomena for listeners. (Original score)

As in Tudor's work, Lucier uses feedback in order to reveal the character of the object of the piece, in this case (and in many of other Lucier's pieces) a room – space. Nevertheless, the method of collaborating and influencing the electronic setup behaviour in Lucier's piece is essentially different. In *Bird and Person Dyning* the components of the "circuit" are compiled from amplifier, microphones and space. The performer, in this case, is a **conductive** part inside of the feedback loop, immanent inside the electronics. The performer scans the space with his/her ears and body as a variable resistor inside a circuit, revealing the natural resonance of the system and collaborating with the space. The interaction with the electronic setup becomes performative, transparent and musical.

The electronic bird in the piece is a brilliant addition; on the musical level, it is used to 'trigger' the space: the glissando sound that it produces creates complex feedback patterns and a heterodyning effect - a feeling that the sound comes from the listener's head. It is also the object that the performer listens to, focuses his/her attention on and researches its effect on space. On the performative level, Lucier manages to create a feedback piece that is transparent, dramatic and poetic, using a ready-made object as a natural, inherent part of the piece. Compared to other acoustic feedback pieces of SAU, such as *Microphone* by Tudor and Ashley's *Wolfman*, *Bird and Person Dyning* elegantly manages to create a piece that is more about the exploration of the space, a piece whose performative aspects are naturally embedded inside its musical identity.

1.6. Collaborating – Cybersonic approach

During the 60's, Gordon Mumma, a key member of the SAU, developed his own particular view on the idea of collaboration and composition with electronic systems. In his article *Creative Aspects of Live-Performance Electronic Music Technology* (1967) he elaborates on this:

> *I am concerned primarily with "system concepts"—configurations that include sound sources, electronic modification circuitry, control or logic circuitry, playback apparatus (power amplifiers, loudspeakers, and the auditorium), and even social conditions beyond the confines of technology (Mumma, 2015, pp 44)*

Mumma's *System Concepts* for composition with electronics later described by him as *Cybersonic* (a compound of Cybernetic and Sonic), considered the application of system theory and control over the field of sound. Although the definition cybersonic in the work of Mumma is not comprehensively presented, I will refer to two main approaches regarded as important to this research.

1.7. Community of Devices

> *The concept of "collaboration" may also be extended to technological levels. In my creative work with electronic-music resources, I have explored a direction that I call "cybersonics." Simply, cybersonics is a situation in which the electronic processing of sound activities is determined (or influenced) by the interactions of the sounds with themselves—that interaction itself being "collaborative.(Mumma, 2015,pp 39-40)*

Mumma, who worked closely with Tudor and Cage in the *Merce Cunningham Dance Company*, shared with them a similar anthropomorphic approach towards technology and his circuits. *[In] Mumma's terminology, his cybersonic instruments were components with a "personality" of their own that "listened to" and "influenced" one another, in no different way from human* (Nakai, 2016 ,p177).

In an interview with Dewar, Mumma refers to the work of SAU as *"building communities"* of electronic devices (Dewar, 2009). The composer's role in this case, is to plan the interaction between the devices and then let it run its course without an external influence, as an organic process (ibid). When listening to pieces of Tudor, such as *Rainforest I* (1968) or *Neural Synthesis* (1992-1994), Mumma's concept of 'community of devices' becomes evident, as it sonically resembles a collection of devices; each device consists of a unique sonic personality, influencing and communicating with each other. The sonic results of these pieces present highly 'organic' processes that are perceived as each piece is emerging by it's own structure, unaffected by an external influence.

In this example of "community of devices", Mumma presents an electronic setup that resembles a modular synth system, where sound units interact with each other via their sound. Nevertheless, in Mumma's personal interpretation for modular synths he emphasises the use of feedback as a deriving force of the system, as sounds were fed back to the system and used as a control signal. As for Tudor, the use of feedback has a crucial meaning, as it reveals the individual personality of the system, transforming it from a controlled object into a collaborator.

1.8. Democratic Musical Society

In a wider perspective, 'cybersonic' could be understood as a term to define the processes of interaction between units, through sounds, inside any system - including electronics, the performer and the space; all of the components of the system share equal status. The piece *Hornpipe* (1967), features a collaborative performance between a french horn played by Mumma, a cybernetic console - a self-built analog computer and sound module - and the room in which it is performed.

In the following quote Mumma describes the course of *Hornpipe* performance:

> *Hornpipe begins as a solo* [French-Horn]*. The cybersonic console listens (with microphones) to the acoustical response of the auditorium* [triggered by the horn solo opening]*. After a few minutes the console contributes its own responses. Hornpipe*

> *becomes a duo. The response of the cybersonic console depends on the horn sounds and the resonances of the auditorium. The resonances of the auditorium are affected by the sound responses of the console as well as by the sounds of the horn. Considering the differences in personality of various auditoriums, perhaps Hornpipe is a trio (Mumma 1970: pg. 1).*

Revolutionary for its time, *Hornpipe* presented pioneering work in collaborative interaction with electronics. To refer to the beginning of this chapter, Tudor describes the shift from *electronic components and circuitry, observed as i**ndividual and unique**, rather than as **servo-mechanisms*** **(**Dewar, 2009: pg. 134**)**. Mumma, at least conceptually, goes a step further when stating: [..] *not merely for their sophistication and speed, but also for the contribution of their personalities. We may treat the artificial intelligence not as a slave, but as a collaborative equal in a democratic musical society* (ibid).

1.9. Large Body Orchestras

Between 1972-1973, Robert Ashley composed two pieces that present unique and original models of interaction and collaboration with electronics. *String Quartet Describing the Motions of Large Real Bodies* (1972-1973) and *In Sara, Mencken Christ and Beethoven There Were Men and Women* (1972) differ from the works presented earlier, as they were based on studio work, rather than live performance, due to their technological complexity (Although performed live with a simplified electronic setup, I couldn't find any documentations of this performances).

Additionally, as Ashley was less of an 'instrument builder' compared to Mumma and Tudor, the electronic setup of the two pieces was realised by 'co-composers'. This notion also influenced the character of the pieces, presenting a theoretical relationship between performer(s) and electronics, as conceived in the imagination of Ashley. Differently, the rest of the models presented here were a consequence of the relationship of the composer with the electronic components of the piece and emerge from their relationship.

Nevertheless, they are included in this research; partly due to the interesting system model they present and to a personal interest in the work of Robert Ashley.

1.10. String Quartet Describing the Motions of Large Real Bodies

> *Have you ever thought about what music you'd like to have at your funeral? I'd choose String Quartet Describing the Motions of Large Real Bodies* (Lucier, 2012, pp. 192)

String Quartet is an electro-acoustic piece written for 4 string players and an orchestra of 42 electronic sound models, driven by the sound of the 4 string players. Ashley described the piece as: *electronic orchestra piece of indeterminate duration and sound 'caused' by the performance of a string quartet ensemble* (Ashley, 1999). The piece is based on the notion of 'coincidence', a subject that Ashley was "obsessed" with at the time of writing the piece(Ashely,1999). Coincidence is expressed in the way the string quartet produce their sound and in the method that the strings' sound is processed in the system.

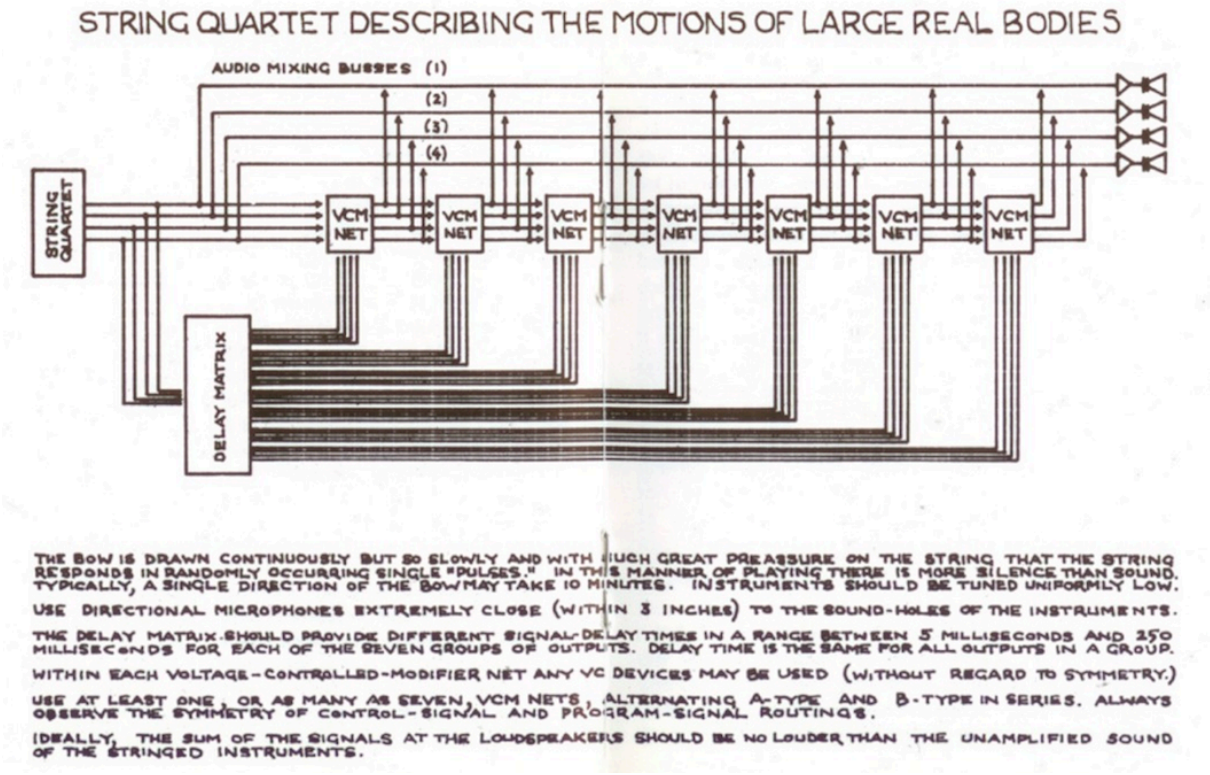


Figure 1. 4.

The beautiful score of the piece contains a visual representation of the model of the orchestra, as well as instructions for the string players.

The string players are instructed to *draw their bows continuously and slowly, and with such great pressure on the string, that it responds in randomly occurring single pulses* (Lucier, 2012, pp 188). This process should create *a stream of intentional but unpremeditated (that is, random) very short sounds, pulses, somewhat like pitched clicks, but with the formants and overtones* (Ashley,1999).

Ashley mentions that the idea for the playing technique on the strings came from a rumour about a performance of *Takehisa Kosugi;* during the performance, Kosugi slowed down the action of taking off his jacket to a length of 30 minutes.

