Sonic Arts Research Centre
School of Arts, English and Languages

Exploded Cello:

Fragmentation and Dispersion as strategies for a site-specific improvisational practice

Written component; Submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy (PhD)

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28th September 2018

Abstract

Music is a temporal practice whose roots may be imminently spatial. This thesis will enunciate the conceptual model and the practical manifestations of a research project in the context of solo music improvisation based on a particular relation between free improvisation and site-specific artistic practices. My activities as a cellist, sound artist with an academic background in architecture are articulated here to think through solo improvisations as a hybrid relation of concert-installation to a specific time and space.

This research focuses on a portfolio of concert-installation site-specific work leading to the development of a system comprised of a conceptual framework, an electroacoustic device, a dedicated sonic vocabulary and spatial and temporal strategies.

Acknowledgments

First of all I would like to thank my two supervisors: Prof. Pedro Rebelo for the pragmatism and clarity in the supervision meetings and the invitation to directly work with him in several projects of recognizable interest for my investigation. Dr. Simon Waters for the long discussions on the thesis subject, the continuous interest in the outputs of my work along this period and the invaluable capacity to unbalance my creative self. I feel extremely lucky to have been able to have both supervisors on such a close range and working together with me to pursuit the conclusion of this research.

Also my colleagues and staff in SARC for all the help, shared knowledge and friendly atmosphere.

During the period of this research I played and worked with an extensive group of people (among musicians, artists, technicians, producers, fellow researchers) who helped, in a direct or indirect way, shape and develop this project. They mainly were part of the contexts in which I presented the work publicly and therefore a fundamental axis of the specificity of this research. I thank them all for the invaluable cooperation:

Alberto Lopes, André Cepeda, Angelica Salvi, Anghus Mceavoy, Anne La Berge, Beatriz Cantinho, Bertrand Gastaut, Brighdin Farren, Bruno Parrinha, Dave Stockard, David Jacinto, David Maranha, Diogo Alvim, Eduardo Patricio, Elisabeth Codoux, Fala Mariam, Felicie Bazelaire, Filipe Pereira, Filipe Silva, Franziska Schroeder, Frederico Rompante, Francisco Fino, Gabriel Ferrandini, Gonçalo Almeida, Gunda Gottschalk, Gustavo Costa, Helena Espvall, Henrique Fernandes, Hernani Faustino, Jacome Filipe, Joana Gama, Joana Guerra, John Darcy, Jonathan Impett, Jonh Butcher, José Alberto Gomes, João Pais Filipe, Kevin Mccullagh, Lisa Conway, Lorcan Doherty, Luciano Chessa & The Orchestra Of Futurist Noise Intoners, Luis Fernandes, Luis Lopes, Luis Vicente, Left Hand Rotation, Marco Franco, Maria Do Mar, Maria Radich, Marilyn Crispell, Marino Formenti, Marta Cerqueira, Marta Revillas, Mathias Stall, Matilde Meireles, Matt Rogalsky, Miguel Carvalhais, Miguel Ortiz, Nicholas

Boyle, Nicholas Collins, Norberto Lobo, Nuno Morão, Orlando Trindade, Pascal Niggenkemper, Paul Stapletton, Pedro Costa, Pedro Lopes, Pedro Santos, Pedro Sousa, Pedro Tudela, Per Gardin, Pablo Sanz, Qube Ensemble, Raymond Macdonald, Ricardo Freitas, Ricardo Ribeiro, Robert Benttal, Robert Van Heumen, Rodrigo Amado, Rodrigo Pinheiro, Rui Chaves, Sara Morais, Sei Miguel, Simon Rose, Steve Davis, Suse Ribeiro, Travassos, Tristan Clutterbuck, Tullis Renie, Una Lee, Vera Cortês, Yaw Tembe, Yedo Gibson.

I would like to thank specifically Nuno Torres, Diogo Alvim and Emily Dekakis for the support in the final writing period, and all my working partners in the artistic and investigation collective to which I belong (OSSO Colective) with whom I have shared my creative work for the past fifteen years and who have always supported it and have been invaluable partners in the creative development of this research.

I would also like to thank my parents (Clarisse and Gil) for supporting my professional choices. Foremost, I need to thank my two daughters (Ema and Julia) and my partner Rita Thomaz for bearing up with all the traveling, long hours in the studio recording and practicing, and the enclosure of the final writing process. This work is dedicated to them.

This research would not have been possible without the financial support from the Fundação para a Ciência e a Tecnologia of the Portuguese Ministry of Education and Science, to whom I am grateful.

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[1] https://www.youtube.com/watch?v=n-DTjpde9-0
[2] https://www.technologyreview.com/s/425143/the-minds-eye/

Introduction

In 2001 I concluded my academic studies in music (jazz and classical studies), architecture and sculpture[3] and from then on I have presented my work in individual and group exhibitions, concerts and performances in Portugal and abroad, and have collaborated extensively with other artists, musicians, architects and performers. Throughout this period the relationship between sound and space has been my main field of artistic research. In this context I have created an extensive body of work around site-specific installations and I have been frequently involved in free-improvised and experimental music projects. In this journey I have edited my music with Creative Sources and Clean Feed (two main labels in Jazz and improvised music from Portugal), and have played with numerous Portuguese and international free improvisors. Some of my installations have been presented in main contemporary art events, like Manifesta 08_European Contemporary Art Biennale or the Architecture Venice Biennale 2006. My artistic work is presented in different formats, materials and contexts. Its diverse outputs are documented in www.ricardojacinto.com.

The research presented here extends this background, investigating my particular interest in the relation between free improvisation (music) and site-specificity (sculpture, sound art and architecture). I focus on the sonic and spatial relations that I can establish between the solo playing of my instrument (cello), the instrument's internal architecture and the surrounding architectural environment. Contemporary rituals around concert and installation have therefore been the main modes of audience engagement with my work. Concerts and sound installations are both rituals which have their own specificities, limitations and codes, bound by certain material and cultural conditions. They have different modes of spatial and temporal occupation, and each requires distinct types of audience engagement with the listening act.

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[3] Hot Clube de Portugal_Lisboa, Academia de Amadores de Música_Lisboa, Faculdade de Arquitectura da Universidad Técnica de Lisboa, Arco: Centro de Arte e Comunicação Visual_Lisboa and School of Visual Arts_New York.

Before this research I had presented my work in concerts and sound-installations and had begun to create hybrid projects where these different modes were articulated (Jacinto, 2015). From this experience I concluded that these distinctions and differentiated practices could be articulated further, and their specific conceptual strategies and procedures expanded. Site-specific projects that combined the vocabulary of improvisation with installation strategies to enhance the experience of place proved particularly fruitful. This project therefore takes a further step in the exploration of this subject within my practice as a cellist and sound artist.

Explorations took the form of practice-based research which, during the last four years, included a large number of public presentations, between solo concert-installations (six of them are included in the portfolio) and other solo/ensemble concerts and installation projects. These happened in various locations and contexts, and the work developed with active artistic contexts and at the academy. The practices of both site specificity and free improvisation are dependent on direct encounters with different places and players; therefore my research methods were contingent upon extensive traveling and contact with other artists, musicians, cultural agents and institutions.

The output of this research is relevant to different cultural agents. Foremost other cellists and free improvisors as they will be able to follow the development of a particular approach both to the vocabulary resulting from the electroacoustic expansion of the instrument itself and the notion of site-specificity applied to the music realm.

Sound artists might be interested in the articulations between Music Improvisation, Sound Art and Installation art, which continue to follow in most situations parallel paths, and building parallel histories. This research could act as a case study for a possible creative articulation between the three.

In another realm gallery and museum Curators or Festival Organizers may find it interesting inasmuch the hybrid presentation format of concert-installation can shed light on the way they curate and produce works by artists that are interested in extending their work articulating performative and installation formats.

Music technologists could find here a specific case where the technology followed a metaphorical idea and was at the service of implementing it to better achieve the perceptual alterations to the instrument´s performance.

My thesis consists of two parts: a four-chapter commentary **text**, including diagrams and photographs, plus an audiovisual **portfolio** with supporting documentation of public presented projects (concerts and installations) and studio recordings.

The portfolio articulates a continuum from solo improvisation vocabulary to commissioned performance and installation work. This practice is documented through photos, audio or audiovisual objects which focus either on the performative immediacy of the system (Chapter III) or relationships between performance and site (Chapter IV). Given the nature of the practice it was important to make decisions about the documentation strategies. Performative elements are presented in their entirety, either in audio or video formats, and installation elements are present through short videos or photographs.

The works included in the portfolio are:

- **Parts and Duration**: **333 parts and 37 seconds for solo cello**. Installation at Vera Cortês Art Gallery, Lisbon 2014 (discussed in CHAPTER I)
- Short **solo improvisation studies** focusing on specific relation to the electroacoustic system. These are complemented by a series of short **videos demonstrating the techniques** developed within the current version of the electroacoustic device (discussed in CHAPTER III)
- **6 concert-installations** presented in professional context throughout the research period: CASCA [Coimbra 2014], EXPLODED [Barreiro 2014], SEGMENTS [Lisboa 2014], LA HALLE [Paris 2017], REFLEXO [São Miguel 2017] and MEDUSA [Porto 2017] (discussed in CHAPTER IV).

This documentation is compiled and organised on both a **USB pen drive** and a website: **http://www.osso.pt/derivas/explode_cell/**, allowing both physical and online access to the referenced photos, video and audio files. For ease of reference, both the pen drive folder organisation and the website have the same structure as the written document,. Whenever appropriate, the reader will find in the text the direct link to the website or reference to the USB pen drive folder where they can find the designated media document(s).

The text describes the Exploded Cello, a system based on a set of conceptual principles directly articulated by an electroacoustic device. This is specifically designed to create a temporary interdependent relation between the cello and a specific location. The Exploded Cello system is expressed in durational installations activated by shorter periods of solo improvised concerts. Over the research period and past iterations of the project (some of them presented here), this hybrid format of site-specific solo concert-installation led me to acquire a particular sonic vocabulary and set of installation strategies which owe much to the particularities of the electroacoustic device. The presentation of this system includes the description of its conceptual model (Chapter I), the components and mechanics of the electroacoustic device (Chapter II), the developed sonic vocabulary (Chapter III) and the various installation strategies (Chapter IV).

Chapter I presents how the system grew from the hypothesis that a site-specific solo improvisation could develop in a dialectic relationship with the notion of ‘acoustic horizon’ (Truax 2001), as a perceptual drift between the instrument’s (inner) micro-territory and the soundscape’s most distant manifestations. From this hypothesis I proposed the metaphor of the Exploded Cello as an image of the process of distributing the instrument in the surrounding environment. This metaphor established itself as the basis for a spatial and temporal formal exploration of the processes to which an object is subjected to as a consequence of its explosion: fragmentation and dispersion. These two processes are used here as conceptual instruments to inform developments in the electroacoustic device, the performance vocabulary and installation strategies. In this chapter I will debate the overall conceptual model of the Exploded Cello system and how it structures the development of a site-specific solo improvisation practice. This model expands musical site-specific improvisation to the realm of sound art through an explicit hybridisation of the presentation format, combining concert and installation rituals.

Chapter II is dedicated to the description of the current version of the Exploded Cello electroacoustic device: a nomadic device that allows the player to intervene in specific spaces based on the model of a solo cello concert that activates a sound installation. This device includes three interdependent components: inputs, digital interface and outputs. This technological apparatus consists of a sound amplification system with several contact microphones distributed throughout the cello's body. These transduce the microscopic details of the performer's actions on the instrument's body, expressed via its internal resonances and structural vibrations. These signals are electronically processed and broadcast over multiple loudspeakers and/or contact transducers coupled to objects or resonant architectures, in an exercise of territorial occupation based on the fragmentation of the instrumental action on the cello and the consequent dispersion of the sonic results. This device, designed for a hybrid practice of concert and installation, expanded my relationship with the cello and the cello's relationship with space, encouraging the notion of drifting between the unpredictable content of the soundscape, the resonances of the surrounding architecture and internal resonances of the body of the cello. The current version of the device was developed over several iterations of the project, which included both public presentations and laboratory research; these had a great influence on the development of the associated vocabulary.

Chapter III summarises the developments of the Exploded Cello's sonic vocabulary, incorporating performance techniques (i.e. cello and electronics), the automated performance of the software, and both of these in relation to the diffusion setup (speakers and resonant objects). This vocabulary is highly dependent on the live operation of the electroacoustic device and its articulation with the Exploded Cello metaphor discussed in Chapter I. This chapter includes extensive audiovisual documentation demonstrating four different audio processes of fragmentation and dispersion that form the basis of the Exploded

Cello vocabulary, each corresponding to a specific setup configuration. Each process includes videos demonstrating the most relevant cello techniques and their particularities and short audio improvisations (studies) where these techniques are developed and articulated.

Chapter IV is the written commentary on a portfolio of six public concert-installations presented during the research period (2014-2017) including the spatial and temporal strategies used in each of them. Since the Exploded Cello system was designed to explore a particular approach in the relation between a solo cello performance and the site where it takes place, this chapter extends the aspects discussed in the previous chapters in the context of installation practices (architectural and sculptural), where the occupation and spatial design of the site are fundamental themes. These reflect and are reflected in the musical performances; it is their intersection that configures a portrait of a particular relationship within a place and time. In all the selected iterations, the Exploded Cello system assumes an instrumental character adapting the relationship between the electroacoustic device, the improvised cello performance and the specific designed or selected external objects. In this portfolio we can track its development through the contact with different contexts and sites throughout the research period (gallery spaces, industrial spaces, stages or open-air public spaces) and how that influenced the different setup configurations (spatial strategies) and activation modes (temporal strategies).

Research context

As mentioned, this research intersects a lineage of practices from different artistic contexts. The following paragraphs generically frame the practice and development of this research.

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In 2006, John Butcher visited obscure parts of Scotland and the Orkney Islands to play and record solo interventions in sites chosen for their specific and idiosyncratic acoustic properties. These included an old military fuel tank in the Orkneys with a 15-second echo, as well as an abandoned reservoir, a sea cave and a mausoleum. The encounters between Butcher´s saxophones and these spaces were recorded and they constitute a valuable document of an improvised dialogue with the soundscape and resonant properties of these particular spaces. As stated in the liner notes of the 2008 album *Resonant Spaces*:

> If Butcher's response to these locations is frequently astonishing – witness the serrated foghorn blasts that moan across the void in "New Scapa Flow"– so is the way that these places seem almost to answer his forays. In "Wind Piece", recorded at the Standing Stones of Stenness on the Orkney mainland, the eerie pitch-shifted coos that merge with birdsong and Butcher's own gurgling breaths could be emanating from the rocks themselves. This is a series of duets, really, Butcher not playing the spaces as much as tussling with them, each performance existing in an ongoing state of modification as he negotiates the different sonic qualities of each of his unusual venues.

This album is an example how the acoustic specificities of a place may affect and directly influence the creation and experience of music. The resonant properties of particular architectural environments can dramatically shape the way musicians (both composers and performers) create and audiences experience music. Space resonance is a natural extension of any musical instrument; be it acoustic, electroacoustic or electronic; and the same sound from any instrument may be experienced in as many different forms as the spaces where its sounds are projected. From the long reverberation time of

Gothic cathedrals to the muteness of anechoic chambers, we can dramatically shape the same sound source and deeply affect the way we perceive sound. Giovanni Gabrielli (Cori Sepzzati, 1520), Ives ("Symphony nº4", 2º mouvement, 1910-24), Stockhausen ("Gruppen": for three orchestras (1955–57), Edgar Várese ("Poéme electronique" 1958), Xenakis ("Terretektorh", for 88 musicians scattered among the audience, 1965-66), or Alvin Lucier ("I´m sitting in a room", 1969) are examples of composers who included space as a fundamental musical parameter and therefore paved the way to creatively think about and explore this relation.