Lucier, explains that the bowing instruction of *String Quartet* is so slowed down that it breaks the sound into distinct sound events; *the analog becomes digital. The sound consists of a train of separate pulses instead of one continuous sound.*

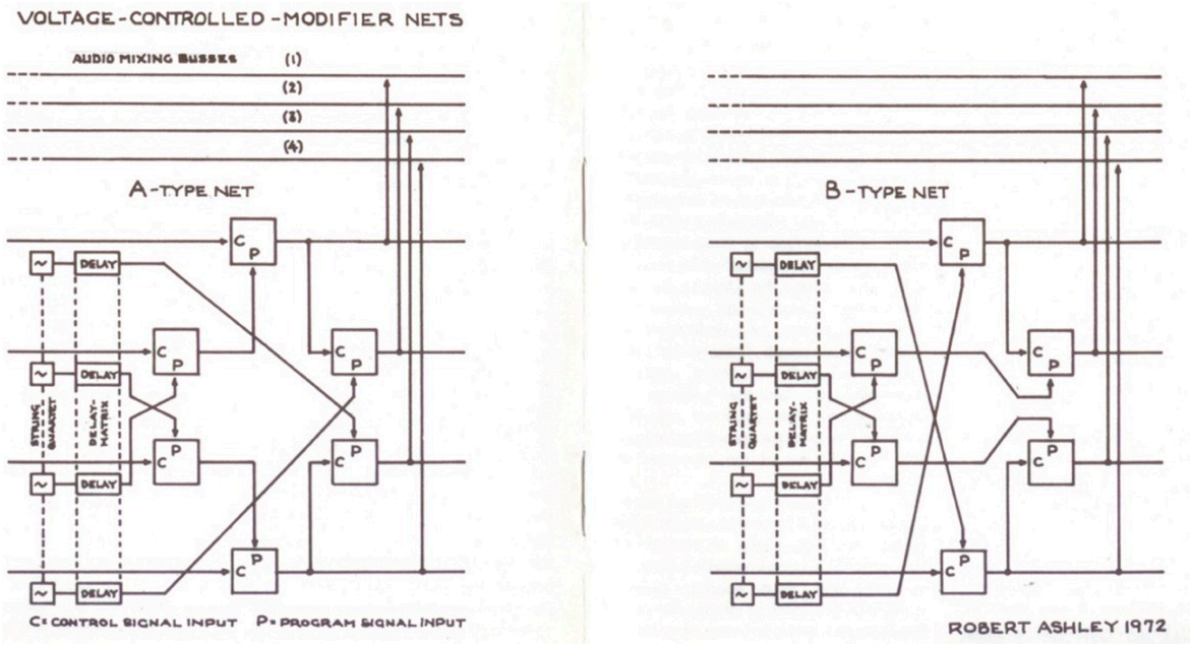


Figure 1. 5.

As seen in the large overview of the score (fig xx) the electronic system is built as a sound matrix comprised of delay line units and VCMs (Voltage Control Modifiers).

The irregular pulses of the string quartet are routed directly to the speakers, but at simultaneously delayed by 5-250 milliseconds through 7 delay lines. The delayed sound is designed to activate the 6 VCM units, which are fed and controlled by the delayed, processed sound of the strings. The VCM section is designed in an iterative way, where each unit processes and controls the sound of the previous unit. Similarly, each unit is also fed to a different delayed signal.

The VCM network is comprised by -theoretically- 42 sound modifier models, each consisting of a Program input(P); input for sound to be modified, a Controller input (C in the diagram); defines the depth of the audio modification. Ashley did not specify what exactly the audio modifier has to use. evertheless, Lucier clarifies that it could *include filters, amplifiers, and modulators* (ibid).

Lucier, provides a quick overview of the matrix processes:

First, the players bow extremely slowly, producing pulses of sound, as short as string sounds can possibly be; second, the sounds are routed through voltage control devices and extremely short time delays that change the timbre of the

sounds. It's a beautiful chain of events. Much of it sounds almost melodic. That's caused by the resonances of the pulses (ibid).

Although a full model of this matrix wasn't realised, a smaller-scale version was made using only one violin performer, and was recorded on a 4 track tape. This tape was fed into a Moog Synthesiser system designed by "Blue" Gene Tyranny and Sam Ashley.

Despite this variance in the amount of violins used, the sonic result of this realisation has a tangible and a unique quality of great value and inspiration for this research.

The next chapter describes how ideas and techniques from *String Quartet* were used in my own piece, *ShuShu II*.

1.12. In Sara, Mencken, Christ and Beethoven There Were Men and Women

In its very truly great manners of Ludwig van Beethoven very heroically the very cruelly ancestral death of Sarah Powell Haardt had very ironically come amongst his very really grand men and women to Rafael Sabatini, George Ade, Margaret Strom Jameson, Ford Madox Hueffer, Jean-Jacques Bernard, Louis Bromfield, Friedrich Wilhelm Nietzche, and Helen Brown Norden very titanically (John Barton Wolgamot in Ashley, 2001)

The piece was composed by Ashley together with Paul DeMarinis, who programmed the Moog synthesiser utilised in the piece. It is based on the poem *In Sara, Mencken Christ and Beethoven There Were Men and Women* (1944) written by the poet John Barton Wolgamot.

The relatively long text contains *128 stanzas, each stanza the same sentence with four variables, three of which are names or name groups or name constructions; the fourth is the adverb of the active verb* (Ashley,2001). The repeating pattern of the piece along with the long list of names, together create a dazing effect on the reader. Additionally, Ashley noticed that *there were no stopping points or punctuation marks along the way to give the reader pause* (Lucier,2012, pp 172). With this notion

Ashley wanted to perform the piece as one block of words, without any breathing in between. This was realised in a studio work were he cut all the breathing part between the stanzas, creating an endless stream of words and names.

Ashley asked Paul DeMarinis to compose an electronic music accompaniment for the voice, a dynamic orchestration to correlate with the recorded text. In the following text, DeMarinis explains course of his work:

> *…[I] use very narrow filters to analyze Bob's voice (i set the filters to extract generally what I understood to be "formants" but also other peculiarities of Bob's vocal instrument) which was on one track of an 8 track tape. These filter envelopes were then fed into very elaborate analog Moog modular synthesizer patches that I could affect (play) in realtime, and we recorded each performance on to one other track of the tape so they were all event-synchronized to the original voice. Each track was made in one continuous pass* (DeMarinis, e-mail Correspondence with the author 11/04/2017).

The sonic result of the piece presents a counterpoint relationship between Ashley's voice and the electronic system. Although the system "follows" and is influenced by the text recording, it steal maintain an independent musical behaviour. The model used by DeMarinis is especially relevant for this research as he utilise machine listening concepts in order to control a dynamic electronic system. The collaboration with electronics is made by extracting information from the performer's signal and by using the sound as an interface for control. This described concept developed into a main motive used in the pieces described along the next chapter.

1.13. SAU - Comparison and Conclusions

The overview research concerning the SAU presented in this thesis tried to follow the work of the Union's individual composers through the framework of collaboration with electronics. The overview started from the Cagean concept of the liberation of sound, followed by Tudor's concept of collaboration with electronics, Lucier's concept of composing and exploring acoustic proprieties of - and in - space, Mumma's cybersonic holistic approach, to end with Ashley's electronic orchestras.

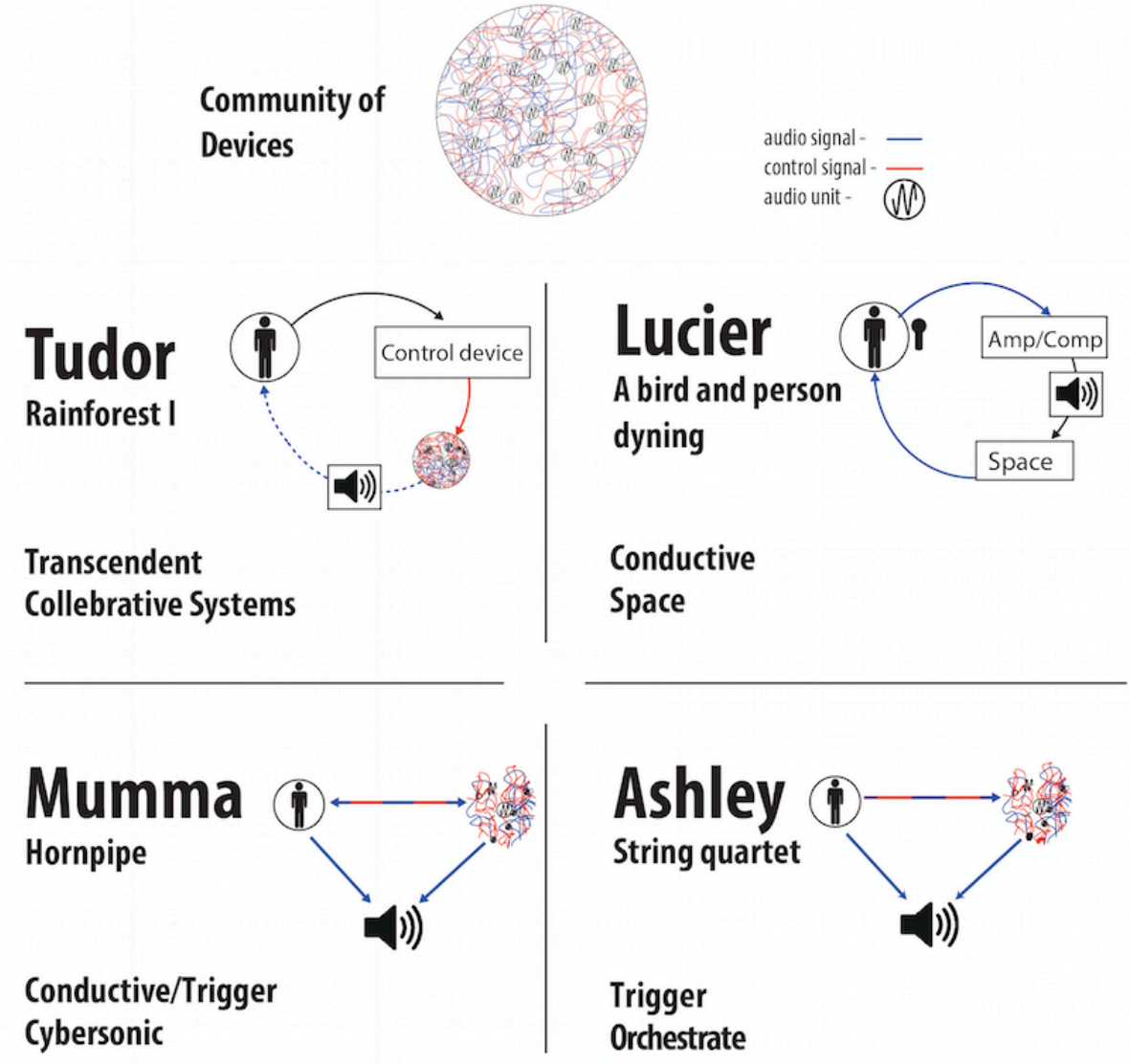


Figure 1. 6.

1.14. Performer in the system

Fig(1.6) contains a graphic representation of the system models presented in this chapter. It features a overview on each model as a **system**, focusing on the

interaction method that was utilised, and the relationship between the performer and the electronic setup.

Tudor / **Transcendent -** articulate a 'creator' approach in Tudor works and the 'freedom' that he give to the instrument he constructed. The 'dash line' represents a collaborative approach with the electronics, based on listening.

Lucier/ Conductive - Refers mainly to *A Bird and Person Dyning*. The performer is a conductive part inside of the feedback loop, immanent inside the electronics. He is as a variable resistor inside a circuit, revealing the natural resonance of the system and collaborating with the space. Similar as in Tudor model, listening is essential in this model.

Mumma / Conductive & Trigger- Mumma's system presented in *Hornpipe* features another conductive model. Mumma's 'cybersonic' approach towards composing articulates the idea of equality of all the components in the system, the 'community of devices', the performer and space (and in certain amount also the audience). Differently from Tudor and Lucier, In Mumma's model there is an **audible** interaction between the performer and the electronic setup, as sound becomes a control interface. This is also suggest a 'listening' capability of the electronic system.

Ashley / Trigger - The model refers to both of the pieces by Ashley presented in this chapter. In both, the electronic circuit functions as a electronic orchestra that follows the sonic output of the performer(s). Differently from the rest of the models, the interaction between the units of the system is only one sided. Although the machine can follow and "listen" to the performer, the performer is not required to listen and/or react to the sonic result of the system. Similar to Mumma, the Ashley's model features an audible interaction.

2. ShuShu Etude Series

2.1. Overview

The *ShuShu* etude series includes the following pieces:

ShuShu I – For accordion and electronics

ShuShu II – For two string instruments, accordion and electronics

I'm a M.F Bird – For a non-vocalist and electronics

SchlagerGabber – For accordion and electronics

2.2. Background

In the beginning of 2016, Meira Asher, an Israeli vocal artist, invited me to work with her on a piece based on Antonin Artaud's radio play *To Have Done With the Judgement of God*. For the second chapter of the piece (appendix CD track 1), Asher asked me to recreate a very simple analog setup she had used before: a gate that opens at a certain loudness of her voice and makes a click sound. On a separate channel, an addition of a wavetable distortion process was applied on the incoming signal of Asher's voice, and was functioning similarly to an amplitude exponential expander; diminishing low amplitudes and increasing the high ones (see Fig 2.1 for both models). This simple setup successfully managed to musically accompany Asher's vocal performance – mostly a dramatic textual monologue. It created some interesting relationships between voice and electronics, thus enhancing rhythmical patterns of her vocal performance.

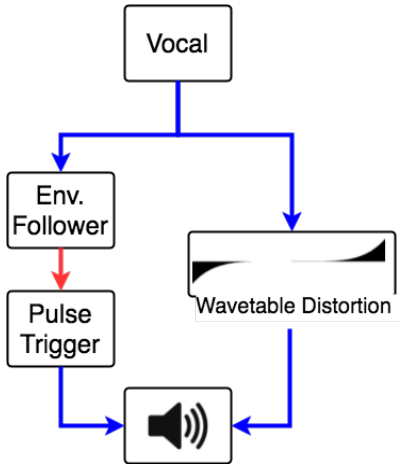


Figure 2. 1.

The resulting success of the model used in Asher's piece was encouraging for more pieces to be composed, built around the notion of sound as the controlling interface. I felt liberated to start composing on small-scale interactions that would be based on the minimalist coupling of ideas of a performer and electronics. Letting go of the physical interfaces was an invitation to invent specific interactions rather than multipurpose instrument design. Furthermore, this allowed me to seed musical ideas stemming from all the spectrum of my musical and personal identity.

2.3. ShuShu – Introduction

ShuShu is a series of etudes composed during the last two years as a part and manifestation of this research. The pieces are inspired by the models of system-based composition presented in the previous chapters: the method of interaction (*In Sara, Mencken Christ and Beethoven There Were Men and Women*), performance (*Bird and Person Dyning*), DSP programming (*Rainforest*) or even by embedding a piece itself inside my own piece (*String Quartet Describing the Motions of Large Real Bodies*).

All of the solo pieces were performed at various venues in The Hague, Berlin, Jerusalem and Tel-Aviv. The solo pieces are composed mostly in the tradition of composer/performer, and were written especially in respect to the chosen musical instrument for performance - in this case, an accordion. The notation is used only due to a personal need of organising time and structure. *ShuShu II* is an exception to

the series as it was commissioned and performed by ensemble *MusicNova* from Tel Aviv-Jaffa, following a graphical score specifically written for them.

The motivation to create these pieces came from the desire to expand musical idioms in live performance, utilising instruments and models that previously used in order to find a new method of interacting with them on stage. The intention was to try to expand the interaction with the computer into the audio domain, where communication would be based solely on sound and musical gestures. This expansion should lead to an audible dialogue between a performer and electronic sources.

I regard this body of work as a study on the composition of systems and interactions, as experiments on ideas that were discussed in the last chapter: cybernetics, interaction models and the development of a behaviour of the system into a linear piece. Some of them are very straightforward, if not simple. It is a (semi-)deliberate choice to use simplicity as a strategic method for researching, an effort to really examine how simple coupling could be used over time and formed into a piece.

2.4. System

In the context of this project, a system would consist of an electronic DSP model (mostly written in Max/MSP), a performer and a method of interaction. This configuration of Circuit (computer sound model), Performer and interaction - using sound as the interface - constitutes the compositional core of these etudes. As the interaction models are designed on a basis of mutual influence, the sonic result of the piece is an outcome of the emerge behaviour of the all components.

ShuShu etudes explore different models of systems. Similar to the model analysis presented in the previous chapter; the models in *ShuShu* differentiate from each other by the musical relationship between the performer and the DSP model. Some pieces present more active DSP circuits that suggest an audible dialog between the units, others present more passive system model, trigger based, that

demands from the performer to be more active. The following paragraphs explain the character of each unit in a *ShuShu* system.

2.4.1. Circuit - DSP Model

The composer Ron Kuivilla, when referring to his attempts to realise David Tudor circuit design in the digital domain, mention the following thing:

> *Computers excel at creating musical preserves (presets and samples) that work perfectly or not at all. So, part of my goal has been to create digital situations that can "fail" musically and gracefully* (Kuivila & Behrman, 1998)

As described in the last chapter, the physicality of sound in space, or of electricity in circuits, was a crucial aspect in the work of Tudor and Lucier. Working within a software environment - linear, flat, precise- raise a challenge to achieve a non-linear and complex behaviour of a system as successfully applied in the work of SAU.

The digital models used in *ShuShu* feature mixed techniques in order to overcome this challenge and to achieve a certain amount of liveliness or 'personality' in the circuit's behaviour. These techniques include extensive use of feedback-based oscillators, cybernetic models and the use of random generators that add 'noise' to the behaviour of the system.

While all the described techniques feature models borrowed for the analog domain, the *ShuShu* circuit design seeks to explore and utilise the properties of the digital medium. This is expressed by using memory-based operations, such as real time manipulation of pre-recorded materials, live sampling and granulation processes.

2.4.2. Interaction

As mentioned before, the interaction between the performer and the circuit is based on sound. The sonic output of the performer is used as the control signal for the circuit through the use of machine listening models.

Standard but customised, machine-listening techniques have been employed, some based on the built-in or external objects found in Max/MSP, while others have been entirely written by the author. The used models are the following:

Pitch/Noise detection (using *sigmund~* and later *retune~*)
Spectral analysis (using GEN examples)
Amplitude and Intensity (self-coded)
Onsets (self-coded)

Additionally, the properties and limitations of the machine-listening algorithms were utilised and explored as part of the system behaviour. This was mainly expressed in the exploitation of pitch tracking models and their points of “failure”.

In this case, what is considered as defective could be transformed and used to define and shape musical behaviour. This approach of experimenting with defective elements is inspired by the early works of SAU. Gordon Mumma describes this approach:

> *[…] we bought "defectives" and "throw-outs” […] I was smart enough to know about things, and I discovered (for example) that certain manufacturing defects in certain models of certain capacitors were unpredictable, and very interesting musically.* (Mumma quouted in Dewar, 2009, pp 118)

2.4.3. Performer

The *ShuShu* pieces could be understood as an ‘architectural sonic space’ where the performer is asked to explore and resonate the musical behavior of that ‘space’.

ShuShu pieces are based on a sonic collaboration with the electronic setup, the performer is limited to set of rules in order to achieve the intended musical result.

The rules of interaction are a mixture of technological – machine listening setup - and musical – performative audible gestures – compositional decisions, both correlate and depands on each other. The performative situation could be compare to a person who needs to communicate verbally with a voice assistant algorithm (for example Siri). If you tried it, you know that you need to speak very slowly and in extreme articulated way in order that the machine will understand you (it could also be a matter of my heavy Israeli accent that confuse the machine). The performer is set in a situation were he/she needs to resonant the system in a very particular way in order to achieve the desired sonic result.

Kuivilla describes tudor lives performance as following*:[a] musical situation in which advance planning is only partially useful, perfect compliance is impossible, and the concepts of contingency and action are essential* (Kuivila, 2004, pp. 22).

The described situation is only partly accurate for *ShuShu* compositions, as they feature more subtle indeterminate behavior of the system then Tudor's. Nevertheless, the concept of contingency is essential in *ShuShu*, as they are based on live collaboration with an the computer. Listening and reacting is needed from the performer in order to realeise the system musical potential.

2.5. System and Form

ShuShu pieces feature a direct correlation between the design of the system and the musical form of the piece. Differently from the SAU works presented earlier, that tends to be static in terms of form and directionality; most of *ShuShu* pieces feature 'double headed' systems, meaning that they internally contain a duality in the potential behaviour of the system. In these pieces, the act of shifting between those states sets a form for the emerging piece. The act of movement between the states of the system is different in each *ShuShu* piece, as some alternate in a (almost) binary way and some interpolate between the states.

3. ShuShu I

For amplified accordion and electronics

3.1. Background

ShuShu I (2016) was premiered at a Sonology discussion concert in Schoenbergzaal on the 03.02.16.