The advent of electroacoustic amplification in the 20th century expanded this notion to include an altered experience of the micro sound. Besides the incredible changes in the disembodied, non-visual, mediated and out-of-time experience (i.e. acousmatic listening) of recorded music and radio (Licht 2009), the use of microphones and signal amplifiers allows the experience of the microscopic details of sound. With this technological apparatus we can experience an extreme proximity to the acoustic sound sources. Sonic magnification is nowadays completely integrated in our popular musical culture — where, for instance, the breath of pop singers is magnified and an intimate sonic relationship is created with the audience (Waters 2017) — to the fringes of underground-culture music contexts — where, for instance, the guttural sounds of Yamatsuka Eye become the expression of a visceral disruptive noise experience. Both share a declared interest in an alteration of perceived distance to the sound source.

Another very relevant breakthrough was the possibility of isolating a micro-sample of a recorded sound and establishing a sonic object relation to it. *Solfège De L´Object Sonore* (Schaeffer and Reibel 1967) mapped a concrete relation to sound and noise institutionalised itself as a credible extension of the musical vocabulary.

> The other value of recording tape, besides its malleability, was its capacity for repetition, not only by rewinding and playing a recording over again but by forming tape loops in which the machine would play a given section of tape over and over without

> interruption. Such repetition made possible the sort of close study of sounds that one would usually associate with a frozen visual image, or with the notation of specific pitches in a musical score. (Licht 2009)

Later, micro sound particles (sound particles lasting less than 1/10th of a second) have introduced in computer music the dissolution of the traditional building blocks of music (notes and intervals) into a more fluid medium (Roads 2001). This introduced a new sonic relation between time and space. One can dive in the morphology of micro-sonic moment; repeating it indefinitely means a new continuous sound will appear. Sounds with new timbres surge and mechanical repetition allows them to be experienced indefinitely. If this repeated sound is part of an acousmatic environment (in a sound installation) the experience of music becomes part of the architectural environment, diffusing its categorisation limits with that of the soundscape. These new extreme durational sound installations changed the musical experience dramatically. This relation between the micro and macro, both in temporal and spatial terms, is fundamental to this research project, explaining the basis for how it can be articulated within a free-improvisation practice.

Free improvisation emerged also in the post-war period, helping instigate a counter-cultural movement that dissolved the hierarchical boundaries between composer and performer. This is a practice that relies on a decision-making in a continuous and unpredictable musical flow. Listening and playing are one and the same thing in this musical ritual. Idiosyncrasy becomes central as each player transports a specific "voice" and all the participants in this ritual have the same responsibility in shaping these "real-time compositions". Free improvisation, as conceptualised by Derek Bailey (Bailey 1993), also cleared the way for the freedom of playing with non-idiomatic vocabularies, allowing for the new extended instrumental techniques to be a common part of the free improvisor's dialects. This musical sub-culture allowed new and very unpredictable encounters that have shaped the development of music in the last 50 years and established a global community of practitioners, far away from mainstream attention. The extension of this dissolution of the distinction between composer and performer included other artistic disciplines and therefore visual and sonic arts became part of one shared creative continuum. The concert is no longer the only ritual for experiencing music and other rituals become relevant, as is the case of the sound installation, shaping new forms of sonic experience. In another context, much closer to the visual arts and sculpture, sound installations questioning the spatial properties of specific sites started to emerge in gallery spaces and museums. Key artists like Max Neuhaus, who was a percussionist committed to the world of experimental concert music (playing works by Cage, Morton Feldman or Stockhausen), abandoned performance to completely focus on sound as entity and explore it in sound installations — as in the soothing drone placed under the grating of a pedestrian triangle in Times Square — or in performances where he would lead the audience to listen to the sounds of specific locations. It is interesting to notice how this path from concert music to sound installation was also walked by Kristina Kubisch, a former flautist who left performance “in favour of doing sound installations, at first constructing wire reliefs mounted on walls and speakerless sound systems that utilised magnetic induction, with the sounds heard through receivers or, later, cordless headphones“ (Licht 2009). Another artist which articulated concert rituals and installation procedures was the violinist Jon Rose. Since 1983, in addition to his work on and about the violin, Jon Rose has been bowing and recording the music of Fences worldwide. A wide range of musical material could be coaxed from these ubiquitous landmarks. The project GREAT FENCES OF AUSTRALIA maps the vast spaces of Australia. Since 2002, violinists Jon Rose and Hollis Taylor have travelled 35,000 kilometres playing and recording the unique sounds of hundreds of fences in every state and territory of the fifth continent. This project exemplifies on one side the carefully development of a musical language based on the specificities of these long metal wires, on the symbolic power of these objects as territorial divisions, mind-body, controlled and wild spaces. Nevertheless this project included the journey along these fences introducing a site-specific character to each performed fence.[4]

[4] https://www.jonroseweb.com/f_projects_great_fences.html

Sound art installations and their creative processes also include approaches to not only apparent sounds in the environment, but unapparent or hidden sounds as well. Notable examples include Bruce Nauman's "Untitled Piece" (1970), where he instructed drilling a hole a mile into the earth and placing a microphone inside, which would feed into an amplifier and a speaker in an empty room; the Japanese art collective WrK's "Phase Difference Between Two Windows by Using Line Vibrations" (2001), in which the vibrations of two windows in a gallery space are amplified to the point of audibility by contact microphones; and even Alvin Lucier´s "I´m sitting in a room", where the resonant frequencies of a room are made audible by recording several iterations of a voice being played back into that same room.

Adding to these there are also several artists interested in the bringing musical instruments as the matter for their aesthetic approaches. Long is the list of artists who painted musical instruments or others which used them as subjects for sculpture. In the beginning of the XX century Braque, who was an instrument collector, used musical instruments as still-lives to develop his new vision of a multi perspective pictorial space. As an example this painting of a small lute called a *Mandora* (Braque, 1909-10). Its fragmented style may suggest a sense of rhythm and acoustic reverberation that matches the musical subject. More than a visual illustration of sound propagation the picture shows the visual narrative of a central fragmented figure which disperses towards the limits of the canvas, loosing its initial reference.

Another artist using musical instruments in its work was Cornelia Parker who later in the XXth century explored the musical instrument through sculptural transformations which introduced deformations that presented new symbolic meanings to these objects. In "Perpetual Canon" (2004) Cornelia Parker explores the deformation of a brass band by the force of a caterpillar. The result is an aesthetic resurrection of the object in a cartoonish manner. "Cold Dark Matter - an exploded view" (1991) is an example of another type of transformation which could be linked to a cartoonish action like a sudden explosion.

Christian Marclay is another artist whose work involved the transformation of musical instruments. His sculpture includes fanciful fabricated impossible-to-play instruments, with awkward deformations: drums whose stems have grown, guitars with their necks melted and droopy.

Closer to this date the greek artist Nikos Veliotis completed the work Cello Powder [the complete works for cello]. This 2008-2009 project was divided in two parts. One that included recording the sonic range of the cello, divided into 100 quarter tones, where every quarter tone was recorded for one hour.. The sonic result e.g. 100 one hour drones was mixed into one audio file called "the complete works for cello" and pressed onto a 100 cds. The second part was the performance. The cello used in the recording was destroyed (turned into powder) in front of a live audience while "the complete works for cello" was played back through speakers. The powder was used to fill jars of approximately 250ml labeled, numbered and sealed. The performance took place during the 2009 INSTAL festival in Glasgow on March 21st.[5]

Also directed to the musical realm other visual artists experimented approaches which dig deeper into the composition systems. Marcel Duchamp addressed music and the musical instrument in a categorical different way. His lack of musical training and his interest in conceptual conundrums led him to experiment with chance systems and mechanical instruments 40 years earlier than John Cage[6]. As an example we can present the second piece of the three musical pieces Duchamp created: “La Mariée mise à nu par ses célibataires même. Erratum Musical” (The Bride Stripped Bare by Her Bachelors Even. Erratum Musical) belongs to the series of notes and projects that Duchamp started to collect in 1912 and which led to the Large Glass. It was neither published nor exhibited during Duchamp's life. There are many notes and projects, each dealing with a different task. They are difficult material to work with, as there are no comments or explanations by Duchamp to assist with interpretation. Even so, it provides enough information for a successful realization. There are two parts to the manuscript. One part contains the piece

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[5] www.cellopowder.com /// https://www.youtube.com/watch?v=5e3O6jJYKOM
[6] http://ubu.com/sound/duchamp.html#music

for a mechanical instrument. The piece is unfinished and is written using numbers instead of notes, but Duchamp very clearly explains the meaning of those numbers, which makes it very easy to transcribe them into notes. He also indicates the instrument(s) on which it should be performed: "player piano, mechanical organs or other new instruments for which the virtuoso intermediary is suppressed." the second part contains a description of the compositional system. Duchamp's title for the system is “An apparatus automatically recording fragmented musical periods”.

My research project follows this lineage of artistic processes, aiming to systematise a particular approach to site-specific improvisation inside the increasingly borderless relations between music and sound art. This will be demonstrated via a very specific approach to my own practice in free improvisation as a cellist with a background in architecture and visual arts.

Chapter I - Conceptual Model

1. Site-specific solo improvisation and the acoustic horizon

In the realm of music, free improvisation is the practice which deals most directly with the notions of being here and now, dealing with the examination of present circumstances, and experiencing "the moment, which is the experience of the flux of its own appearing and disappearing" (Ninh 2014, .28). This assumption has a correlation with the notion of site-specificity: a term used to describe artworks that are created in direct relation to a particular location. Since the late 1960s this term has been coined in different ways and its limits have been stretched in many directions. From the early minimalist topological/ architectural approach, to the institutional critique (focusing on the system of socioeconomic relations, through which art and its institutional programming find their possibilities of being), to today's site-oriented practices (where we find a more intense engagement with the outside world and everyday life, favouring "public" sites outside the traditional confines of art) we have witnessed artists questioning site in multiple ways (Kwon 2004).

There is a direct relation between free improvisation and site-specificity, as they both bring to the creative process a sensitivity to the here and now. Location and moment are dependent on each other and their perception is always the result of a particular subjectivity. Site-specific improvisation would entangle the improvisor's idiosyncratic discourse with the data perceived over a given period in a particular site. In a short but very lucid text the musician Wade Matthews lists this data in terms of sonic content (natural, human or mechanical noises) and resonance:

> These aspects are by no means static, so the preparation of a "site-specific" sonic work necessarily involves recognising the processes of change which are continually occurring at that site.
>
> (Matthews 2002)

Free improvisation is a relational and dialogical process. Be it in solo or ensemble contexts, listening is a fundamental part of this process; musicians listen to what surrounds them and gear their musical actions towards the constant surprise of the next sound to appear. The exceptional quality of improvisation's unfolding character also introduces in the event a shared responsibility between player and audience, as listening is a shared experience. Players are not just delivering and audience just receiving. Although there are technically predetermined roles, listening is a discovery, a prospective experience shared by everybody included in the listening ritual. Listening is one of the foundations of free improvisation and also one of the keys to site-specific improvisation. The improvisor's careful selection of a sound palette and use of silence and dynamic levels are fundamental to this process. The improvisor interrogates a site by playing, as well as by listening. Site-specific improvisation presupposes a constant, intense and untiring perceptive effort on the part of the player (Matthews 2002). Inevitably, this also has an effect on the perceptive experience of the audience, and the result is music which guides its listeners towards greater consciousness of the setting.

Playing a cello solo is the most intimate musical relationship that I can exhibit in front of an audience; it amplifies a relationship I have between tactility and sound. Playing cello, functions as a crucial index of my 'presence', 'focus', 'purposefulness' or 'conviction' (Waters 2013). This particular intimacy with the instrument is reflected in an extreme performance fragility but also in an overwhelming power of manipulating the acoustic space. I have been playing improvised cello solos for seven years now and it has become a central part of my interests as a musician. Solo free-improvisation is a situated mediation between my intimate relation with the cello (a kind of micro-territory framed by my own vocabulary on the instrument) and the specificities of a surrounding territory in terms of sonic content and resonance (Mathews 2002).

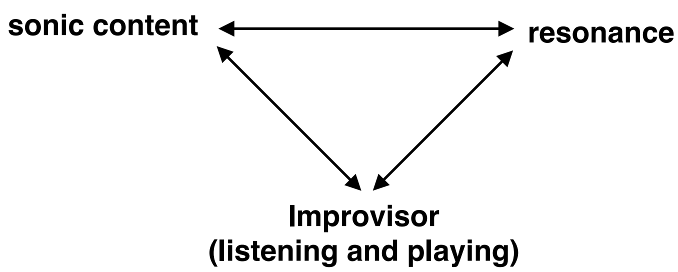

Figure 1: Solo site-specific improvisation

The locations where these solos took place included both musical venues, such as concert halls or auditoriums, and a large number of other spaces (industrial spaces, art galleries and museums, outdoors, bars), where unintended sounds from other activities also occupied the acoustic arena (Blesser and Salter 2007). The acoustic character of these spaces (their resonant properties) was also different, ranging from an anechoic chamber to extremely reverberant industrial space. All of these places were characterised by these factors and their sonic specificity was defined by their dynamic (i.e. in time) articulation in my creative listening.

> As he plays, the flutist is bringing into existence a sonic space that is defined by the limit of audibility of his flute in each direction, upward toward the skies as well as outward on the earth around him, into which he is projecting himself. It is his own sonic territory, in which his ideas of relationships are valid.
>
> (Small 1998)

In these improvisations I explored the relationship between my embodied vocabulary on the cello, a careful listening to the soundscape and the qualities of the response of the space I was playing in. The soundscape gave me sonic material to converse with (i.e. the quality of the sounds and the qualities of their transformation over time) while the aural architecture provided the relation between the acoustic properties of the space (its resonance and the way it affects the cello's projection in space) and my emotional relation with it. Once the relation between soundscape and aural architecture became a central concept governing my improvisation listening practice, the notion of acoustic horizon — as comprising the most distant sounds that may be heard in a soundscape — (Truax 2001, pg. 67) became the conceptual instrument to think of my performance has a listening drift in the site's dynamic and mutant sonic depth variations. The proposal that solo improvising could be primarily influenced by a listening practice which would consider an active sonic mapping of space led me to develop a musical vocabulary for solo improvisation that considers the exploration of a specific moment and place as its primary source of inspiration.