The piece was initially written for accordion (played the author), double bass (*Ilya Ziblat Shay)* and electronics. It was later performed numerous times with solo accordion. A documented recording of the piece was released on tape by the *Noiseberg* label, based in Berlin.

3.2. Overview

ShuShu I was the first composition in researching the musical possibilities of a system for accordion and electronics. It features a double headed system, the first based on synthesis and the second on live sampling, both driven and controlled by the same source: a contract microphone attached to the right side of the accordion (see fig x - ShuShu I simple). Using a pitch analysis unit, the accordion signal is 'divided' into two; pitched sounds controls and triggers a 'bird synthesiser', while noisy sounds are sent to a live granular-sampler. The form of the piece was derived from the design of the system, through alternating between the two sound processes. The alternation is made by playing different sound material on the accordion.

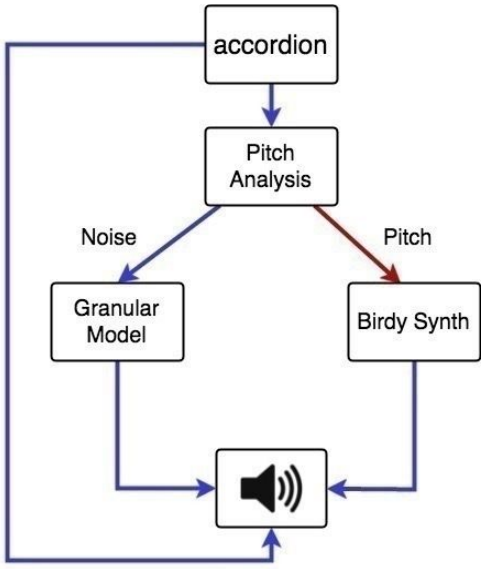


Figure 3. 1.

Aesthetically, this piece tried to achieve a poetic quality; I was falling in love during the writing of the piece and I wanted to write something sweet for my lover. The major challenge for composing the piece was in regards to the use of electronic methods in order to create something that is abstract but still adorable. The main coupling of the piece is created by playing a pitch note on the accordion: this controls the 'bird synth' that accompanies the melody of the accordion. This coupling also suggested the melody that should be played or improvised on the accordion; tender and sweet.

The second head of the system presents a granular process based on the model used by Agostino Di Scipio in *Modes of interference*), re-written from PD to Max/Msp, with some adjustments to fit the different material in the piece. The granular texture mixed with the bird-like sounds together create interesting textures and rhythms; a pseudo-natural environment driven by an accordion.

3.3. Circuit

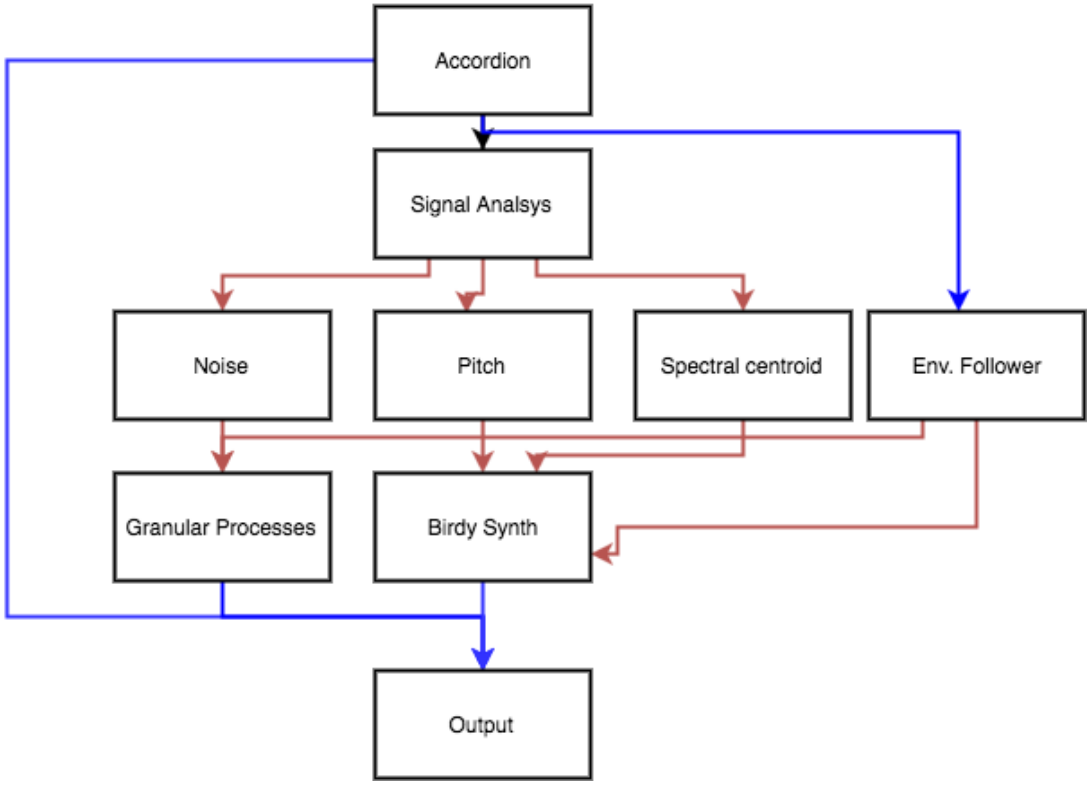


Figure 3. 2.

3.4. ‘Bird-Synth'

The 'bird-synth' unit is a playful term for the sound processes triggered and controlled by the melodic content of the accordion’s output. It is comprised of : a sine oscillator, an envelope follower, a pitch detector and a spectral centroid analyser.

In order to avoid pitch following clichés (that could not be avoided for other *Shushu* pieces) and one-to-one mapping, the frequency of the 'bird-synth' is not controlled by the pitch itself, but rather by the spectral content of the input. This was measured by a spectral centroid unit taken from the gen~ FFT example library in the Max/MSP environment. Focusing on the "centre of mass" of the spectrum was useful to achieve a successful interaction with the accordion sound without making the interaction limited to a melody line. In the presented method, rather than the exact melody that the performer plays the synth can be influenced by the dynamics of the player; piano dynamics tend to be less bright than forte dynamics. In addition, the analysis information is not only used to control the frequency of the sin oscillator, but

is also controlling the frequency of a random signal generator(rand~) that interpolates the phase of the oscillator. The combination of the two creates the 'birdy' sound signature.

3.5. Granular processes

The granulation process used in *ShuShu I* is based on a model presented by Agostino Di-Scipio in his piece *Modes of Interference I* (for trumpet). Ever since a realisation of the piece in 2014, I was impressed by the rich and dynamic sound texture created solely from small sounds of the trumpet.

In the score of the piece, Di Scipio refers to the processes as *Cascaded Granular Resampling*, *as the whole process follows from an cascaded, iterative design : the output from the first granulation is the input to the second, and the output from the second is the input of the third* (Di Scipio, 2005, pp 17).

Another main feature of this model is the utilisation of only one control signal: an envelope follower analysing the microphone amplitude. This was the main control on the parameters of granulation process, which are: scanning speed(frequency), grain size, density. Similar to the bird synth, the control signal influences not only low level control, but also high level of control over oscillators and random generations, a second-order control model.

3.6. Amplification and Spatialisation

The accordion in *ShuShu I*, apart from being used as a melodic instrument, is additionally used as an amplified object. As shown by John Cage in *Cartridge Music*, the use of a contact microphone over an object reveals a micro sound world that is hidden from the listener. In *ShuShu I* an *AKG C411* condenser contact microphone was employed to achieve a similar effect. The contact microphone, along with heavy compression processes, modified the instrument character to become more noisy, more percussive and rich; with tiny small sounds created from the hidden mechanisms of the accordion. This particular amplification method was essential for the granulation processes, which store and gather all the micro sounds and morph them into an immersive texture.

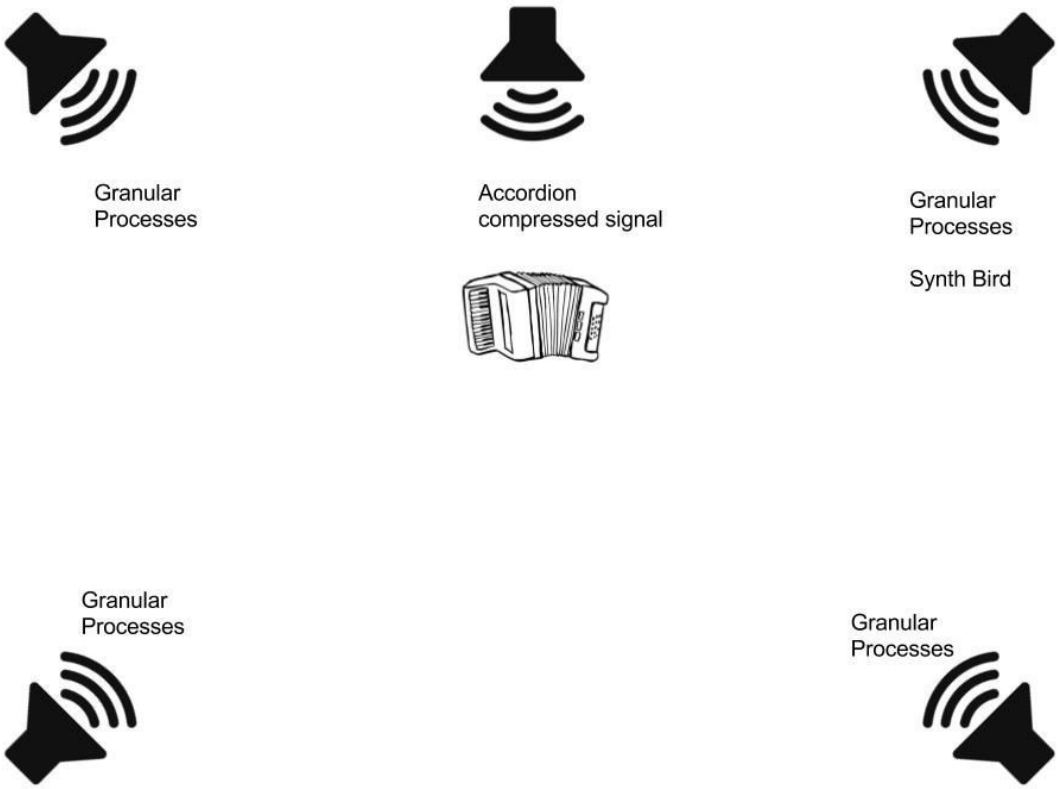


Figure 3. 3.