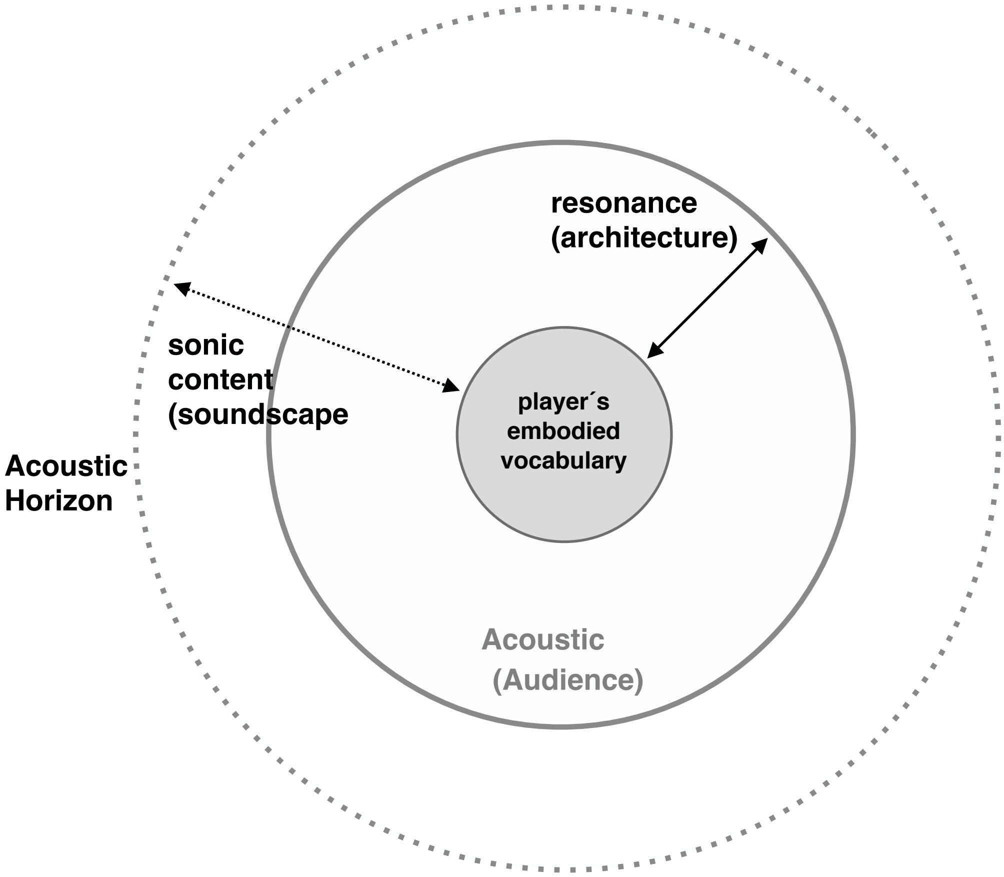

Figure 2. Solo site-specific improvisation and the acoustic horizon

> I sit with the cello in full immobility and listen to the outside, focusing on distant sounds (quite indifferent to the musical ritual). Almost faded sounds that cut through the old stone walls. I look for the soundscape qualities: the patterns, the density, the sources … and I start by playing a short and strong sound. It activates the room resonance and then fades out. In that short sound I explore the relation between my location in space and time with the perception of its limits. I define an arena. Closer to me there is the sound of the audience; its movements. I wait and then start playing a longer bowed pitch. I focus on the new colour that the architecture gives to the cello’s sound. Suddenly my focus may change to the tip of my fingers, and the soft sound of the finger pressing the string becomes the centre of my listening. The bow stops and that event results in a micro sound and I place it in the centre of my improvisation flow. [7]

[7] Short notes on improvisations, own diary (Ricardo Jacinto 2013), referencing solo improvisation at CAVE 211 / https://soundcloud.com/rjacinto-1/solo-cave-211

This short narrative describes what I call a listening drift between the distant acoustic horizon and the closest and most intimate sound that I produce on the cello: the very soft touch of a finger pressing a string onto the fingerboard. Maybe this sound has no audible projection, but even if it is not perceptible to the audience there is an internal micro-resonance in the cello's body. I thought of John Cage's lesson concerning his mythological visit to the anechoic chamber (Cage 1973).

In 2007 I have put into practice the idea of improvising in one of these extraordinary sound laboratories. The experience was conducted in a duo configuration (cello and alto saxophone) [8] but it was very relevant to understanding the dramatic influence that resonance and the soundscape's sonic content have in site-specific improvisation, as this location almost completely erased these two parameters. At first, the organisation of time (the moment unfolding) was dramatically altered, as in that situation the acoustic space is defined solely by the direct sound coming from the instruments. There seems to be nothing beyond the limits of these acoustic bodies. Therefore the relation between players became much more active as the pauses had no space. Musical silence had no space. During the session something interesting happened: the acoustic horizon moved from an outside distance relation to internal distances. I could hear the alto saxophone very close to me but I could also hear quite loudly the detailed micro-sounds of my hands on the cello or my clothes touching the wooden body. Later in the recording session, long musical pauses became more prevalent and a new horizon appeared: inside our bodies and our instruments' bodies. This experience led me to develop an extended conceptualisation of the notion of acoustic horizon.

2. Inverted acoustic horizon and the listening drift

In our sensory system hearing is one of the senses that best informs an omnidirectional perception of space. This feature is accompanied by auditory selection mechanisms that give us the ability to focus on particular sound

[8] Cacto 2007 - Nuno Torres: alto saxophone / Ricardo Jacinto: cello: https://ricardojacinto.bandcamp.com/album/cacto

events, even in very dense and dynamic soundscapes. The acoustic horizon determines, in a way, the relation between the subject and the surrounding space by the former's attention to the outer limits of a sonic geography in a specific space and time. The extent and profile of the acoustic horizon depends on the interaction of the sound sources with the topography of the surrounding space, being as dynamic as the number of sources that are active, the character of its attributes (intensity, duration, pitch, timbre and position) and the listening abilities and listening discipline of the subject who wants to interpret it. The act of listening to a soundscape and interpreting the acoustic environment (Truax 1984) reveals an unstoppable layering of sound events and implies an incredibly dynamic sound-mapping of the space around you.

> I'm lying in the bed, tapping on my laptop. A dog is barking in a distance in between the squeaking of car tires on the road. I may close my eyes, stop tapping, immobilise my body and concentrate solely on listening. I´ll try to refrain myself from being a sound agent. No apparent movement from my body and all the objects in the room are also resting. The room is silent, in pause. A brief moment of indiscernible talking outside. The street "comes" into the room from the thin layers of the glass windows on my right side. The sounds from the outside resonate inside the room. My head lies on a fluffy pillow. A very soft crepitation surrounds the back of my head as my weight slightly depresses the pillow volume. This sound texture momentarily becomes the primary focus of my listening exercise.[9]

The exploration of spatial perception through sound may depend on the testing of its limits (horizon). In a certain space, the more limited the sound sources and the less resonant the space is, the closer one seems to be to a perceived silence. The experience of going into an anechoic chamber is an example of testing a radical relationship with silence and experiencing its perceptual impossibility. Inside an anechoic chamber, even if you are isolated from outside noises, immobile, experiencing almost an open-field situation, you will eventually start hearing the noises of your own body or even having aural hallucinations (Cage 1973). This leads to the definition of an inverted acoustic horizon. The nonexistent outside noises, and in this case the almost total

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[9] Short notes on improvisations, own diary (Ricardo Jacinto 2014)

absorption of room reflections, gives us the opportunity of listening to micro sounds produced inside our body. This architectural device provides a way to explore, with no electrical amplification, the extreme magnification of the interior sounds of our body. These very ‘soft’ (near silence) sounds are, in this context, perceived as extremely intense sonic manifestations:

> For, when, after convincing oneself ignorantly that sound has, as its clearly defined opposite, silence, (…) one enters an anechoic chamber, as silent as technologically possible in 1951, to discover that one hears two sounds of one’s own unintentional making (nerve’s systematic operation, blood’s circulation), the situation one is clearly in is not objective (sound-silence) but rather subjective (sounds only), those intended and those others (so-called silence) not intended.
>
> (Cage 1955)

Cage suggests that the dichotomy between sound and silence is rather one between intended and not-intended sounds. There are ‘only sounds’ and silence is a perceptual mirage. This situation provides a similar experience, in its conceptual and perceptual structure, to the attentive listening and immersive quality of an ‘outside’ soundscape. After spending some time in an anechoic chamber, and once you get used to the acoustic deafness, the acoustic horizon suffers an inversion. Due to the particular aural conditions, one’s listening threshold has lowered so much that the auditory system is excited primarily by your body resonances. Your body becomes a territory for acoustic mapping: a micro-territory. This experience expanded my perspective on the listening drift as a driving motor for solo improvisations, to include an analogy between the interior and very soft sonic manifestations inside one’s body and the same micro-structural resonances in the instrument’s body. Thus, improvising in a specific space and time can be based on a listening drift between the micro-sonic resonances of the player’s actions inside the body of the instrument to the depths of the exterior soundscape. Site-specific improvisation starts to operate as an extended dialogue between the player (with an existing musical vocabulary), the instrument’s sonic micro-territory (internal resonances) the space resonances (within its aural architecture) and the sonic content of the soundscape.

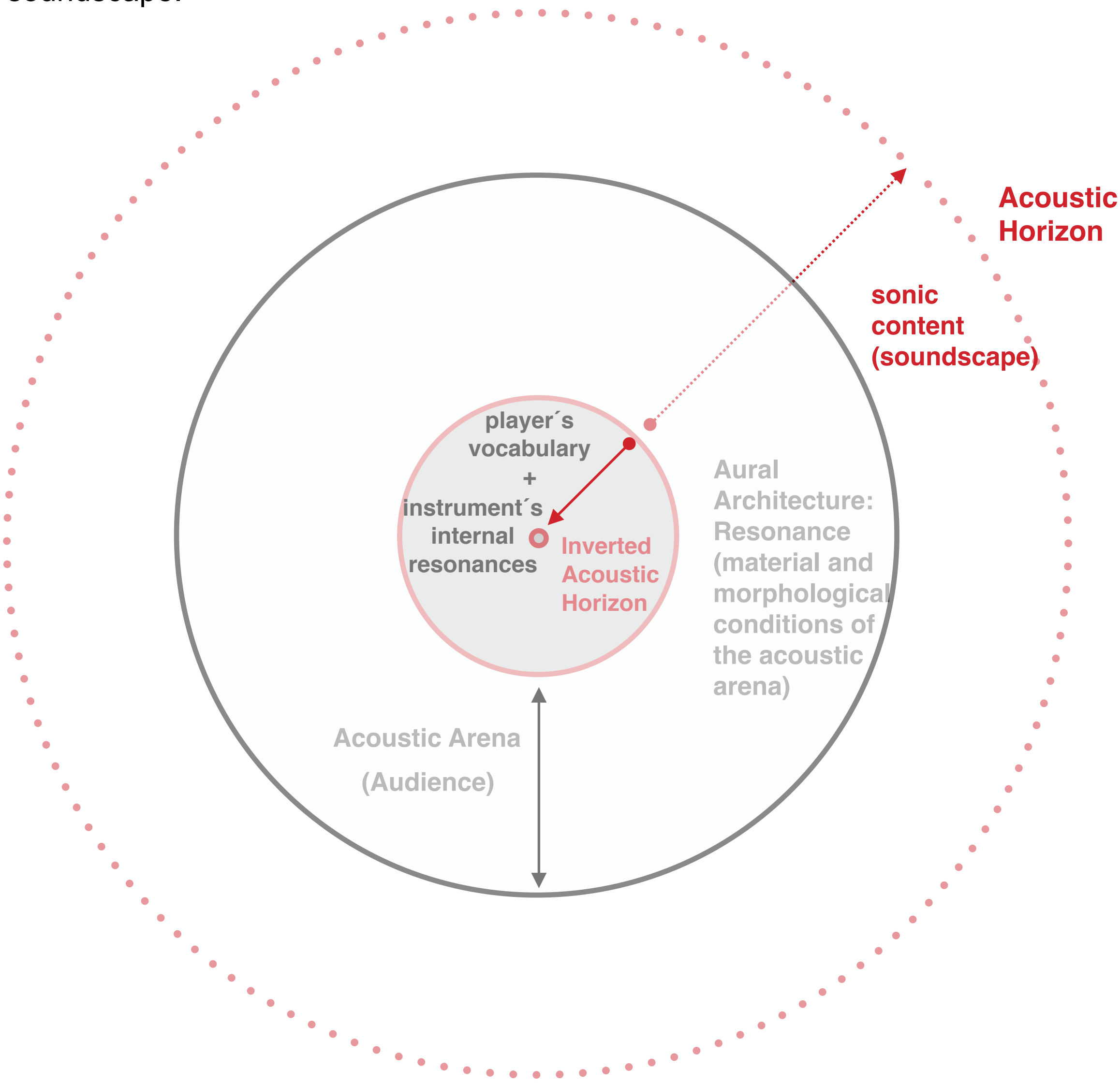

Figure 3: Solo site-specific improvisation diagram and the two horizons

This centripetal diagrammatic organisation of the relation between a solo player, the instrument and the surrounding environment is an extreme simplification of the performance ecosystem (Waters 2013), which is activated by the concert ritual. Any specific relations that a musician improvisor might establish with a specific site are much more complex and multi-sensorial than the apparent simplification of this diagram, which analyses this relation based on purely sonic concepts and contents. Nevertheless this diagram begins to propose a graphic translation for the aural cartography of the territories involved in an improvisation flux based on a spatial listening drift. It can even be used as a proto-score for a site-specific improvisation.

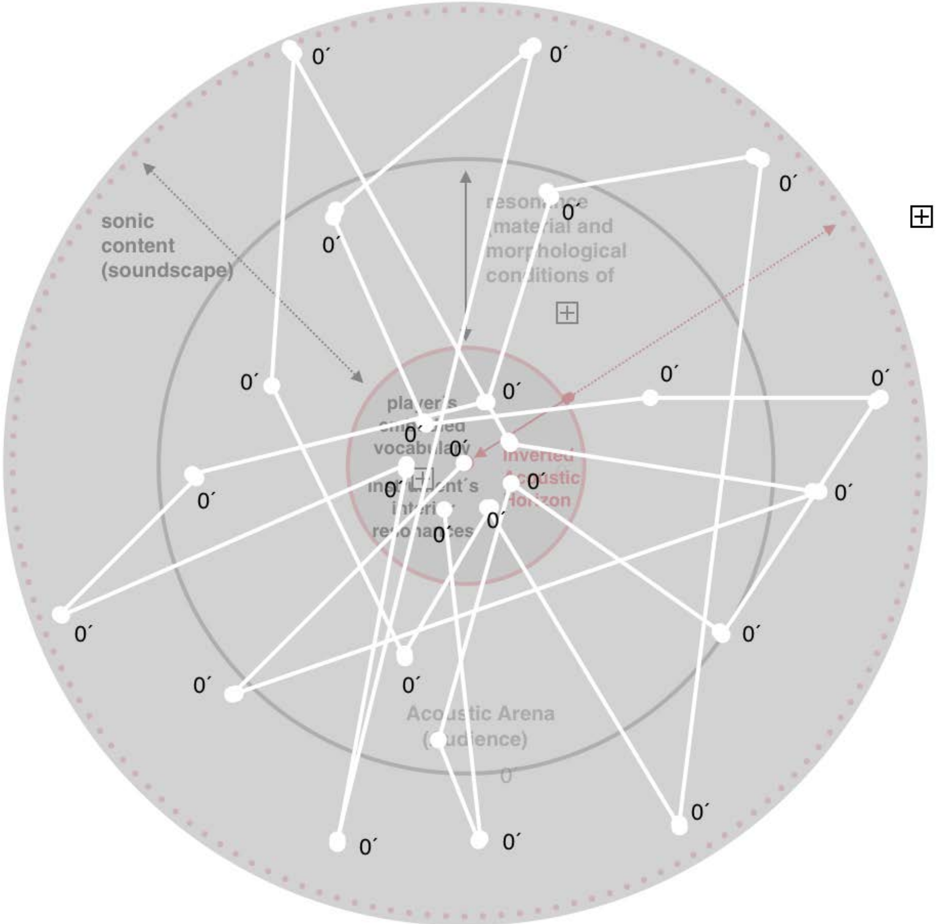

Figure 4: Indicative map for the listening drift

This soloist “map” suggests a possible listening drift between specific focus points inside the different zones of the concert’s acoustic territory during an improvisation. It graphically indicates the path of a dynamic spatial listening which can shift between the instrument’s acoustic micro-territory (inverted acoustic horizon) to the complexity of the concert’s acoustic territory (the relations inside the performance ecosystem). This listening is inextricable from the sounds being produced on the instrument by the player and the way they affect and transform the sonic environment, and therefore how they change the acoustic horizon’s depth. Playing with this map as a proto-score implies a continuous discipline managing the use of instrumental silence (to let the concert's acoustic arena receive unintended external sounds), playing near silence (to explore the simultaneity and increased perception of very low-volume sounds that might exist in the space) or playing at continuous higher volumes (occupying the totality of the acoustic territory). Following this approach, I decided to use microphones that could pick up the most minimal noises of my playing of the cello in different parts of its body; this amplification system would give myself and the audience the possibility of perceptually moving closer or even into the instrument, as if the cello's architecture seemed to grow beyond the scale of the human body. A multi-microphone system, distributed through the instrument, that I could dynamically mix while playing the cello in order to explore the drift from the inside to the outside of the instrument; with this system I could develop an improvisation vocabulary based on the spatial drift between internal and external horizons. I wanted to extend my performance vocabulary to also include playing with the perceptual distance to the cello, using an electroacoustic extension of the cello that would enable playing with the perceptual movement between micro and macro, extremely close and very far, inside and outside.