The spatialisation setup of the piece is flexible and dependent on the venue in which it is performed. Nevertheless, in each situation I tried to maintain the same principals: close, localised sound projection of the accordion and wide diffusion of the granular processes (stereo image or quadraphonic). This model introduces a spatial depth to the piece, as the localised sound opens the piece and later the granular texture slowly covers the space. The 'bird-synth' sound is usually localised in a speaker farther from the performer, in order to emphasise the feeling of a separate sound process, emerging from the interaction with the accordion sound.

3.7. Performance and Conclusion

Although I performed *ShuShu I* numerous of times, I still find it very challenging to perform, as the piece is very fragile due the simplicity of the system. The performance needs to maintain a certain gradually and patinas in order to expose to the audience, slowly, the behaviour of the system. If played to fast, the ‘magical’ coupling of the bird synth with the accordion becomes an annoying effect. Same

thing with the granulation processes, if the performer is not sensitive enough to the result of his actions, to the details of the texture, the immersive potential of the coupling fades rapidly.

With this stated, The piece is one of my favorite *ShuShu* pieces to perform. The coupling between the accordion and the synth bird, create a very suppressing situation for the audience, a sense of magical happening. Followed by immersive texture, ‘nature like’ sounds it is accomplished, in my opinion, to create a graceful piece.

4. ShuShu II

For two amplified string instruments, accordion and computer

4.1. Background

ShuShu II was commissioned by ensemble *Musica Nova* (Tel--Aviv) for a concert named *Wave~Line- Shadow* and performed at the *Teiva* venue on the 13.04.2016. The piece was performed with two cellos and accordion and accompanied by a live electronics system programmed in Max/MSP. A 5.1 sound system was used to create an immersive sound experience.

An edited version of the piece, titled *ShuShu Jaffa,* was created by using recorded material from the *Musica Nova* performance, mixed with additional studio material produced earlier, during the implementation of the electronic system. *ShuShu Jaffa* was released as part of the project *Audio DH - Sonic Manifestation by 250 creators from Den-Haag*.

4.2. Overview

ShuShu II was a very challenging piece to write, as it was commissioned by an external ensemble, it is the only *ShuShu* piece that I didn't performed myself. Additionally, the specification of the instrument performed the piece was a consequence of the ensemble instrument possibilities compromised with my compositional needs. Therefore, the odd ensemble of two cellos and accordion. Furthermore, the limited rehearsal time with the ensemble demanded me to present more structured foundation for the piece, as a possibility for a processes of learning the system with the ensemble, understand it, was not possible.

As consequence of the situation, the interaction model of the system was designed in an orchestration model - similar to the model used by Ashley as describers the previous chapter. A more passive interaction with the performer, that is not based on listening rather by just active instruction of the performer.

Additionally, a graphic score was used in order to expedite the learning process of the piece.

ShuShu II contains three parallel sound layers: cello unison, accordion, and an electronic matrix system reacting and following to the two layers. The piece is structured in the following form: Opening(Accordion) /- A /- B /- A'.

The piece features compositional and conceptual ideas influenced by the electronic works of Robert Ashley, mainly *String Quartet Describing The Motions Of Large Real Bodies/*

4.3. Main ideas

4.3.1. Cellos

Around the time of composing the piece, I was fascinated by the tangible sound quality of Robert Ashley's *String Quartet Describing The Motions Of Large Real Bodies (*1972), presented in the previous chapter. For the piece with *Musica Nova* I it was decided that Ashley's piece would be embedded as the conceptual 'anchor' of the piece. This was realised by creating an extension of the physical gestures instructed in the score, as well as extending the electronic system's matrix.

4.3.2. Part A

In his piece, Ashley instructs string players *to draw their bows continuously and slowly, and with such great pressure on the string, that it responds in randomly occurring single pulses* (Lucier, 2012). I was trying to imagine how to "stretch" Ashley's instructions, how to draw a gesture that could precede *String Quartet*.

As pressure was the main instruction of the score, I decided to transform Ashley's instruction into a longer gesture: a gesture that will be based on a process of increased forced pressure. The gesture begins with a floating flageolet through a distorted pitch and ends with rhythmical percussive sounds, made with the maximum pressure. The described gesture was used as an instruction for the cellos from part A to B. Part A' returns to the middle of the pressure gesture process and continues in the same manner as in the original part A.

4.3.3. Part B

The cello section in part B features an electronic sonic expansion of *String Quartet,* while maintaining the same pressure instructions described in the score. In the original piece, the irregular pulses of the cellos create a very unique and disturbing texture; Lucier notes that it *sounded like the creaking of the rigging of a sailboat* (Lucier,2012 pp 129). *Ashley's* electronic matrix system, proposed in the score, adds a sparks of electronic processes on the cellos pulses.

The electronics layer coupled to the cello in Part B is comprised of three layers: simplified realisation of *String Quartet* matrix, granular processes (similar to the one used in *ShuShu I*) and trigger based pre-recorded material. All of the above are used to create an intriguing and disturbing sonic space as a free-interpretation to the one created in *String Quartet* piece.

The realisation of *String Quartet* Matrix (described in the last chapter) was made in accordance to the original score, with a reduction to only two string instruments, instead of the original four. In the VCM (Voltage Control Modifier) units, Ashley used a general name: audio modifiers. Alvin Lucier, explains: *"[..] modifier to cover a number of unspecified devices. It could include filters, amplifiers, and modulators of different kinds"*.

The modifiers used in *ShuShu II* were of two kinds: Type A ; Frequency Modulation and Type B; Ring Modulation. A real time granulation process (as described in *ShuShu I*) was used in order to create more dense texture and to add a digital 'edge' to the sonic result.

The third layer in the piece contains pre-recorded material triggered by one of the cellos, using an onset detector. Each successive onset detection, triggers a short grain from a sample, with random location and random length.

While trying to find a material that would blend in the sonic texture of Part B, I found an old cassette tape recording containing a live documentation of a punk band from Jerusalem. The sample contains two minutes of repetitive manipulation on the

tape, fast forwarding and releasing, thus revealing the original material and then fast forwarding again.

As the memory of the recording had a special value for me and of tangible sonic of an iteration of suspension and release, I found it appropriate for it to be used in the piece.

4.3.4. Accordion

In commercial arabic music, it is especially common to use a sharp monophonic sawtooth synthesiser sound. The timbre of that sound is similar to a synth lead in popular dance music, mixed with a Zurna (traditional arabic flute) sound. Somehow, perhaps due to the use of Maqam scales, this sound creates a very unique and mesmerising feeling. By using a pitch tracker object called *sigmund~*, the accordion is coupled with a synth of a similar character as to the one described above.

The *sigmund~* object, as many other pitch tracking models, often fails to provide stable information about the subject of its analysis. With the sigmund~ object, a failure situation expressed with sending null messages when no pitch is detected or by suggesting an octave above or bellow the played note. Additionally, as the algorithm was designed to predict a monophonic voice, when 'challenging' the object with a cluster of sounds, *sigmund~* starts to 'play' an unpredictable arpeggio between the notes played. Although it is possible to stabilise the behaviour of the object and minimise the amount of errors, these 'mistakes' are used in *ShuShu II* as a feature for musical behaviour. As acoustic feedback was transformed from a technical problem into musical material, so could the machine listening errors be understood as potentially having musical behaviour, thus being a subject for experimentation.

In *ShuShu II,* I used the null messages from the pitch tracker to create rhythmical patterns; every time the synth unit receives a 'null' message, it triggers a random process that output an LFO rate. Together with the sharp synthesised 'Zurna' sound and the random octave glitches, this synthesis model creates a contrasting sound image, an aggressive sonic timbre that tends to break and fail. The described

process is programmed to gradually over-take on the natural accordion sound, as it correlated to the accordion loudness using an envelope follower with a exponential scaling. This behaviour creates a digital extension of the natural accordion sound and blends the two smoothly.

Returning to Ashley's music world, more specifically in the liner notes of *Automatic Writing* (1974-1979), he describes the four characters of the piece. Besides the characters, he mentions that the Moog synthesiser and the organ are also characters inside the piece. Electronic sounds with clear identity in Ashley's compositional world could be understood as characters in an opera, as they have their own unique voice, behaviour and identity. The unified sound comprised by the accordion's sonic character and the process in which it functions in the piece, creates a special identity, a character in way.

4.4. Score and Structure

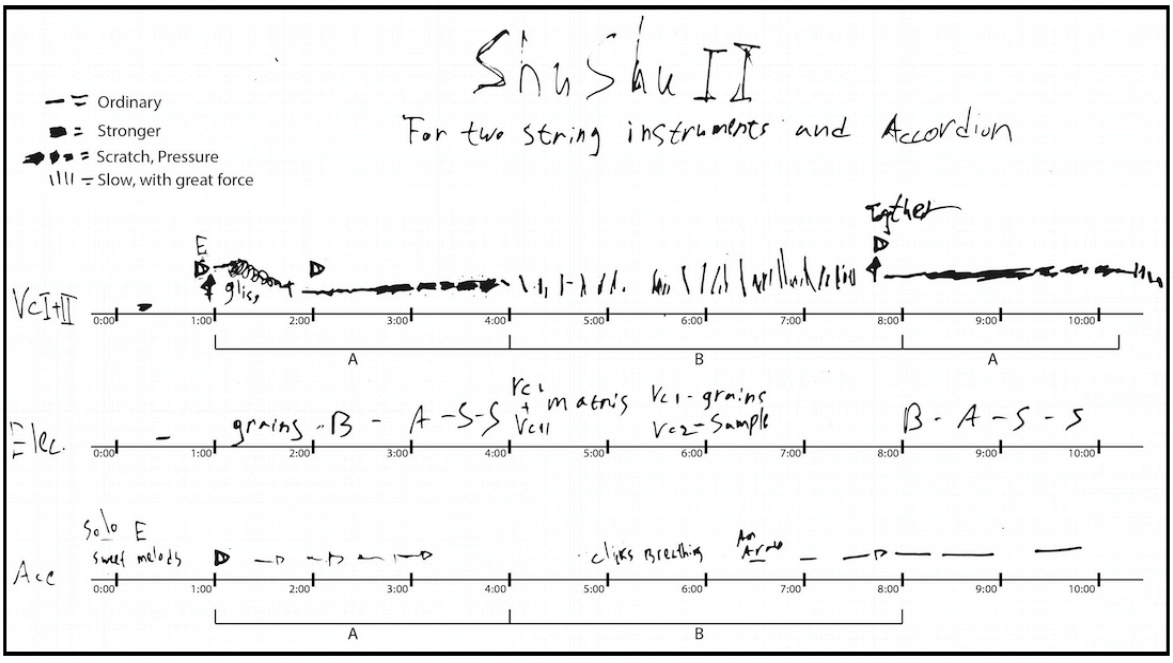


Figure 4. 1

The use of the score in *ShuShu II* was not intended initially and was a result of the lack of time of rehearsing time with the ensemble (the aesthetic look of the score might suggest the time limitation I had). The first rehearsal with the ensemble hinted that the work with the players needs more structure and form rather then only intuitive and talkative approach I am regular to use when collaboration with other

musicians. As a result I used a very simple score, mainly to maintain a time line for the transformations between the sections of the piece. The score presented here should be addressed as a documented framework paper, a tool; as the work with the ensemble also included oral explanation and group work with the players.