Describing the 'Harmonic Bridge' project, Bill Fontana writes:

> This sound sculpture will explore the musicality of sounds hidden within the structure of the London Millennium Foot Bridge. This bridge is alive with vibrations caused by the bridge's responses to the collective energy of footsteps, load and wind. This sonic world is inaudible to the ear when walking over this bridge. It will be revealed by the use of the accelerometers (which are vibration sensors) that are listening to the inner dynamic motions of the bridge. Harmonic Bridge will be realised by installing a network of live accelerometers on different parts of the Bridge in order to acoustically map in real time its hidden musical life. The live sonic mapping will be translated into an acoustic sculpture by carefully rendering sounds from this listening network into a spatial matrix of loudspeakers. This sculpture will not only render the natural acoustic movements of the Bridge, but will tune the presence of this live sonic data to the characteristics and architecture of the two spaces in which the work is presented: the Turbine Hall of the Tate Modern, and the Main Concourse of Southwark Station of the London Underground.[10]

[10] http://resoundings.org/Pages/Harmonic_Bridge1.htm

This installation explores a situated projection of the hidden interior of a piece of architecture. The interior's structural resonances of the bridge are made audible in another specific place, thus potentiating on one side an exercise of extreme sonic proximity, on the other a site-specific dislocation. The multi-microphone system would aim for a similar objective.

3. The exploded cello metaphor

Looking again at the "listening drift map" (p. 32) all these points positioned between a centre and a periphery present similarities with an "image of an explosion": a central core which bursts into pieces and radiates rapidly from the centre to the periphery. This is very similar to the way our listening focus is activated, in fast movements across space between specific and fragmentary sonic cues: we´re in a certain position but our perceptive focus can be in one place in one moment and in another place in the next instant, close or far away. Mapping a place through sound is a continuous and subjective listening process. Listening to its soundscape is, in this case, spatially drifting in a limited territory of "an infinite and undetermined composition" (Shafer 1977). From this conceptualisation and diagrammatic transcription of the perceptual listening drift between micro and macro sonic territories of the acoustic environment, I poetically evoked the image of an explosion: a cello that loses its integrity when its body is fragmented into multiple pieces and dispersed through space. This simple narrative of a cello dissolving in the surrounding space became the main structuring metaphorical force of this research: an improvisation process based on playing the explosion's consequences of fragmentation and dispersion. [11] In very early stages of the research the explosion narrative was interpreted in two different ways, which shared the same sequential processes of fragmentation and dispersion but in contrasting manners: the concrete, organic, unpredictable and violent character of a mechanical explosion, and the abstract, diagrammatic, controlled and geometric character of an exploded-view drawing.

[11] Although we may consider that the phenomenon of dispersion begins when fragmentation occurs, for methodological reasons I considered the two events autonomously in order to identify (and develop) their specific processes and the possible links between the two.

3.1 Mechanical Explosion

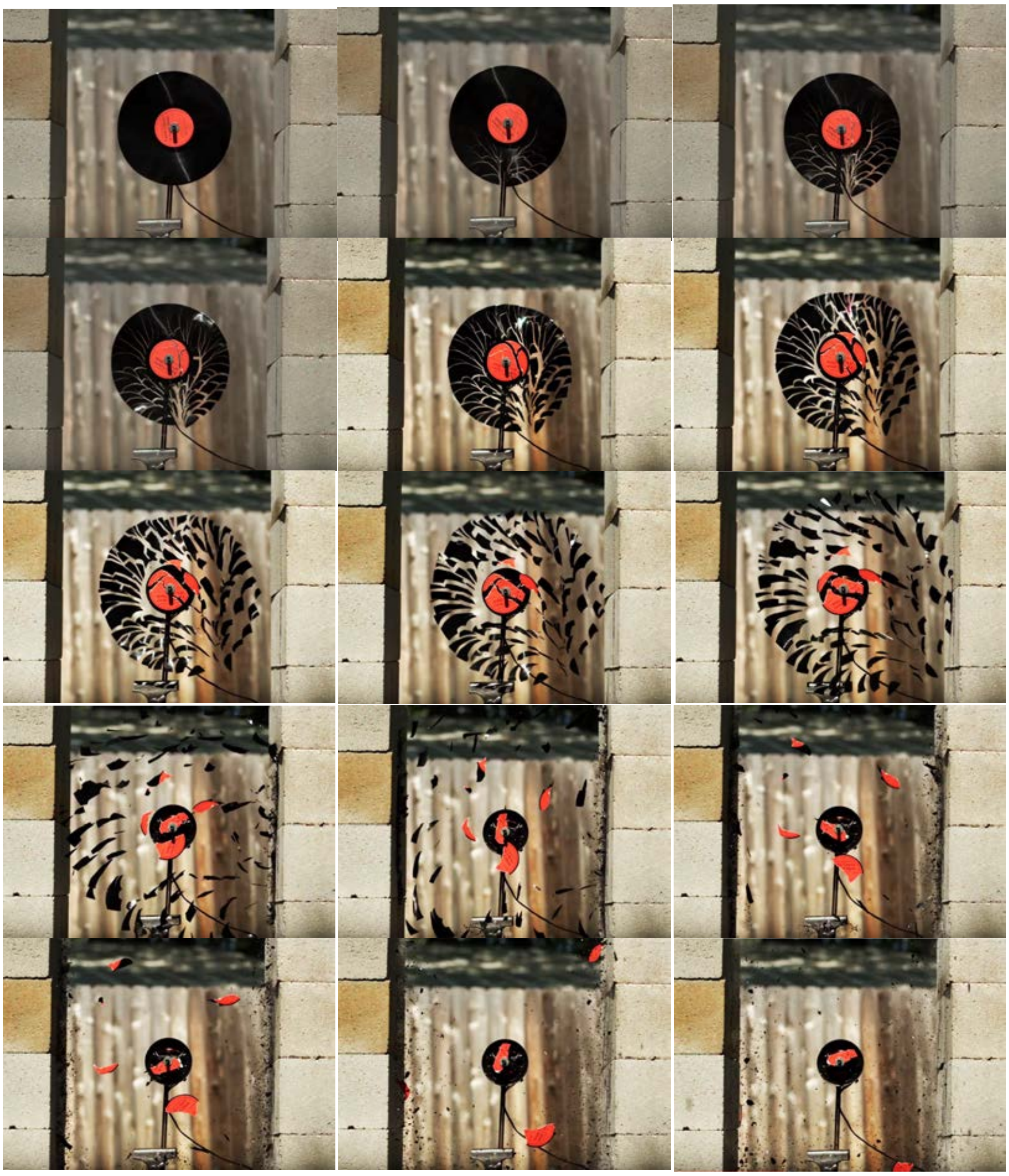

Figure 5: Stills from video of a vinyl record subjected to an extreme rotation force

The term “exploded cello” can be interpreted as a complete shattering of a body and dispersion of the consequent debris. A mechanical explosion involves a sudden and often violent burst of energy resulting in the shattering or blowing apart of the object into multiple fragments each with an independent formal identity. They return to a kind of primal material state. If watched in extreme slow motion, as in the video presented in Figure 5, after the initial burst we witness a very fast fragmentation which does not compromise the form of the object and then a much slower dispersion which leads to a complete disaggregation of the object into thousands of fragments that completely lose their immediate relation to the form of the initial object. This is a definitive disintegration process.

3.2 Exploded-view drawing

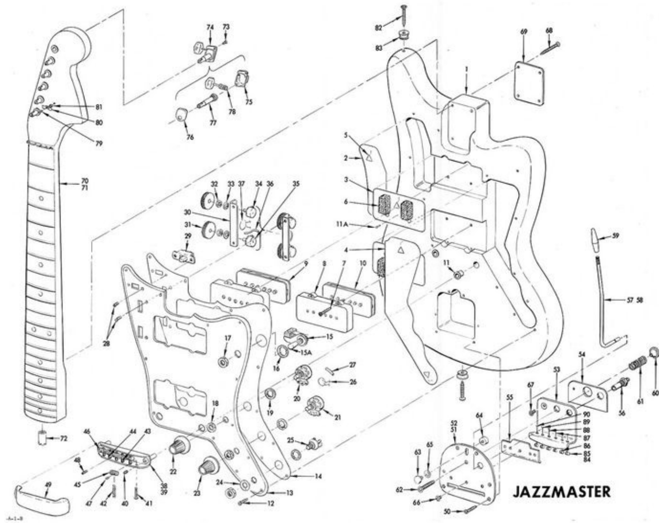

Figure 6: Exploded view diagram of a Jazzmaster electric guitar

The term "Exploded View Drawing" emerged in the 1940s, and was later defined as a "three-dimensional (isometric) illustration that shows the mating relationships of parts, subassemblies, and higher assemblies. May also show the sequence of assembling or disassembling the detail parts."[12] It is an isometric perspective diagram which shows the components of an object slightly separated by distance. An object is represented as if there had been a small controlled explosion emanating from its middle, causing the object's parts to be separated an equal distance away from their original locations. It is constructed in such a way that the explosion of the parts follows an “on axis” movement (x,y,z) so that the collapsing of the object is easy to preview. It is a reversible method. The action of “exploding” an object in a diagram, separating its constitutive parts, and consequently spreading them on a certain area is an effective gesture of formal analysis but at the same time it is a formal process of disintegration of the object. Its primary form vanishes and its dismembered body

[12] Thomas F. Walton (1965). Technical Data Requirements for Systems Engineering and Support. Prentice-Hall. p.170

is now occupying a larger portion of space: a zero gravity space. The object somehow loses its place and floats.

Figure 7: “Cosmic Thing” Installation by Damian Ortega 2002
(ICA_Boston 2009).

In this 2002 sculptural installation by Damian Ortega, a 1:1 scale Volkswagen Beetle is disassembled and presented as a four-dimensional exploded-view diagram. In this case the effort to transform a drawing protocol into a real presentation of the built parts introduces the experience of time and weight into the diagrammatic process. The “people´s car” that once enclosed a common (almost universal) private space (Nicolau 2006) is dissolving in space, losing its integrity. The audience witnesses a moment of suspension of this movement that corresponds to a diagrammatic representation of the car and may walk within these new spaces between the fragments. There is a “visual explosion” that contradicts the gravity force to which the parts are naturally subjected to. The car cannot escape its sculptural presence, and hence establishes new relations with the surrounding: notions of interior and exterior, up and down, become dubious. It is as if the object is starting to disappear, to lose its identity. This is a powerful spatial situation, making visible the trajectory between the micro and the macro; the title (Cosmic Thing) expands on this. If one imagines the final consequence of this type of explosion it would be the loss of a geometrical relation between the parts and a puzzle to solve: the initial formal identity of the object is gone and is now “hidden”.

Figure 8: Distributed and aligned parts of a car

3.3 Fragmentation and dispersion

Fragmentation and Dispersion are formal consequences of an explosion. The previous different readings of the metaphor open up two different possibilities for addressing the “explosion” spatial image. In the first case a violent mechanical explosion takes place, fragmenting the object into much smaller and multiform pieces, while in the second case the explosion is controlled and analytical, keeping the parts´ integrity. The former proposes a violent, unpredictable and definitive action while the latter proposes a controlled, projected and reversible action. These observations on each of the "explosion types" were relevant to the development of the formal strategies applied to the design and performance of the electroacoustic system and the vocabulary developed with it, as each have different spatial and temporal implications.

During the research I approached the mechanical-explosion image in an installation work. "Parts and Duration: 333 parts and 37 seconds for solo cello" [13] was an installation which followed the interpretation of a text score:

> Parts and Duration:
> solo to be performed by anyone with any instrument
>
> Place the instrument horizontally. Distribute several contact microphones on its body and, while recording all the signals separately, crush it as slowly as possible with maximum pressure, at a steady speed. Arrange all the pieces in groups In a disciplined way. Diffuse the recorded audio tracks in independent speakers.

This score proposes a very clear sequence of systematic actions, with very unpredictable formal outcomes. The limited pressure usually applied by a player to its instrument is hyperbolised, compromising the physical integrity of the instrument, and the action is centred on the preparation of a clinical audition of a highly unpredictable fragmentation act followed by the organised dispersion of the resulting parts.

PARTS & DURATION

Video of recording process and installation images.

Files also accessible in USB pen drive in folder: CHAPTER I / PARTS & DURATION

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[13] Presented at Vera Cortês Art Agency, Lisbon (2016)

Figure 9: Recording process for Parts and Duration

Figure 10: Cello fragment

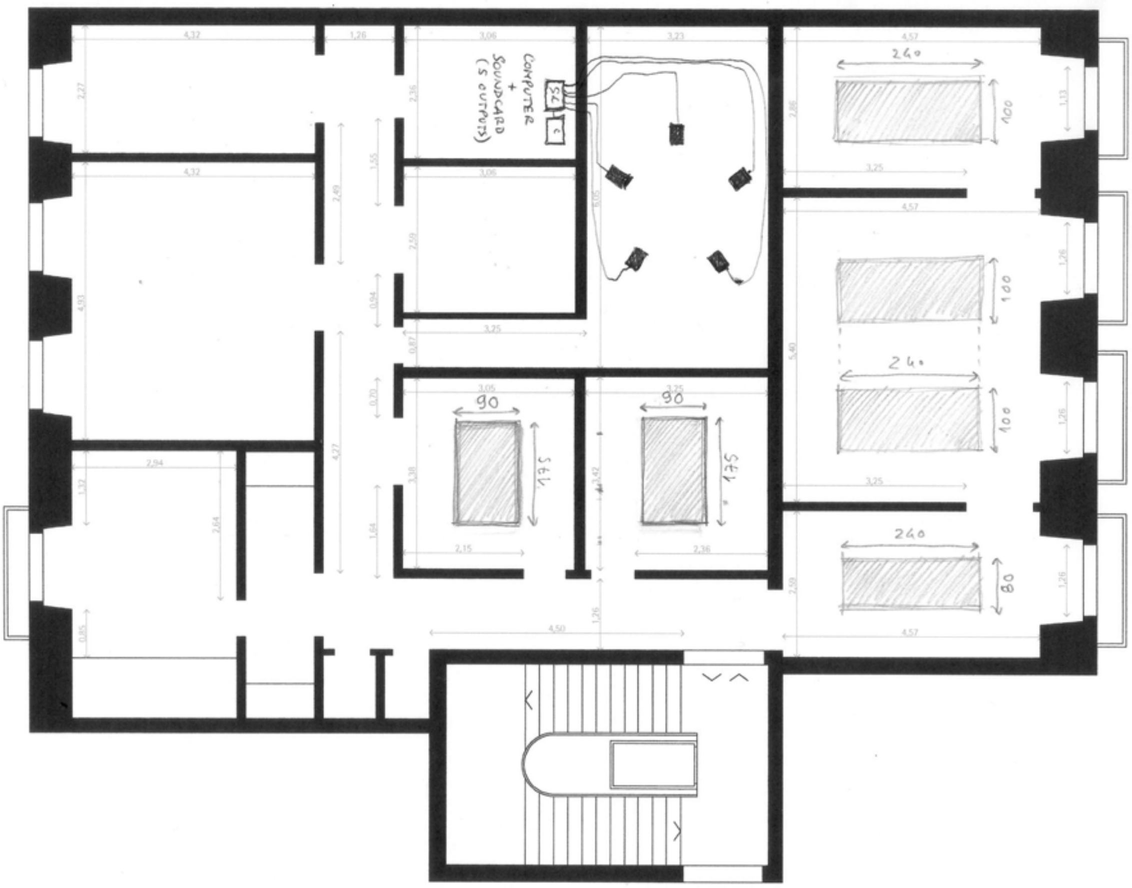

Figure 11: Installation plan

Figure 12: Installation view (tables 1 to 4)

Figure 13: Installation view (Table 6)

Figure 14: Installation view (speakers´ room)

This installation [14] was structured along the sequence of events following a mechanical explosion: a performative moment of fragmentation where the object's initial form is still recognisable, although the body is already shattered

[14] **Parts and Duration**: **333 parts and 37 seconds for solo cello**. Installation at Vera Cortês Art Gallery, Lisbon 2014

into pieces, and a dispersion period where the fragments lose their relation to the initial totality. The latter is durational and the object's initial form is unrecognisable, giving place to independent fragments with independent formal identities. The instrument's fragments are distributed on a grid structure occupying a much wider portion of space than the discrete object would, and the dramatic sound of its slow fragmentation creates a repeated soundmark on the exhibition space. The object loses its formal integrity, becoming unrecognisable in both design and sound, but at the same its constituent parts and interior are exposed in detail.

Contrasting with this approach, the "exploded-view diagram" reading of the metaphor (with its reversible structure) was the image that structured the development of the Exploded Cello system -- a system supported by an electroacoustic device that would allow me to play the destruction and reconstruction of the cello's sonic image. This reversibility was fundamental to play the movement from interior to exterior, and to play and improvise with distance. I play with the fragmentation of my gestures on the instrument and their dispersion in space and time.

4. The "exploded cello" metaphor as the system´s model

My first hypothesis for the translation of the exploded cello metaphor into a conceptual model to approach site-specific improvisation aimed for the development of a hybrid format of presentation: concert-installation. The hypothesis established the following articulations:

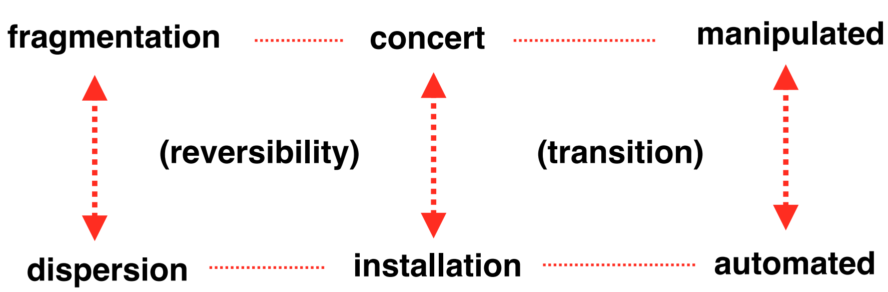

Table 1: Articulations between concert and installation

Fragmentation is the stage of the explosion sequence which relates to a concert ritual, and dispersion is related to an installation event. The concert implies manipulated processes and the installation relies on automated processes. The transition between the two should be inspired by the reversibility of the exploded-view drawing. This relational hypothesis was based on the analysis of certain identified characteristics of both presentation modes and the type of engagement that audiences have with them, especially concerning listening modes. The concert period would be here seen as a ritual preparing the body of the instrument to become part of (dispersed into) the surrounding space in an installation mode. Neither presentation mode has a fixed, definitive set of behaviour rules, either on the part of the audience or the performer. We can say they are bound by an expectation, a certain ritualised experience in which the audience agrees to participate.

My solo improvisations tend to happen in relatively short timescales (around 45 minutes). They are intense performative moments and both myself (i.e. player) and the audience are focused on the unfolding process of live improvisation. Player and audience are usually located in a fixed position in space, listening at a certain distance, and the central visual and sonic focus is the performer and the instrument.

In a solo concert, the whole event develops around the actions of an individual and the way they model time and space through sound. The audience usually sits still and listens attentively to the music–contemplating the live unfolding of events. A sound installation may invite the audience to indulge in a drift through space, without a predetermined spatial or even temporal sequence, and without a single focus point. In this case the audience is also responsible for the duration of the experience. This means that playing or listening to a solo concert or experiencing an installation aim for different timescales and consequently different listening modes.

By expanding concerts into installations, I intend to shift the audience’s engagement with the solo concert apparatus and create the conditions for an alteration of their relationship with the expected spatial and temporal framing of the intervention.

To do this required the development of an electroacoustic device to support this hybrid approach of concert-installation, integrating the earlier mentioned multi-microphone setup, dedicated software to manage the signal flow and a multiple-output setup mostly dedicated to integrating the transformation from concert to installation. I will address the main conceptual orientations and strategies (i.e. digital signal processing and setup) for the development of the electroacoustic device, according to each process (fragmentation and dispersion), the associated presentation format (concert, installation) and the activation process (manipulated or automated).

4.1. Fragmentation: concert and manipulated activation

The solo concert mainly addresses the system's performance in terms of fragmentation of my gestures on the cello. My solo performance concentrates on manipulating the perceptual fragmentation of these actions and focusing on the exploration of instrument's hidden, interior resonances. As previously mentioned I would use multiple contact microphones to have a discrete sonic amplification of different parts of the cello's body. This sound-mapping of the instrument creates an augmented sonic perception of the instrument. Several parts of the cello are amplified with equal detail and the performance of the instrument loses its expected acoustic balance.

A key influence for this research was Mark Dresser´s (Dresser 2010) approach to the amplification system for the double bass and his thorough mapping of the bi-tones and natural harmonics. His research also included the development of a personal musical vocabulary (which articulates jazz, classical and extended techniques) that owes significantly to the technological alteration of his instrument:

> Bi-tone and double bi-tone technique is naturally soft and of a limited acoustic projection capability. This limitation led me to consider unorthodox amplification methods. Since 1983 I've

> been using different electromagnetic pick-up designs originally inspired by guitarist/composer Tom North. The one I've been using since 2002 is designed by luthier, engineer and bassist Kent McLagen. He made two sets of hand wound electromagnet pickups one under each string that he imbedded into the fingerboard. One set of 4 is located between the nut and the first half-step, the other set is embedded a minor sixth up the neck. Both are wired into a two channel pre-amp made by Jim Hemingway and controlled by a volume pedal into a Walter Woods stereo amplifier and Epifani speakers. I use volume pedals for both the McLagen system and the Realist bridge pick-up as a way to play with the mix in performance. (Dresser 2010)

In “Guts” (2010) his methodology and techniques are thoroughly presented and in the solo album “Unveil” (Clean Feed, 2005) his vocabulary is used in a masterful way, showing the full potential of his amplification system. The use of contact microphones is not new in solo bass improvised music (cf. Fernando Grillo in the '70s and Joelle Leandre's work from the '80s onward) [15] but Dresser's vocabulary seems to expand the investigations into tighter rhythmic structures, more microcosmic and much more aware of the way his system accentuates the overtone material and how this influences the overall direction of the improvisations.

Figure 15: Dresser demonstrating his prepared double bass. (Guts 2010)

[15] https://www.allaboutjazz.com/herb-robertson-elaboration-and-mark-dresser-unveil-by-clifford-allen.php

This sonic enhancement and multifocal sonic mapping of the instrument has a visual reference in the technological device used to both capture and project the images in David Hockney's 2010 video installation "The Four Seasons".[16]

Figure 16: The nine camera rig

Figure 17: Hockney monitoring the images from the nine cameras

"The Four Seasons" is an immersive video installation with four large panels, each with nine high-definition video screens. A car rigged with nine video cameras, all set at slightly different zooms and angles, was driven slowly through the Woldgate landscape, capturing the sequence in each of the four seasons. These sequences were displayed simultaneously on panels placed around a room. There is an similarity between the Exploded Cello sonic solution and the visual strategies that David Hockney has used since the '70s in his

[16] Woldgate Woods (Spring 2011, Summer 2010, Autumn 2010, Winter 2010)" , 2010 // 36 digital videos synchronized and presented on 36 monitors // Duration: 4:21
https://www.vqronline.org/articles/david-hockneys-timescapes

photographic collages, which are the basis of this videographic project. Both strategies have a naturalistic expression in the representation of the chosen objects or spaces, as they aim for a thorough exercise of observation, but they are both slightly disruptive in the articulation of the parts when reconstructing the represented object.

> “(…) Having nine separate perspectives forces the eye to scan, and it is impossible to see everything at once. This seems to make the outside edge less important, almost taking it away.”
>
> (Hockney 2012)

This strategy introduces a very intense visual vibration between the whole and the parts. Snapshot prints are arranged in a grid formation, pushing the two-dimensionality of photography to the limit, fragmenting the monocular vision of the camera and activating the viewer in the process. In the case of “The Four Seasons”, this strategy is augmented by the introduction of time and movement.

Figure 18: David Hockney, “Ian washing his hair” (1983)

Both references informed each other in the development of the fragmentation strategies for the Exploded Cello system, as the approach to sound and vision is seen as absolutely complementary in the construction of the Exploded Cello performative period: the concert. Both the intensified (i.e. close up) and multiple-pickup amplification of Dresser´s system and Hockney´s fragmentation of the monocular vision into a slightly different multi-perspective observation of an object deeply influenced the idea of sonically diving into various points of the the cello's body and broadcasting it using short delays and panned diffusion of the sound of each microphone. The objective of extending my musical vocabulary to include all the new micro-sounds that result from my performance on the instrument was as relevant to the fragmentation experience, seeing as the actions on the cello are not synchronised with the diffused sounds. The concert period would be concentrated on listening into the cello's body through extreme and multiple amplification and starting to play its sonic disintegration. The fragmentation strategies include spectral, spatial and temporal changes:

- Spectral: four microphones placed in different resonant points of the cello resulting in different outputs with different timbral qualities.
- Spatial: slight disembodiment of the sound output due to minor panning differences for each output in a stereo projection placed in the back and close to the cello
- Temporal: very short latencies associated with the projection of the four microphones.

4.1.1. Four signal pan delay

Fragmentation has an associated digital signal processing (DSP) which controls linear variations between a minimum and maximum delay times and panning positions for each of the four contact microphones. This is coupled with a particular diffusion hardware setup configuration: a full range stereo public address system (PA) placed behind me.

Gesture and sound are synchronized in time and located at the source (centered cello position) while each microphone signal is diffused with a unique short delay and slightly dislocated from the cello's position in the stereo image. Besides the extreme perceptual proximity to the body of the instrument that this amplification allows, the DSP includes slight different latencies (delayed output signal) to each of the four microphone signals and slight differences in panning position in a stereo PA, thus introducing a slight "out of sync" experience when seeing the Exploded Cello played live. This part of the electroacoustic device (corresponding to the fragmentation process) allows a diffuse temporal and spatial image of any gesture that I perform on the instrument, as result of a very short and small temporal asynchrony in articulation with a spatial asymmetry of the projected sound. This initial part of the explosion narrative happens in a situation of maximum focus on the cello's micro-territory (concert). This fragmentation process associated with a fixed focus on the player and the instrument was tested within several solo concerts where I performed with just this part of the system operating.

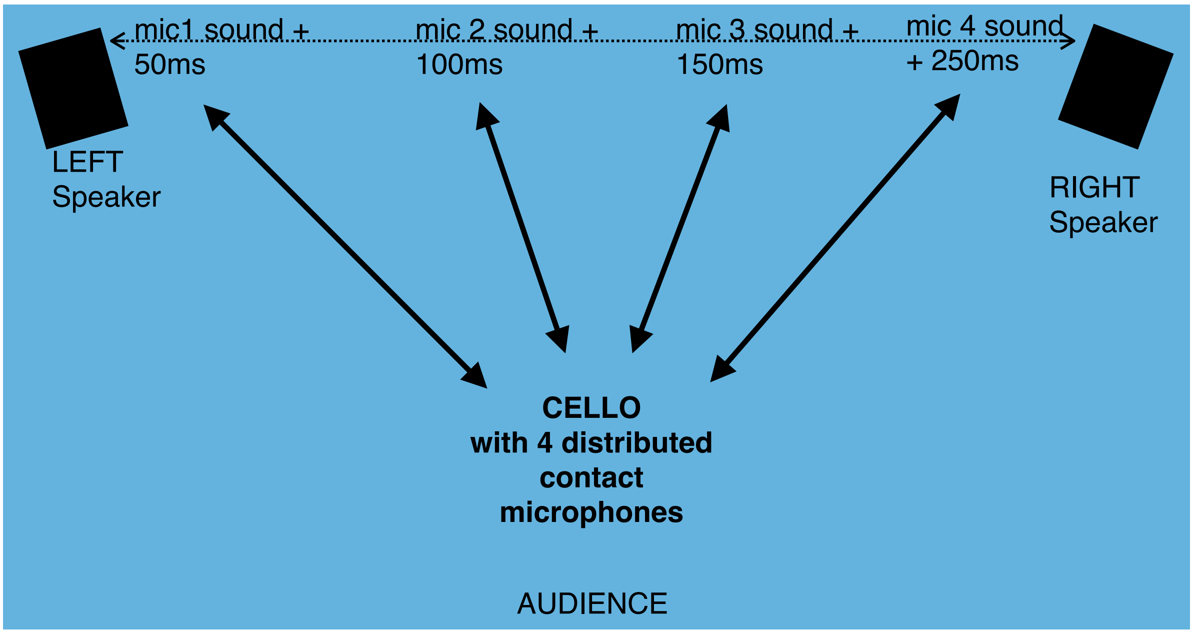

figure 19: Diagram of cello´s microphone distribution in the stereo PA.