Consequently, the score and the piece maintain a strong indeterminate character as they mostly describe general gestures for the cellos and improvisation cues for the accordion.

The score consists: illustrated instructions for the cellos unison gesture; a verbal description of the electronic processes that follows the cellos; instructions and improvisational cues for the accordion.

4.4.1 Part A

The cello pressure gesture begins at two separate high flageolet notes (E and D) followed by a one minute glissando towards open D string. Gradually the players should bow with more force producing acoustic distortion and noisier sound until they arrive to B part. The described processes is illustrated with a painted line movement represent the amount of pressure required from the cello player.

Opening: The accordion is instructed to play a “Sweet melody in E (Pentatonic modal scale is suggested) around a minute. The improvisation should not be to dense and it is mainly used as a vehicle to introduce the special relationship between the accordion and the saw-zurna synth - the sound character explained in the previous chapter.

Followed by the opening, the accordion slowly support the cello gesture on the open D string until all of the instruments reach a unison. The accordion stays silent throw half of part B, while the cellos and the electronic layer is establishing sonic texture frame for the accordion return.

4.4.2. Part B

The middle section of Part B, present the peal the piece, superimposing the accordion improvisation on top the texture created by the cello and the electronic

layer. The accordion is instructed to gradually play longer, and stronger improvisational phrases on a phrygian mode. The superimposition is made to achieve a perceptual transformation of the cellos section sonic character; from a sparse static texture to a background rhythmical companion for the accordion melody; from a forward **textural** material towards a supportive rhythmical background. I conceived it as a very successive part of the piece.

4.4.3. Ending - Part A'

Part A' towards the end repeats the gesture suggested in A part from the middle of it. The piece ends with sparse pulses of the the cellos along with 'leftovers' of processed sound of the electronic system.

4.5. Electronic System - The Matrix

As demonstrated in this chapter *ShuShu II* features a mixture of sound processes, synthesisers, and machine listening units. The main control unit of the system - the matrix - is designed to follow the players throw the different parts of the piece and trigger the dedicated processes for each state. This is achieved by **basing** the matrix on conditional parameter analysis, driven from the information gathered by the machine listening units. The following description summarise the electronic processes used in the piece, the machine listening units and a table with describing the matrix behaviour.

The system included the following units:

Accordion - Bird Synth (as used in *ShuShu I*), sawtooth synth (described in the paragraph above)

Vc I+Vc II

Rumbling bass: same idea of the Bird Synth but lower down to 60-20 Hz.

Granulation processes: as used in *ShuShu I. (Vc I)*

Sample Triggering: Triggered pre-recorded material (Vc II)

Cellos Matrix: Cybernetic model inspired by *String quartet…*

The following parameters were analysed by the computer: Pitch (Acc+Vc), Spectral Centroid (Acc+Vc), Continuity (Vc) or Irregularity (Vc), Amplitude(Acc+Vc).

Cellos	**Accordion**	**Electronics**
No Sound	Pitch	**Accordion** pitch tracking, sharp saw
Pitch, continuous sound	Pitch	**Cellos** granular texture **Accordion** Bird Synth
Pitch, Pulsed sounds	Pitch	**Cellos** Delay line matrix , Sample triggering **Accordion** pitch tracking, sharp saw
Noisy continuous sound	Pitch	**Cellos** Rumbling bass **Accordion** Bird Synth

As can be heard in the the recording, the matrix described in the table above becomes more flexible in real-time performances. The movement between different states is not discrete and a certain mixed behaviour occurs during the piece. I find this complex behaviour important for the reasons of giving depth and “character” to the system, as if it has is own nature.

4.6. Amplification and Spatialisation

ShuShu II shares the same spatialisation and amplification concepts used in *ShuShu I* (described in the previous chapter). All of the dry compressed signals are

localised near the instrumentalist who produces them, while the electronic texture sounds are spread wide around the speaker system in order to create an immersive spaciality. The triggered sampled material is located in the rear speakers while a their reverb image is located in the front - creating a wide space image.

A close-miking setup and compression processes are used on the cellos to achieve a ‘crispy’ and ‘punchy’ signal, needed for the pulse’s gesture played in part B, as well as for the granulation processes.

4.7. Conclusions

The different work methods and techniques presented on *ShuShu II*, mainly the use of a score and a complex machine--listening approach, were consequences of working with an ensemble. This process was a very important lesson for comprehending the potential of using a timeline and the advantage of having a predetermined structure and instructions.

Furthermore, the use of *String Quartet* matrix with the additionally parallel electronics layers could be re-think in the light of *Ashley* coincidence concept that initialised the piece. Additionally, Accordion melodic line could be develop into more detailed. The piece itself should and could have been developed into a larger scale piece, where each section could be composed with more details with more emphasis on small events. Hopefully, this will happen in the near future.

4.8. Concert notes

ShuShu (Keep it quiet!) is a series of compositions dealing with composing relationships between a computer, acoustic instruments and a performer. Through the use of piezo microphones (special microphones that amplify resonant bodies) the vibration of the acoustic instrument itself, as well as its micro--sound world, is brought to the foreground. The use of the computer in this piece multiplies these small sounds, which are later turned into a sonic texture similar to a building that is slowly cracking, a collapsing structure or a fabric that is being frayed.

5. I’m a M.F Singing Bird

For a non-vocalist and electronics

5.1. Background

I’m a M.F Singing Bird was written for a research concert organised by the composition department of *Koninklijk Conservatorium*. The only version of the piece was performed by the author at *Studio Loos on* 16.01.2016.

5.2. Overview

I’m a M.F Singing Bird is a study on the use of microphone as a control signal over an electronic system. The piece could be understood as contemporary version of Robert Ashley’s *The Wolfman* (1964), as it utilises a similar feedback setup and performative methods.

In *The Wolfman*, Ashley used an acoustic feedback system comprised of: a performer, a microphone, loudspeakers and the space (fig 2.x). The microphone is used as the point of contact between the performer and the system, as a tool to influence the sonic behaviour of the system. The performer plays a character of *The Wolfman*; a shady night club singer. Using his mouth as a resonant chamber and producing very quiet sounds, the Wolfman influences the feedback oscillation that is emerged from the high gain of the system.

In *I’m a M.F Singing Bird* the Wolfman is replaced by a 'shady rapper'. Along with Larsen tones, the electronic system produces slow rhythmical patterns that fit to the contemporary adaptation of the *Wolfman*, and place it in a *trap* (Hip-Hop genre) club. Both of the layers are influenced by the performer’s use of the microphone.

5.3. Rhythmical Feedback

The first idea for the piece was to create an acoustic feedback process that will map the acoustical characteristics of the room and express them in rhythmical

patterns. In other words, to resonate the low frequency oscillations of the room. Sadly, a stable setup solution was not found in order to create this process without risking a permanent damage to the Sonology department's studio loudspeakers. In order to evoke an acoustic feedback in frequencies under 20Hz, the amount of the amplification needs to be high and that would put the PA system in danger.

Therefore, the solution was to use a programmed rhythmical oscillator that was influenced by the space. This was achieved by using the microphone as a control signal over the behaviour of the rhythmical oscillator. The rhythmical oscillator is a collection of sine oscillators, chained together to create rhythmical patterns. I used various of modulation methods to achieve this effect such as: phase modulation, pitch modulation and delay lines.

5.4. Electronic system

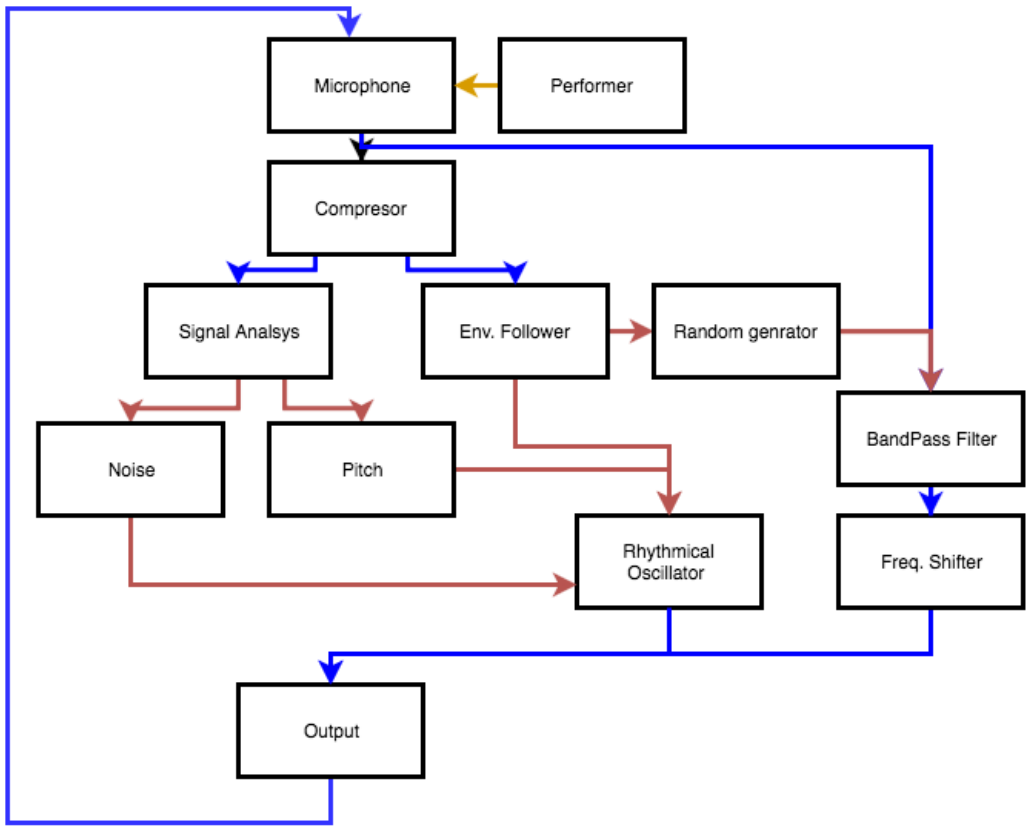


Figure 5. 1.

The design of the system features two main sound branches. The first is the rhythmical oscillator presented in the previous paragraph, and the second is the acoustic feedback oscillation, modulated by a bandpass filter and a frequency shifter. The design of the system was made in way that would give the performer a possibility to phrase different sound lines using only the microphone. For example, the use of the performer's mouth over the microphone would create gliding tones, caused by the acoustic feedback process that is run through a frequency shifter. The amplitude of the feedback oscillation is influencing the frequency shifter's depth. A direct, breathing sound on the microphone influences mostly the frequency of the rhythmical oscillator, as it is noisy and loud. XXXXXX

5.5. Compositional process

The work on *I'm a M.F singing bird* was very intuitive. The process of tuning the system was the most demanding part of the work. Each parameter in the system needed a specific range to be mapped on in order to delimit the most interesting musical behaviour. As the system works in a cybernetic method, each parameter influences the overall behaviour of the system, complicating the act of predicting and controlling it. The system itself, even without an active performer, has its own life.

David Tudor, in an interview with Hultberg describes these phenomena:

I discovered that if you work very seriously in electronics there is a point where a certain sound-world or a certain color conception can appear, an electronic set up that's hooked together with a certain idea. And all of a sudden you realize that it has a life of its own. And that's when it occurs to me, 'it's I who have done that,... I have given life to this configuration. (Hultberg,1988)

Working inside a feedback system involves a long process of listening and tuning. You change one parameter, listen to the system react, then you change another parameter and suddenly something else starts to occur. Personally, I can spend hours just listening to a behaviour of a system. In the discussed piece, the use of low frequencies on a very high volume - without filtering DC offsets - creates a physical relationship between the acoustic feedback processes and the rhythmical

oscillator. One can hear the feedback struggling to emerge between the low frequencies' rhythms, and this phenomenon has a certain beauty in it.

5.6. Conclusions

I'm a M.F Singing Bird presents a very capturing sound character and a unique musical behaviour that is individualised through space. Despite that, with the controlled methods presented to the performer, the full potential of the system and the piece were not realised. This situation raised a common dilemma often experienced when designing electronic systems for live performance: Is the solution for this 'problem' technical or compositional - if possible to separate the two when using a system model?

Is it a matter of better DSP programming, or a matter of adding more control methods? Or is it a symptom of a lack of performative imagination? Of course, there is not a definitive answer to the questions introduced here. Nevertheless, as performance is the least developed 'unit' in this composition, the challenge of finding non-technical solutions to these dilemmas currently seems more appealing. The performative approach of *ShuShu I,* characterised by sensibility and subtle musical changes, rather than extreme movements might potentially suggest a solution for such issues.

6. SchlagerGabber

For Accordion and electronics

6.1. Background

The piece was premiered at *De Vinger* club, Den Haag on 16.12.2016 as part of *Kernel-Panic* festival. The version discussed here was written and performed along with Ilya Ziblat Shay on double bass. A modified solo version of the piece was preformed several times in Jerusalem throughout 2016.

6.2. Background

The name of the piece is a compound of two Dutch/German popular music genres names; Schlager: a 'kitsch' song tradition, and Gabber: an underground speed-based electronic dance music, characterised by an impossible tempo of 200 BPM. The two could be understood as two folk genres with opposite aesthetics.

The original idea for the piece was to create a system based on the interaction of two instrumentalists with one sound process; two performers playing with one software environment. Ilya and I were interested in experimenting with rhythmical folk elements as the main musical material that would be used in the piece. The use of rhythm would be utilised as a control parameter over the system behaviour. The abstract idea of rhythm was transformed into a machine-listening program that measured intensity. Intensity, in this case, was understood as the amount of successful onset detection and the time difference between each event. The relationship with the system was to be inverted: if the players would play fast, the system would produce slow rhythmical pulses, if the players played slowly, then the rhythm would speed up until it arrived to an audible pitched oscillation (above 20Hz).

The final version of the piece - for solo performer - presents a reduction of these notions, keeping the fundamental idea of rhythmic relationship between the player and the system as the identity of the piece. Echoes of the planned folkloric motive

can be found in the peak of the piece where the performers improvise on a Hijaz Maqam, in a similar manner to the *ShuShu II* improvisation piece.

6.3. Electronic system

The system features two main states: a rhythmical state and a unison state, both based on the same sound processes. The interaction of the performer with the system is based on two pitch tracking units, that follow the output of the two sides of the accordion: bass and piano. Additionally, the performer can scale down the pitch tracking result by using two foot pedals dedicated respectively for each side of the accordion. The manual pedal control replaces the intensity method described above.

The main circuit of the piece was written in SuperCollider. The circuit is based on two different oscillators: a *Gendy3* and a *SinOscFB*. *Gendy3* was used due to its unique sound quality; on the edge of noise but still with recognisable pitch. *SinOscFB* (a sine oscillator with phase modulation feedback) has similar sound qualities; when tuned into over-modulated mode it starts to behave in a chaotic way. Both of the Ugens feature a synthesis model that is characterised by an interesting balance between chaotic behaviour and periodic behaviour.

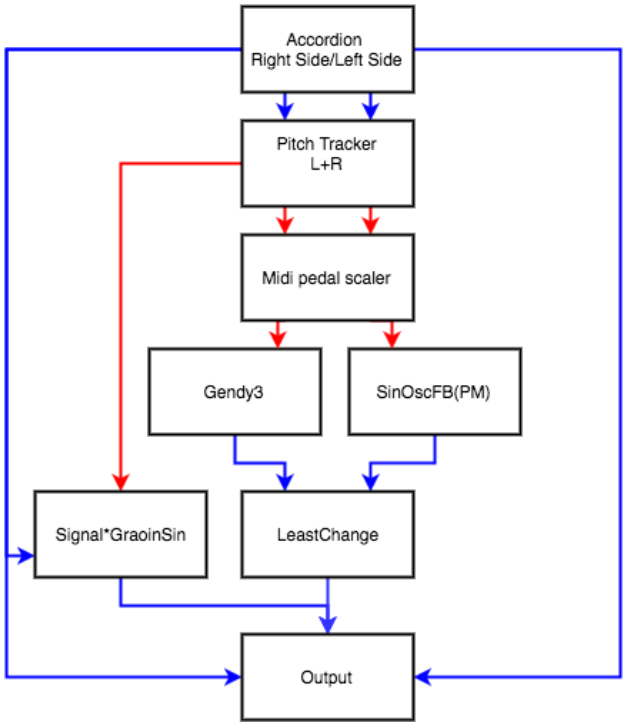


Figure 6. 1.

Each Ugen is controlled by two pitch trackers that follow the accordion signal, with separate tracking for the left and right side of the accordion. Through the use of the foot pedals, the performer can down-scale the pitch of the unit, from the original pitch detection to an LFO rate.

The “black box” of the circuit is a non-standard Ugen called *MostChange*. The Ugen takes two signals and calculates the magnitude difference of each signal per sample; the signal that its magnitude changes the most will be the output.

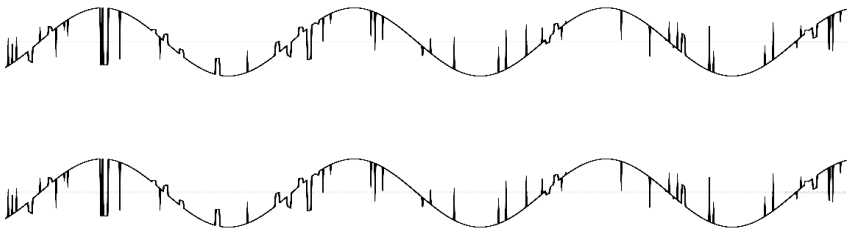


Figure 6. 2.

The sonic result of *SchlagerGabber* setup is raw, noisy and rich at the unison state, while rhythmical or ‘spiky’ on the LFO state. In between the two states, the performer can discover variable musical behaviours. Most of them are characterised by a sharp digital quality and a ‘glitchy’ outcome, due to the use of the components in the system; mainly the *MostChange* Ugen.

6.4. Performance and Structure

The form of the piece was derived from the design of the system; an interpolation between one state to another. A regular performance of *SchlagerGabber* starts with a fade-in sound, lasting between 30-60 seconds, and ends with a fade-out of similar length (both programmed in the software). In between, the performer manually controls the movement between the rhythmical state towards the unison state. The unification between the accordion and the electronics was deliberate in order to create a peak in the piece; a cathartic feeling. This movement may repeat 2-3 times

with variation on the melody played on the unison and a variation on the clustered playing of the rhythmical part.

6.5. Conclusion

The design of the *SchlagerGabber* system presents a unique model in the *ShuShu* series, as the interaction between the performer and the system is not based solely on the use of sound as the interface. The 'hybrid' model in the piece presents a situation where the performer plays along with the system during the rhythmical part, whereas during the unison part the performer plays with the system. This model gives the performer more freedom to choose what musical material to superimpose on the system's behaviour. Furthermore, the circuit design features an extended unpredictable behaviour than in the rest of the pieces in this series, something that could suggest that a more improvisational approach is needed for the realisation of the piece.

6.6. Program Notes (Original Version)

SchlagerGabber.il is a turbo-folk anthem, imagined by two (eternally displeased) Israelis living in Den Haag, playing on two instruments and one software.

We play, you clap.
We are happy, everybody goes home.
Political consciousness has been happily addressed, the end.

7. The Visit of the Iraqi Delegation (work in progress)

For Archive recordings, Riqq drum and a synth

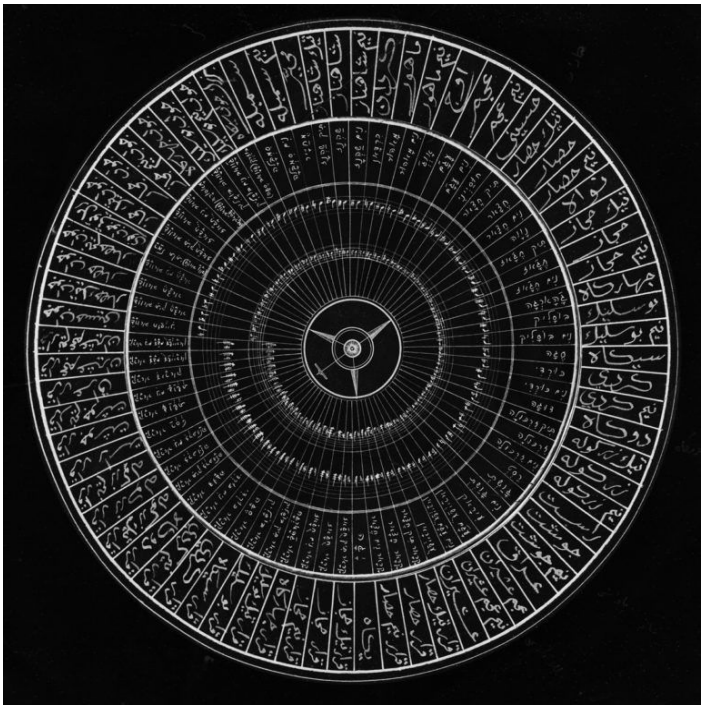


Figure 7. 1.