4.2. Dispersion: Installation and automated activation

This period is seen as the explosion's second phase (dispersion) and is therefore structured and developed around spatial, temporal and spectral strategies of dispersion. These include the unpredictable and fragmentary distribution of micro-samples from the concert in space and time (granulation process), using external objects as resonators. The spectral transformation of the instrument's sound was central to the idea of using other external resonating bodies.

As mentioned, the installation's timescale and audience listening mode is different from that of the concert, in the sense that the fruition period is larger and it does not have a single focus point in space (i.e. cello). The installation period includes fragments from the solo improvisation distributed in the intermediary resonant architectural objects surrounding the instrument.

In the Exploded Cello the sound projection depends on a multi-channel spatialisation system which is fully active during this period. Adding to the membrane-speaker stereo PA, a group of vibrational transducers (contact speakers) are coupled to resonant objects, selected (or designed) and specifically installed to activate new relations between the cello, its sounds and the surrounding architecture and environment.

The external objects configure an intermediary architectural gesture between the cello and the specific surrounding spatial morphology. This gesture is foremost a resonant architectural extension of the cello, which proposes a spatialisation device that takes the spectral character of the resonators, their design and spatial interaction with the specific site as central aspects of the dispersion of the exploded cello fragments (i.e. sounds). The vibrational transducers are coupled to these objects and both the randomly automated diffusion of recorded sound fragments plus a direct input of the cello's amplified sound are projected using their resonant surfaces. In the installation period the cello loses its spatial and symbolic centrality in favour of this wider dispersion of the sounds and the spatial occupation of these other intermediary objects/ architectures.

What is the basis for the selection or design of these specific resonant objects/architectures? The Exploded Cello has, in its core structure, a temporal and spatial shift from concert to installation. This shift is central to the overall installation design of the Exploded Cello´s interventions. There is a constant in each intervention, which is the placement of the cello with the stereo conventional loudspeaker PA symmetrically positioned behind it, all facing a possible audience area. This configuration is a recognisable setup in the current Exploded Cello system´s device. On the other hand, the intermediary objects are given a specific configuration in each site. Therefore the dispersed extension of the cello has two primary installation strategies: the selection of local object(s) or the creation of specifically designed object(s). Once selected, these objects/structures are placed in ways that intensify the dispersion experience of the sounds in each specific site. A central relevance is given to the way the form and placement of these resonant objects in space, affect or alter the architectural spatial flow (architectural promenade) proposing new ways for the audience to engage with the surrounding spatial morphology.

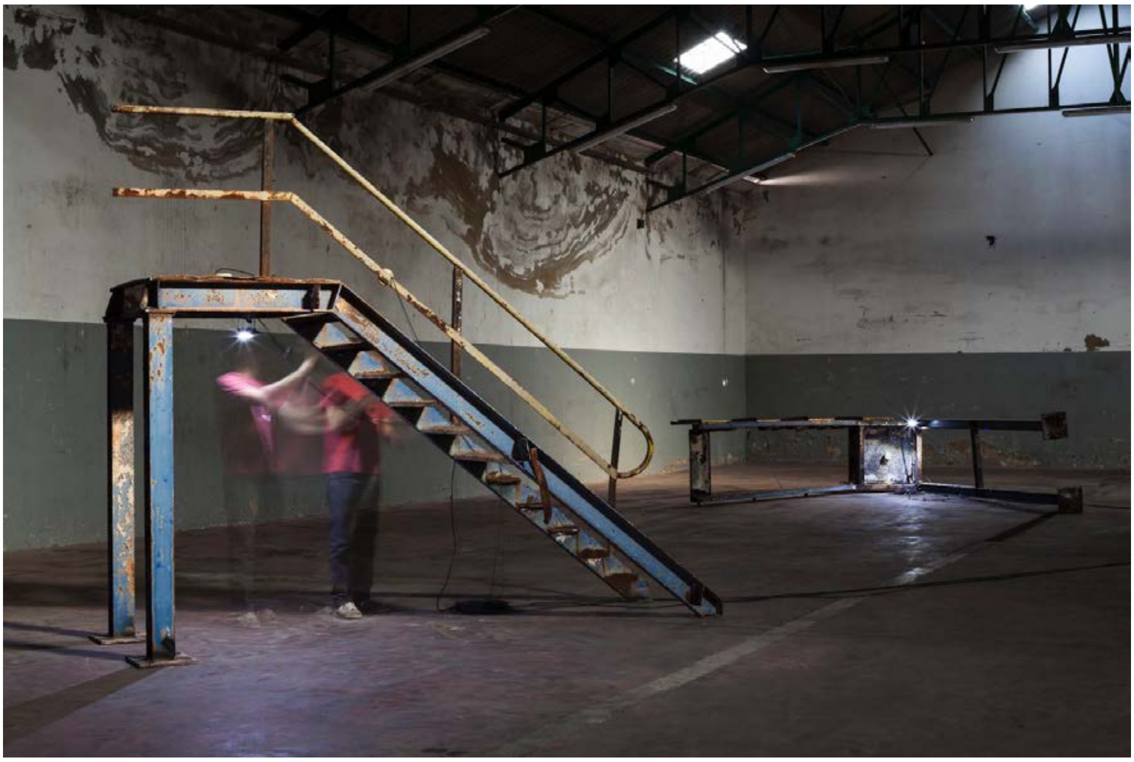

Figure 20: Selected objects for “Explodido” (2014)

Figure 21: Designed objects for “Segmentos” (2014)

These intermediary resonant architectures/objects, when embodying the sound of the cello, will increase the experience of detachment and reinforce its dispersion in new occupations of the surrounding. In this case the piece “Rainforest” by David Tudor was a main reference, and participation in one reinterpretation of “Rainforest IV” heavily influenced the initial process of the research project.[17]

Figure 22: Installation view of “Rainforest IV” (2014)

In “Rainforest”, David Tudor´s instructions do not oblige the performer/sculptor to engage in any specific formal or conceptual dialogue with the surroundings when choosing the objects, nor with the source of the sounds. The selected objects or designed sculptures result from a set of instructions:

> Each composer designs and constructs a set of sculptures which function as instrumental loudspeakers under their control, and each independently produces sound material to display their sculpture’s resonant characteristics. The appreciation of Rainforest IV depends upon individual exploration, and the audience is invited to move freely among the sculptures. [18]

Its interpretation is centred in the creation of electronic sounds that “display their sculpture´s resonant characteristics”, and not in the way these sounds, when occupying the resonant character of the objects, establish a specific spatial and contextualised relation with the surrounding space. This was a perspective that I came to find increasingly interesting in this project, although it was not a

---

[17] See Appendix 2: Information on Serralves “Rainforest IV” version

[18] http://composers-inside-electronics.net/rainforest/rainforest/INTRO.html

question for Tudor. Through the electroacoustic device that was being presented as part of the Rainforest installation the selection of the resonant objects and their distribution in space could easily and powerfully inquire the specific architectural nature of a site in its design and materiality.

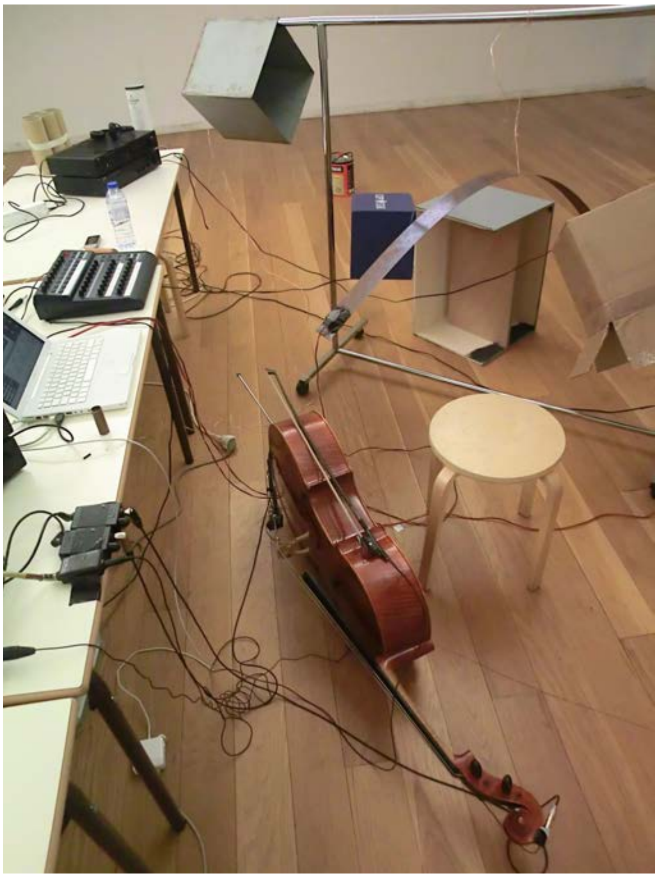

Figure 23: Testing resonant objects for Rainforest

The process for creating an installation-performance for Rainforest IV has in its basis the contact with the exciter-transducers technology, its operating mode and technical particularities and furthermore the choice of resonant objects.
This part of the process is of great relevance in the final installation both in sonic and visual terms. Following Tudor´s instructions and posthumous interpretation of the documentation available from earlier iterations one can find objects from several proveniences and it seems that the its choice is somewhat indifferent to the genealogy of the chosen objects or the sculptural relevance. The choice is mainly triggered by the resonant properties of the objects. As they are chosen from sites where they exist as leftovers or garbage usually there is

not much control of the type of objects to use and they tend to be light and body-size for easy transportation and suspension in space.
In the course of this process we recorded an Impulse-response for each of the selected Rainforest objects. This procedure, used by Matt Rogalsky in each iteration of the piece, was a way to minimize the technical impact (with the use of on piezo pickup for each object) that re-amping each resonant object would require. Re-amping was a procedure that was previewed (by Tudor himself) for live performances, with the help of “piezo pick-up” attached to the surface of the “object being transduced”.

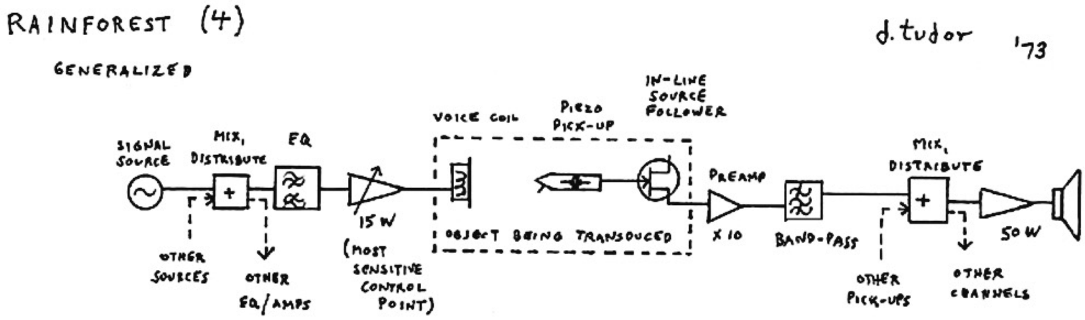

Figure 24: General signal flow schematics for Rainforest 4 / David Tudor, 1973

The impulse-response of each object was later used in the convolution of the input sounds from each performer. This process was very important for my research as I could build an initial vocabulary of resonant objects with contrasting designs and building materials that were later used to do several studio testing with the exploded cello system.

David Tudor´s performance-installation piece was also extremely relevant in the sense that it presented a type of listening narrative that depends on each audience member’s autonomy of movement. The resonance of the different objects’ surfaces induces the audience to try different proximities to them, almost on the verge of haptic listening (a type of listening which needs and invokes extreme proximity, touching and movement). The use of vibrational transducers on surfaces of metal, wood or glass transforms sound into a “palpable” manifestation, and this characteristic of “Rainforest” is sonically overwhelming (Driscoll and Rogalsky 2004). Similarly, the Exploding Cello installation setup gave the audience the possibility of experiencing the cello's sounds as they occupy different selected resonating objects.

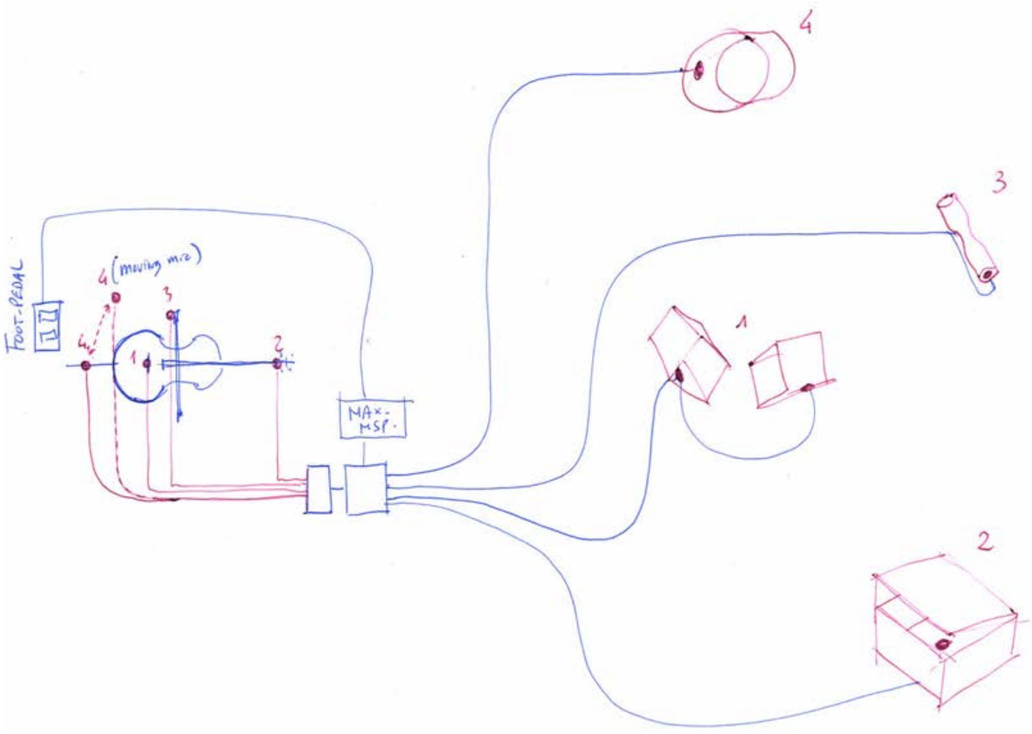

Figure 25: Sketch for the Exploded Cello setup for "Rainforest IV" (2014)

These references supported the development of the device's software to include a granulation automated module to support the installation period.

The spectral, temporal and spatial changes are maximal compared with the fragmentation strategies:

Spectral: use of vibrational transducers in external objects resulting in a direct filtering of the cello's sound colour

Spatial: distribution in multiple vibrational speakers adding to the previous fragmentation setup (PA and cello's vibrational transducers)

Temporal: out-of-time projection of recorded material of the improvisations using automated processes

4.2.1. Automated distributed granulation

Dispersion also has a fundamental associated DSP (Automated and distributed granulation) and a dedicated hardware setup configuration using multiple transducers in external and distributed resonant objects for sound diffusion (adding to the previous stereo PA).