7.1. Overview

The Visit of the Iraqi Delegation is the title of a collection of etudes written as part of my long time collaboration with the percussionist *Ariel Armonie,* as the duo *Ensemble of Love and Terror*. These etudes are consciously influenced by the compositional ideas discussed and explored in this research.

The title of this piece comes from an archive of recordings containing different pieces performed by the Iraqi musical delegation at the first international Congress of Arab Music in Cairo 1932, an essential event in the history of modern arabic music. In the piece hereby presented, possible musical relationships emerged from a coupling of the archive recordings with contemporary computer based electronic

system, that includes the following units: Multi-function sampler of the archive recordings, a Tudor machine; feedback based synth inspired by David Tudor aesthetics, and a performer.

A première of the etude *Taqsim Kanun*, will be performed at the *MusraraMix Festival,* Jerusalem, 07.06.2016.

The piece will be performed again as at the *Schoenbergzaal*, Den Haag, 27.06.2017.

7.2. Background

Ensemble of Love and Terror[1] (ELT) was officially formed around 2014, as free-improvisation duo, a platform where I could push my limitations as a improviser and to examine my self-built instruments (*FWWM*, *Tudor Machine*) together with a talented and experimentalist drummer. During the last two years, as part of my growing interest in the interaction between acoustic instruments and electronics, the duo started to explore new techniques of performing. Furthermore, our shared interest in experimenting with folkloric motives combined with electronics led to the change our performance setup. From a duo performing with a full drum set and electronics, our current setup involves a Riqq drum (traditional arabic tambourine), an accordion and an electronic setup.

Several approaches in regards to the combination between the acoustic instruments and electronic processes were examined. The first was to process the acoustic sound and 'electrify' it. On appendix 1.x is an example of the Riqq drum processed through a granulation process. Using a random speed scanning per grain and compressed texture the Riqq transformed into an undefined large percussion instrument, as the spectrum of the instrument expanded. For the accordion, I used a

[1] The name of the duo is quoted from a popular Israeli song named *Under Mediterranean Skies* :
under the mediterranean skies / your hands stroke me with a rare stroke
elections is ahead / you are a political beast- Particularly keen with minorities/
now there is the time in eastern /style / half the world sings Greece/
my body shivers, anyhow / from **terror and love**

similar sound process presented in ShuShu II, pitch-tracked, glitchy Saw-Zurna Synth.

7.2. Maqamat

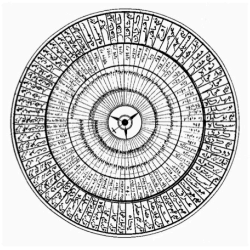
As a consequence of new aesthetic performances, in early January 2017, ELT was invited to collaborate within an audio-visual installation named *Maqamat.* The work was created by the visual artist Dor Zlekha Levy and musician Aviad Zinemanas and was exhibited in Tel-Aviv museum from the 7.3-6.5.2017. The installation was based on the recordings of the Iraqi musical delegation at the first international Congress of Arab Music in Cairo. The delegation, comprised mostly by jewish musician, mirror the current Israeli-arab conflict. In the article: *When Maqam is Reduced to a Place* (appendix D) by Eyal Saui Bizawe he **elaborates on this notion**:

> *For Jews and Arabs alike (as well as for other minorities in Arab countries), in the 1920s the concept of nationality—whether Arab or Zionist—was in its infancy, in as much as the movements had not yet reached a head-on clash. Local national identity—Iraqi, Egyptian or other—could still contain Jews and other minorities, and one could still imagine a society with multitude origins, ethnicities and religions, all united in one[…]* ***This is the moment, almost the last moment, when a different future could still be imagined****. (Bizawe, 2017)*

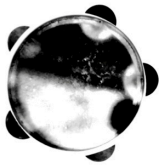
Maqamat also sheds light on the personal story of two members of the delegation, the internationally acclaimed musicians Ezra Aharon and Yusuf Zaarur. *These musicians later immigrated to Israel, settled here and left their reputation behind* (Lamir & Werener 2017). For musicians like Aharon and Zaarur, there was no real place in the new formed Zionist society, as it was established around the idea of new Hebrew culture. In the new formed society, arabic music was ignored, discriminated and oppressed by the cultural institute[1] (as well as yiddish based culture).

7.3. The Visit of the Iraqi Delegation - Sketches

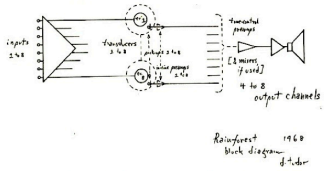
As the piece is currently in working processes, a final recording of the etudes could not be submitted in this current research. Nevertheless, I found it important to share the working processes of the piece, as it demonstrate the compositional ideas behind the piece. The recording of this sketches contains demo material prepared for *Maqamat* exhibition, additional recordings made in the beginning of March and studio material made by the author as part of the compositional research.



Multi Function Sampler - Archive



Riqq



“TudorMachine” feedback oscillator

The system of *The Visit of the Iraqi Delegation* features a very unique model, as it contains three components in the system(and the interaction method). The system is composed of : Multi-function sampler of the archive recordings, a Tudor Machine - feedback based synth inspired by David Tudor aesthetics, and a performer - Riqq player. The following sketches features interaction only between two units of the system, Riqq coupled with Sampler, Riqq coupled with Tudor Machine and Sampler coupled with Tudor Machine.

Sketches for 'The Visit of the Iraqi Delegation'(appendix A)

1. Riqq coupled with Sampler - Darbi

2. TudorMachine coupled with Sampler - Taqsim Kanun

3. Riqq coupled with Sampler - Taqsim Kanun

4. TudorMachine coupled with Sampler - Taqsim Kanun - *Feedback behaviour*

5. TudorMachine coupled with Sampler -Al-Qubiachi(Vocal)-*Feedback behaviour*

Conclusions

To the question "*When did you first sign your name to a composition?",* David Tudor, during an interview, replied the following:

I was working in electronics a great deal and at one point when I was working on an electronic set-up, the thought came into my head, 'well, this is mine', you know, 'this belongs to me.' At that point. I signed my name to the composition (Tudor quoted in Hultberg,1988). [Tudor refer to Fluorescent Sound, 1964]

A similar feeling accord to me when working on ShuShu I. Although I had presented pieces before and performed my music for many years, that feeling of 'clicking' and knowing that you did something that it's truly yours, happened there.

What was there? An artistic decision of choosing certain material to corollate with other material. Relatively simple interaction, but it was a choice that emerged from my aesthetic and conceptual ideas, rather then a product of experimentation with a material. I regard this decision, and many others that followed the work on ShuShu, already as a success in the course of this research.

Following this notion, the *ShuShu* etude series presents a beginning of a personal compositional path. As each piece examined a slightly different view on system composition, they all suggested the need for further examination of those methods. *ShuShu I* revealed the fragility of performing and improvising with a limited system design, while *ShuShu II* demonstrated the potential of using time based notation as a framework for a piece. *I'm a M.F singing Bird* raised the question on how to explore system with large musical potential with constraining methods of control. *ShlagerGabber* proposed a duality that allows the performer to play **along** as well as **with** the system. All of the above mentioned subjects should and will be examined in a deeper manner in the near future.

Future work

As suggested from the unfinished work *The Visit of The Iraqi Delegation* and hinted in *ShuShu* series, the subject of social resonance in my work became crucial to my

compositnal work. I find the model presented in *The Visit …* - coupeling sampled material together with electronic systems - to have great potential. This model could be expanded to include any ready-made object that suggests a meaningful interaction and counterpoint with electronic systems. Additionally, social resonance could be understood more literally; during the last 3 years I have been curating an experimental music festival in Jerusalem. Last year's event succeeded on reaching a wide-range audience, comprised of people from different age groups and social backgrounds. With this success, this year the festival is planned to be placed in the centre of Jerusalem, aiming to reach even broader audiences and for a wider social resonance of expermintal music.

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Appendix A. Contents of the accompanying CD

Appendix B

Appendix C - List of selected concerts and works 2016-2017

30.01.16 *The Unbearable Lightness of Coherency @ Hatieva,* Jaffa Tel-Aviv
La recherche de la fecalite **-** Amir Bolzman,Meira Asher, Haggai Fershtman
A chapter from ***To Have Done With the Judgement of God*** by Antonin Artaud

03.02.16 *Schoenbergzaal,* Den Haag
ShuShu I Ilya Ziblat Shay - Bass, Amir Bolzman, Accordion & electronics

21.02.16 *Teiva Venue*, Jaffa Tel-Aviv
To Have Done With the Judgement of God - Radio play by Antonin Artaud
Meira Asher - Vocals and electronics, Haggai Freshtman - Drums,
Amir Bolzman - Bass, Accordion, Electronics

Ensemble of Love and Terror **Winter tour 2016**
24.02 Amsterdam *OCCII "PITPOURRI*
25.02 Den Hague *Studio LOOS - Wonderwerp*
26.02 Rotterdam - *City Art Rotterdam*
27.02 Berlin - *West Germany*
29.02 Berlin – *Bethanien*

28.02.16 *Noiseberg*, Berlin
ShuShu *I(Solo)*

16.03.16 *Studio Loos @ RC# 11*, Den Haag
I'm a M.F Singing Bird

13.04.16 *Wave~Line- Shadow* by *Musica Nova @ Teiva ,* Jaffa Tel-Aviv
Shushu II Performed by *Musica Nova*

19.04.16 *Pergamon club*, Jerusalem
Ensemble of Love and Terror

01.08.16 *Pergamon club*, Jerusalem

Ensemble of Love and Terror

04.09.16 *Systematix @ Mazkeka,* Jerusalem

ShuShu I*(Solo),* ***Ensemble of Love and Terror***

08.09.16 *Hedim - Jeruslaem Forest*, Jerusalem

Curated sonic night event for *Jerusalem Season of Culture*

16.12.16 *Kernel Panic @ De Vinger,* Den Haag

SchlagerGabber Ilya Ziblat Shay - Bass, Amir Bolzman, Accordion & electronics

22.12.16 *HivHuv Festival @ Musrara School For art and music*, Jerusalem

SchlagerGabber*(Solo),* ***Ensemble of Love and Terror***

24.12.16 *AlMacan Gallery, Jaffa Tel-Aviv*

ShuShu I*(Solo)*

28.12.16 - *Hamazkeka,* Jerusalem

Agasim: Yael Lavie - Kanun, Amir Bolzman - Accordion and electronics

SchlagerGabber*(solo)*, *We Daret El Ayam* (special arregment of *Oum Kalthoum*)