As a reference to the musical/sonic output of this automated process compositional approach I would recall “Dot Piece”, a exercise from *Search and Reflect* by John Stevens.

> Using only clicks (the shortest sounds we can make) each individual in the group tries to locate a space (silence) in which to place their click (dot). Because of the group activity, the silences are minute and pass by rapidly, so by the time you have heard a space, and attempted to put a dot in it, that space may have vanished.
>
> Begin from the group's silence. The aim is to find a space (silence) in which to place your dot (click). The first person to get in with a dot has succeeded in using the first available silence. From then on everyone is seeking an available gap in which to place their dot. This produces a particularly colourful and dynamic interaction.
>
> It is as if there was a blank canvas which you must try to cover with small dots (as with an abstract pointillist painting), while the rest of the group are rapidly filling up the canvas by trying to do the same thing. The music, unlike a canvas, is dynamic and constantly changes as the clicks move past. A closer analogy could be a group of people standing on a bridge above a river, trying to cover the surface of the moving water by catapulting paper darts onto it.

Figure 26: “Dot Piece” from *Search and Reflect* - by John Stevens (1985),

The sonic result aims for the image of a river’s moving water where paper darts are falling and covering it, and this results from a dispersed agency of each member of the group to only make a sound when there is silence. This simple instruction results in perpetual change with minimum use of sonic material. This improvisation strategy informed the development of automated DSP to manage the sonic outcome of the installation/dispersion period. This process would take an ever-changing form: a “flow of sonic debris”, an image of continuous dispersion. The unpredictable nature of this dispersion is due to a random automation of several parameters of the electroacoustic device’s dedicated software.

4.3. Extensions: other Exploded Cello vocabulary developments

In the course of the research other formal processes appeared as extensions of these main fragmentation and dispersion processes and their dedicated hardware and software setup. The development of this vocabulary was a direct consequence of the electroacoustic device's development (hardware and software) and they added fundamental processes to the overall vocabulary. These three fundamental extensions remained part of the Exploded Cello vocabulary.

4.3.1. Direct resonance in external objects

This process arises from the dispersion spectral strategies, although it operates only during the concert and usually in a transition period.

Some of the resonant objects used in the iterations had extremely rich resonant properties (e.g. cymbals or light metal structures). The direct input of the sound of the cello in these type of objects was also developed and added to the Exploded Cello vocabulary.

Figure 27: Studio test using a resonating light metal structure (2018)

Figure 28: Setup for the ensemble concert “Harmonies” (2017)

A particular piece which informed this manipulated dispersion approach was Alvin Lucier´s “Music for Cello with One or More Amplified Vases” (1992). The continuous glissandi, from the lowest to the highest pitch in the cello, activates at various times the resonances of each vase. The movement of the listening focus from the cello to the vase materializes the displacement of the cello’s sound into another space (the micro-space of the vase’s interior).

As in this piece, each of the selected resonant bodies for the Exploded Cello have particular modes of resonance and spectral qualities that influence the player’s performance when used as cello extensions. These external resonating objects are also new spaces incorporating the cello’s sounds and thus intensifying the experience of transfiguration of the cello, of its dissolution in the surroundings.

4.3.2. Internal Feedback

This was a formal process which appeared as an extension of the idea of mapping the resonances in the instrument's body, looking at it as a micro-territory along which I would move when playing.
The multi-microphone system was already listening to different zones of the instrument, but what if I could use this setup to modulate the feedback ringing frequency when coupling a vibrational transducer to its body?

When a system allows a direct audio feedback loop (|: microphone - amplifier - speaker :|) the exponential rise in the ringing frequency takes the system to an uncontrolled amount of acoustic energy; If no change occurs in one of the system's components then the system becomes saturated. Audio feedback is the expression of a system out of control. In "The Self-Resonating Feedback Cello" (Eldridge and Kiefer 2017) state that in these types of expansions to acoustic musical instruments "the performer's relationship with the instrument is evolving to become one of negotiation, rather than control". Therefore introducing the fast-growing acoustic feedback in the vocabulary led me to develop its articulation with the electroacoustic device and include it in the final output of the research.

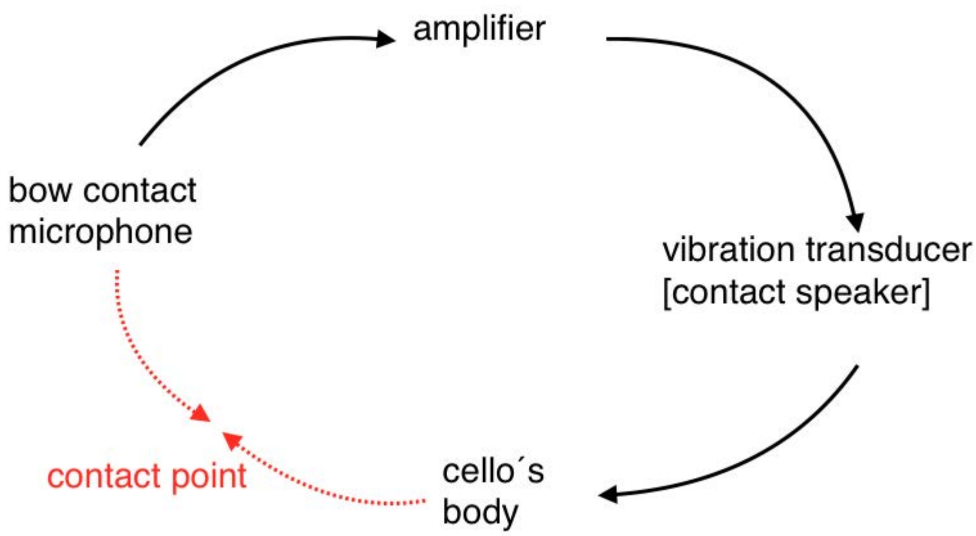

Figure 29: Signal-flow diagram for Internal Feedback

To achieve this I placed two vibrational transducers (output channels), in the top and back plate of the cello to close the internal feedback with the contact microphones. After several tests the direct manipulation of the cello's internal feedback loop uses only the bow microphone due to the direct gestural control of the ringing frequency. Using the bow as a microphone, I could search for different feedback points along the instrument's body.

4.3.3. Feedback Network

The feedback vocabulary extended also to the installation period (i.e. dispersion vocabulary) in experiments with self-regulating feedback systems. These were extremely expressive in the construction of a dispersed, fluid sonic impression due to its ever-changing and organic sonic pattern design.

Self-regulating feedback systems were themes that intersected with and emerged in my research first and foremost by the work of both my supervisors (Pedro Rebelo´s project "Disturbance" [2012] and Simon Waters´s project "VPFI flute" [2007]) and then from my contact with the works of Nic Collins and Agostino di Scipio. The final approach to feedback in the Exploded Cello system dovetailed in a very simple way with the previous system's components and introduced new particularities to the system's performativity.

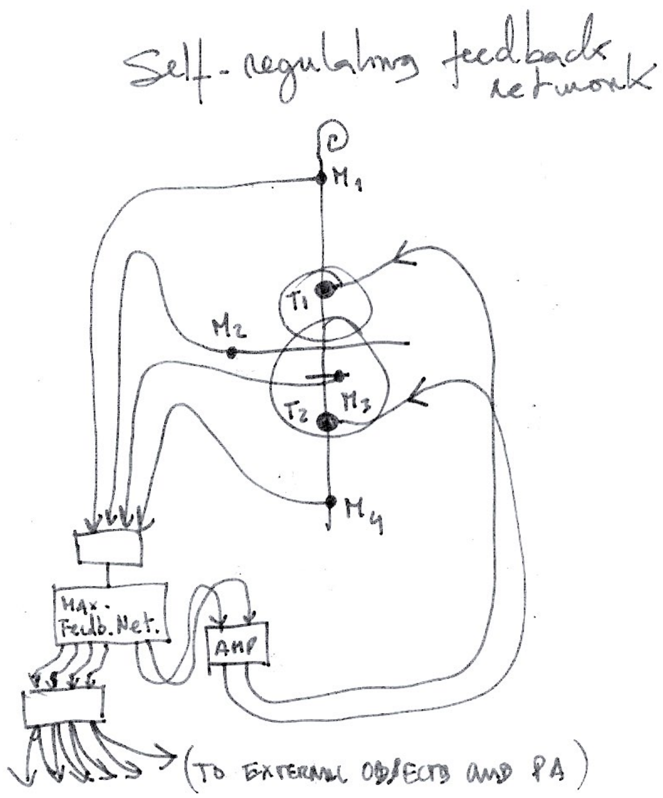

Figure 30: Signal-flow diagram for feedback network

The different distances between the the four distributed pickups and the two vibrational transducers was an operative way to modulate the resulting feedback resonant frequencies.

5. Playing the model

By now we have a series of formal processes corresponding to the explosion's consequences (fragmentation and dispersion) to which we can relate a group of strategies:

	CONCERT	INSTALLATION
explosion narrative	**FRAGMENTATION**	**DISPERSION**
formal processes	**Four signal pan-delay**	**Distributed Granulation**
Extensions: processes	**internal feedback**	**direct resonance in external objects** **feedback network**
strategies	_PRESENCE OF IMPROVISOR IN DIRECT CONTROL _CENTRAL OBJECT IS THE **CELLO** _SHORTER TIMESCALE = FASTER TRANSFORMATIONS _SHORT AND LIMITED TEMPORAL AND SPATIAL DISPERSION _INTERNAL SPECTRAL TRANSFORMATION _LIMITED FRAGMENTATION OF SONIC MATERIAL _AUDIENCE IN FIXED POSITION _Relation to the site: there is still a clear differentiation. One and the other. Environment is otherness. More centrality.	includes COMPUTER AUTOMATED AND INDETERMINATE PROCESSES cello loses centrality to the intermediary designed or selected objects/architectures. LARGER TIMESCALE = SLOWER TRANSFORMATIONS = INCREASE DEGRADATION / SENSE OF FLOW _LARGE SPATIAL DISPERSION _EXTERNAL SPECTRAL TRANSFORMATION AND DISPERSION _INCREASE FRAGMENTATION OF SONIC MATERIAL _SIGNAL DEGRADATION AUDIENCE DRIFTING IN SPACE Relation to the site: The sound occupies parts of the site. There is more dispersion.

Table 2: Fragmentation and Dispersion processes and strategies

These processes and general strategies are presented here in discrete relation to the concert and installation periods but they are actually guidelines for the overall event where there is a transition between these two presentation modes. The transition from solo concert to installation is a fundamental precept of the project. The concert is supposed to be experienced as a ritual of transformation of the cello into the surroundings, following a change in the presentation mode: concert to installation.

Exploring the acoustic horizon; with an attentive and creative listening to the soundscape's sonic material, plus a dedicated approach to the acoustic properties of the venue; should play a significant role in the development of the improvisation and influence the transition to the installation period. Therefore, the analogies between the explosion narrative (fragmentation and dispersion), the sonic processes (plus their extensions) and the presentation modes (concert and installation) that structured the Exploded Cello system, were never to be used as an illustration of the metaphor's narrative: explosion (cause) followed by fragmentation and dispersion (consequences).

Improvisation should be inspired by the "exploded-view geometric reversibility" and therefore the vocabulary should be used along with an attentive listening to the resonant character of the concert-installation arena and the content of the soundscape. Going back to the listening drift diagram[19], the Exploded Cello vocabulary is to be used in a way that this drift between the micro- and macro-territories (the two edges of the acoustic horizon) continues to operate as the conceptual structure of the improvisation.

These processes represent the structural vocabulary basis for the solo improvisation within the Exploded Cello system and, following the reversibility property of the exploded-view diagram, they could be articulated in four different ways: linear sequence, retrograde sequence, alternate sequence or juxtaposition. What triggers their selection is a similar process to the listening-focus movements between the cello's body and the acoustic horizon, and it depends on the specific conditions that the system creates in every specific location where it is played.

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[19] Refer to Figure 4 on page 32

Therefore the transitions between concert and installation modes, or fragmentation and dispersion, may happen with different velocities and their sequence could be non-linear according to the explosion metaphor; playing this metaphor should imply the freedom of articulating the processes in different ways. Improvising with the Exploded Cello system is an exercise similar to the objective of an exploded-view diagram: an implicit movement between explosion and collapse, assembly and disassembly. These processes are also part of larger macro-structural cycles of concert and installation and their use follows the specific ecosystemic relations of the iteration: interpretation of the site's resonant and sonic properties. When the transition from concert to installation is done, besides the change in the audience's mode of spatial approach (fixed position to moving), there is a shift in the timescale of the event which influences the way the improvisation develops within the transition period and triggers the changes in the electroacoustic system's behaviour. These characteristics inform the system's electroacoustic device (hardware and software), which structures in a different yet complementary way the dynamic relation of myself and the audience within the event and the specific location.

In five of the six iterations of the Exploded Cello concert-installations presented in the portfolio, the temporal macrostructure includes an initial concert period which "activates" a longer-term installation.

Table 3: Simple temporal macro structure

Nonetheless, just as the selected sonic processes could be used in different sequences and articulations, an expanded approach to the piece's macrostructure could include the transition back from installation to concert.

CONCERT → **INSTALLATION** → **CONCERT** → **INSTALLATION** - - - →

one day →

Table 4: Expanded temporal macro structure

This macrostructure of several cycles of concert and installation proved to be a powerful tool to structure the intervention, as it engages both the audience and myself with the space and the setup in different ways during its development. The initial concert to installation period would present a first contact with the surrounding space in its two listening models: still and moving. The possibility to "replay" these procedures adds more perspectives to the overall setup and the vocabulary being used.

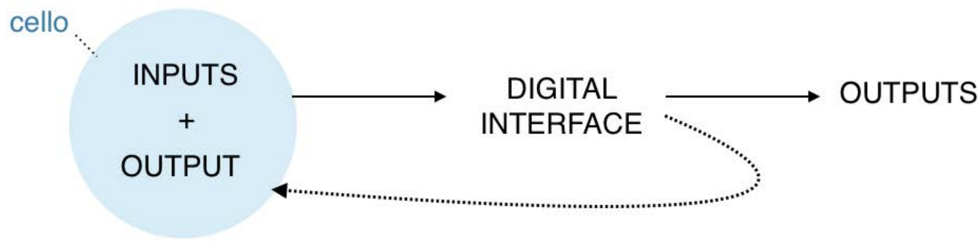
In the final chapter a thorough description of the last concert-installation, MEDUSA, gives more detailed information on this type of macrostructure and its development (pg.171). Differences in vocabulary and approach to the installation setup testify the relevance of this macrostructural approach.

Chapter II - Electroacoustic Device

This chapter is dedicated to the description of the fundamental components of the electroacoustic device designed specifically as an extension of the cello to perform the conceptual model described in Chapter I. This electroacoustic device appropriates the design and vocabulary of a pre-existing musical acoustic instrument with a two-century history: the cello. It follows the increasing research interest during the 20th century in the electroacoustic expansion of acoustic instruments, thus testing the expansion of the instruments' musical vocabulary through spatial projection (Harley, Maria Anne 1994), and developments in micro sonic amplification of acoustic manifestations. These electroacoustic instruments propose new relations between the player, the audience and the presentation space. This research follows the lineage of these developments, focusing mainly on the threshold between free improvisation and sound art. It proposes an electroacoustic extension of the cello ~~designed~~ to perform the it´s metaphorical explosion. Therefore, this device is the basis of the development of a specific performative (concert) and installation vocabulary. During the research this tool went through several changes and adaptations but kept its fundamental structure and behaviors. In this chapter I will describe the final version of the device, with references to some of its developmental stages.

1. Structure description

The device is structured around the relationship between a group of inputs (contact microphones on cello), outputs (speakers: vibrational transducers on cello and exterior objects and conventional stereo loudspeakers) and a digital interface (running max-msp software) following this macro-structure of signal flow:



Figures 31: Diagram for device´s structural components

It has two modes of behaviour (manipulated and automated) and two modes of relation with the audience (concert and installation). This is the technological basis for the approach to each specific site of presentation. The Exploded Cello's electroacoustic device depends on an intrinsic relation between its hardware and software which is uniquely calibrated for each specific installation setup, in response to the particular architectural (aural, haptic and visual) environment.

The current version of the electroacoustic device is based on a group of four contact microphones distributed on a cello's body. The incoming signals from the four microphones are digitally processed in the Max environment [20]. The software programme manages both directly manipulated (Internal Feedback, Direct resonance in external objects, Four signal pan-delay) and automated digital signal processes (Feedback Network, Distributed Granulation). The software's manipulation is achieved during performance with the use of a foot pedal (four buttons and one expression pedal). The sound card's eight outputs are then connected to a multi-speaker setup which includes a full-range stereo membrane speaker system with sub-woofers (two outputs) plus 10 vibrational transducers (contact speakers). Eight can be mounted in locally designed or selected resonant object(s) and the other two are mounted in the cello's body.

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[20] https://cycling74.com/

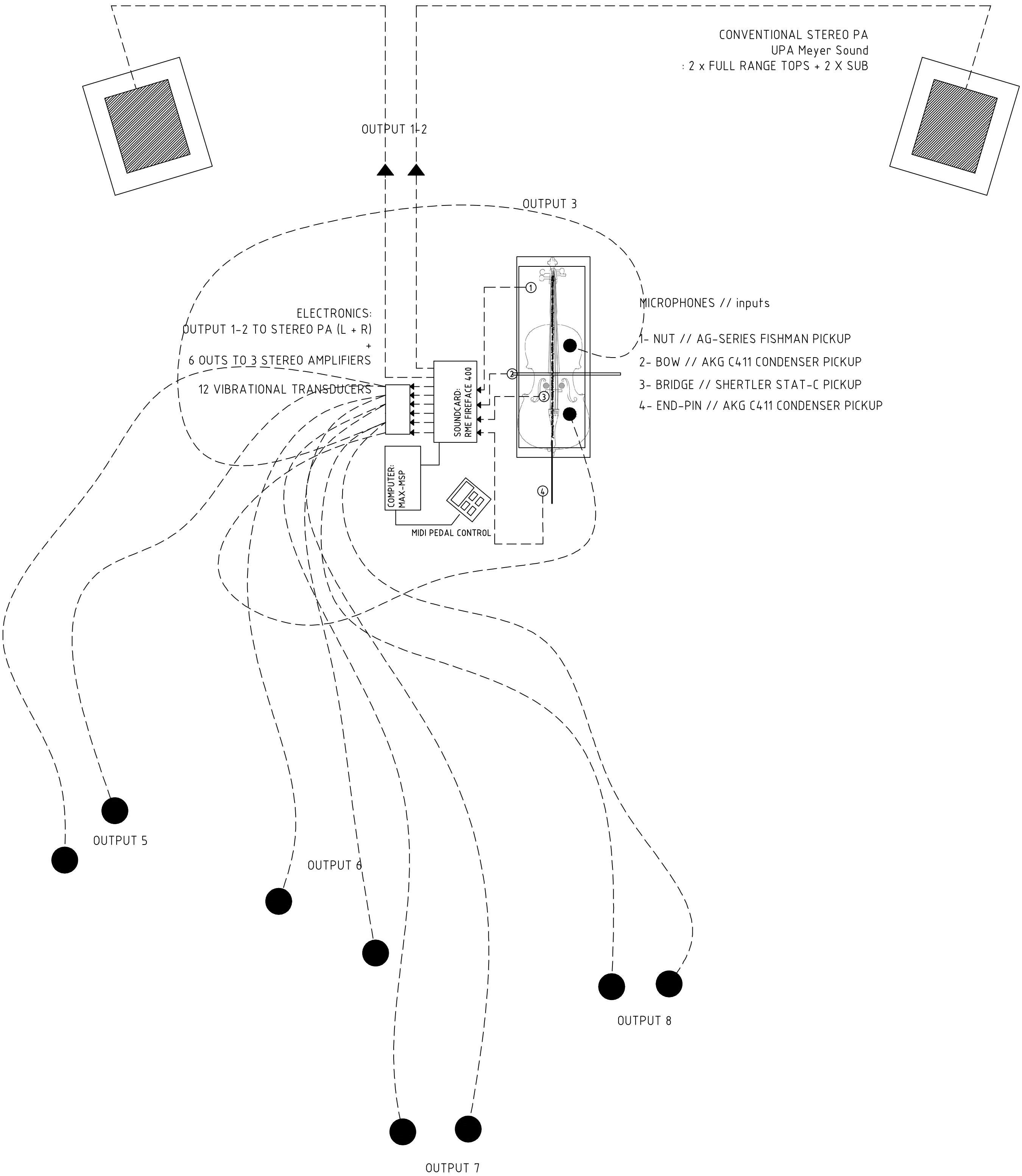

Figure 32: Device components plan

 

Figures 33 and 34: Photos of a live concert-installation at Serralves Museum, Porto (2017)

2. Inputs: contact microphones

The cello is an acoustic string instrument, and its “architecture” is based on a physical entity (combination of design and materials) that optimises the vibration of a set of four strings of different thicknesses, severely tensioned onto a resonant hollow body using a wooden bridge as the central vibration transmitter. The modern acoustic cello’s overall design has been stable since the beginning of the late 17th century when Antonio Stradivari (1644-1737) developed the cello size that we know today. The history of the cello[21] records that designs continued to evolve only minutely during the late 1800s and early 1900s. The most noticeable change was the endpin which, although not changing the acoustics, was included to establish a connection between the instrument and the ground making it easier to balance. The right amount of bow friction, plucking or percussion will easily and strongly resonate the cello’s top plate, inducing the resonance of the hollow body chamber which acoustically amplifies and projects the sound of the instrument (Henriques 2002). [22]

When in a “classical” concert hall, orchestral instruments such as violin, cello or upright bass are usually amplified with omnidirectional condenser microphones. These microphones are particularly effective at producing a natural sound as

[21] Vienna Symphonic Library // https://www.vsl.co.at/en/Cello/History

[22] Cello parts diagram can be viewed in the Appendix section.

they do not focus their attention on a particular area of the instrument, but capture a larger area that includes the bow, strings, F-holes and so on.

> During classical concerts, feedback is usually not a concern because the PA is only used for “sound reinforcement,” and sound pressure levels rarely exceed 90 dB. In concerts where a loud PA is needed, in order to avoid feedback and bleeding, the acoustic string instruments are commonly amplified using cardioid microphones at a relative short distance from the instrument (close-miking technique). The cardioid microphone can still deliver a “natural” amplification, but only captures the sound from a specific area, which may or may not sound “right”. Since it is a “microphone,” it will inevitably pick up sounds from adjacent instruments, the house system and the monitors. If there is the need to increase the monitor’s volume then feedback will occur. In very loud environments therefore sound engineers tend to use contact microphones to overcome feedback problems but severely compromising the “natural” sound projection of the instruments.[23]

According to the conceptual framework presented in Chapter I, there is a clear objective of playing the fragmentation of my gestures on the cello’s body with a discrete and interior amplification on distinct points on the instrument. Therefore one structural component of this device concerns the implementation of a multiple contact-microphone setup in the cello to amplify the specific sonic results of my playing actions in different zones of the instrument. This allows micro-sonic events, which have no relevant acoustic projection or could only be heard in extreme proximity to the instrument, to now come to the foreground of the instrument’s sonic vocabulary. Contact-microphones are very effective in “listening” to the particular resonances in different points along the instrument body, and pick up distinct structural vibrations depending on their placement on (or in) the instrument body.

> Piezo pickups, often used in acoustic guitars and less often in electric guitars, actually do pick up vibrations rather than

[23] Interview with Peter Janis for Pro Sound magazine (25th July 2017)

> electromagnetic disturbances. Those are much closer to a microphone in their operation and they will pick up things like taps on the body that a normal pickup won't.[24]

The choice of contact-microphones seemed adequate to isolate the sonic amplification of my actions in different zones of the instrument's body. Electromagnetic pickups would only work in the strings (which is the case of Mark Dresser´s system) and my objective was to amplify also the percussive and rattling noises exterior to the string vibration performance. The final choice of microphones included affordable, market-available contact microphones, although the initial objective of this research was to work with a setup of four accelerometers (i.e. vibration sensors). Due to budget limitations this was not possible to pursue in the course of the research but some of the initial tests included a multi-accelerometer setup and they were fundamental to developing the system.

2.1. Tests using accelerometers as contact microphones

The use of accelerometers as highly sensitive contact microphones was popularised in sound art by Bill Fontana [25]. Although an expensive technology its use is widespread as a technique for field recordings of large structures' internal vibrations, seismic vibrations or any kind of extremely low- or high-frequency vibrations. The detail and sensitivity that this technology presented, along with its being very small and lightweight, [26] seemed adequate to fulfil the project's aim of having an extreme sonic representation of the internal resonances of the cello. Therefore I followed the article "Sonic Nirvana: Using MEMS Accelerometers as Acoustic Pickups in Musical Instruments" (Reilly, Khenkin and Harney 2009) and wanted to test these sensors´ acuteness in recording the various resonances of the same action on the cello in different points throughout its body. This step of the research was conducted in the anechoic chamber of IST (Lisbon) using four Bruel and Kjaer Delta Tron accelerometers

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[24] https://www.seymourduncan.com/blog/the-tone-garage/whats-the-difference-between-a-pickup-and-a-microphone

[25] "Harmonic Bridge" - Tate Modern, London (2006)

[26] The dimensions of the sensors used were 10x10x10mm / weight = 4.8 gram

(type 4508B) and recording hardware from the University's physical engineering lab. The results were clear in terms of the spectral variations concerning the different selected points for placing the accelerometers; the quality of the recorded sound was extremely sharp and accurate, showing that this would be a technology to use in future developments of the electroacoustic device.

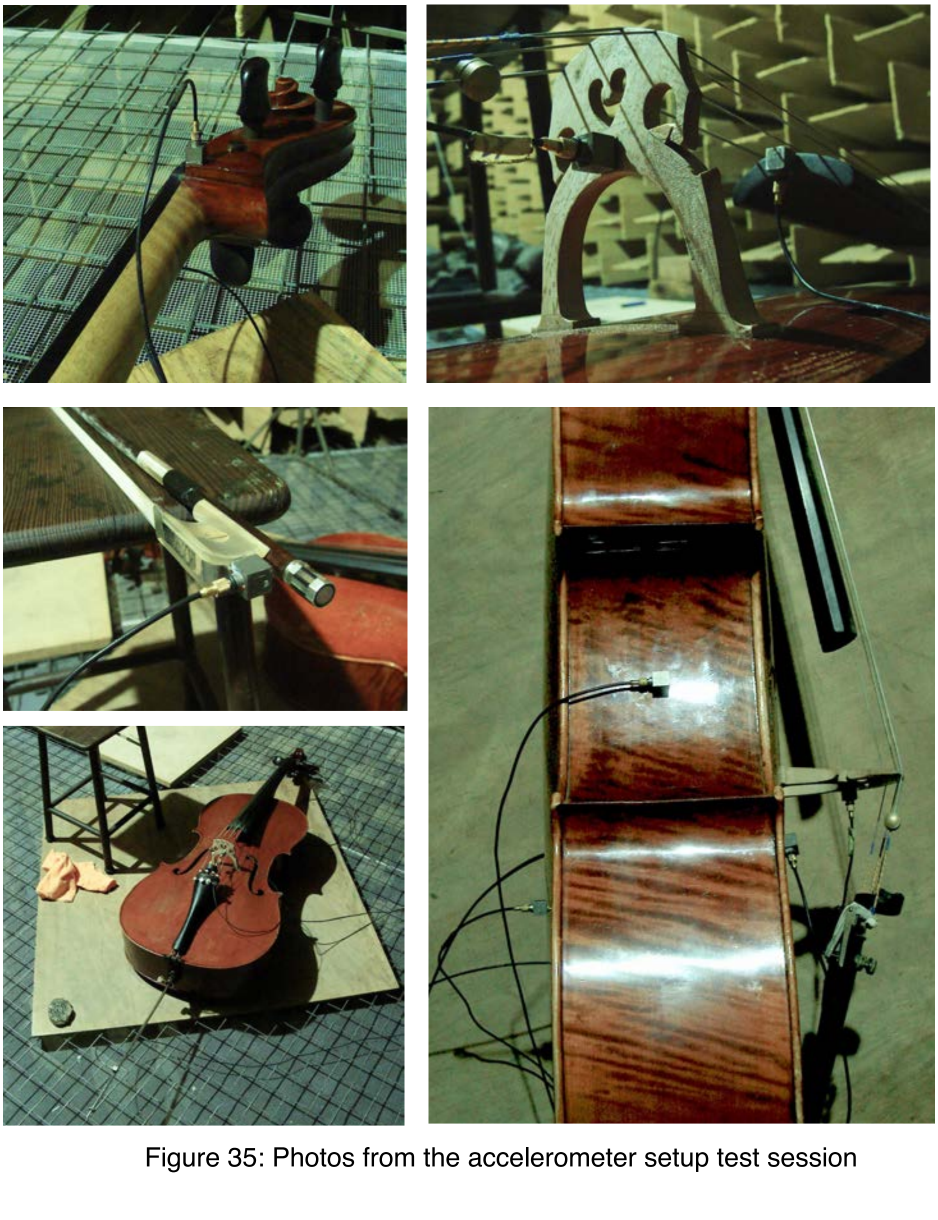


Figure 35: Photos from the accelerometer setup test session

Audio results from the accelerometer test session: The following sound example uses material selected from this recording session. All audio is from the same gesture of playing an open C string, recorded in four distinct points on the instrument's body.

DEMO 1_accelerometers recording.wav

You will hear each accelerometer separately and then the four being summed, one by one, till you hear the complete mix with the four recordings.

[duration: 00:47]

File also accessible in USB pen drive in folder: CHAPTER II / DEMONSTRATIONS

Following this group of tests, a series of experiments with affordable contact-microphone models were necessary to implement a final sonic mapping of the cello with the definitive placement points on (or in) the cello's body.

2.2. Final choice of microphones and placement on the cello

The final decision for the contact microphones' placement took into account three parameters: the cello's architecture (and the relative resonant independence of the parts), its combination with previously embodied playing techniques of the instrument and the identified types of contact microphones.
One of the main preconditions of the amplification system was that it must not constrain the "classical" approach to the instrument while affording a number of extended techniques and development of other playing experiences on the instrument. After a large number of tests miking the resonant properties of different points of amplification I concluded that there were four points (i.e. top nut, bridge, bow's frog and endpin) where the timbral properties and the sonic reaction to my actions on the body were more distinct, while also mapping the full instrument's main areas (body, neck, endpin and bow).

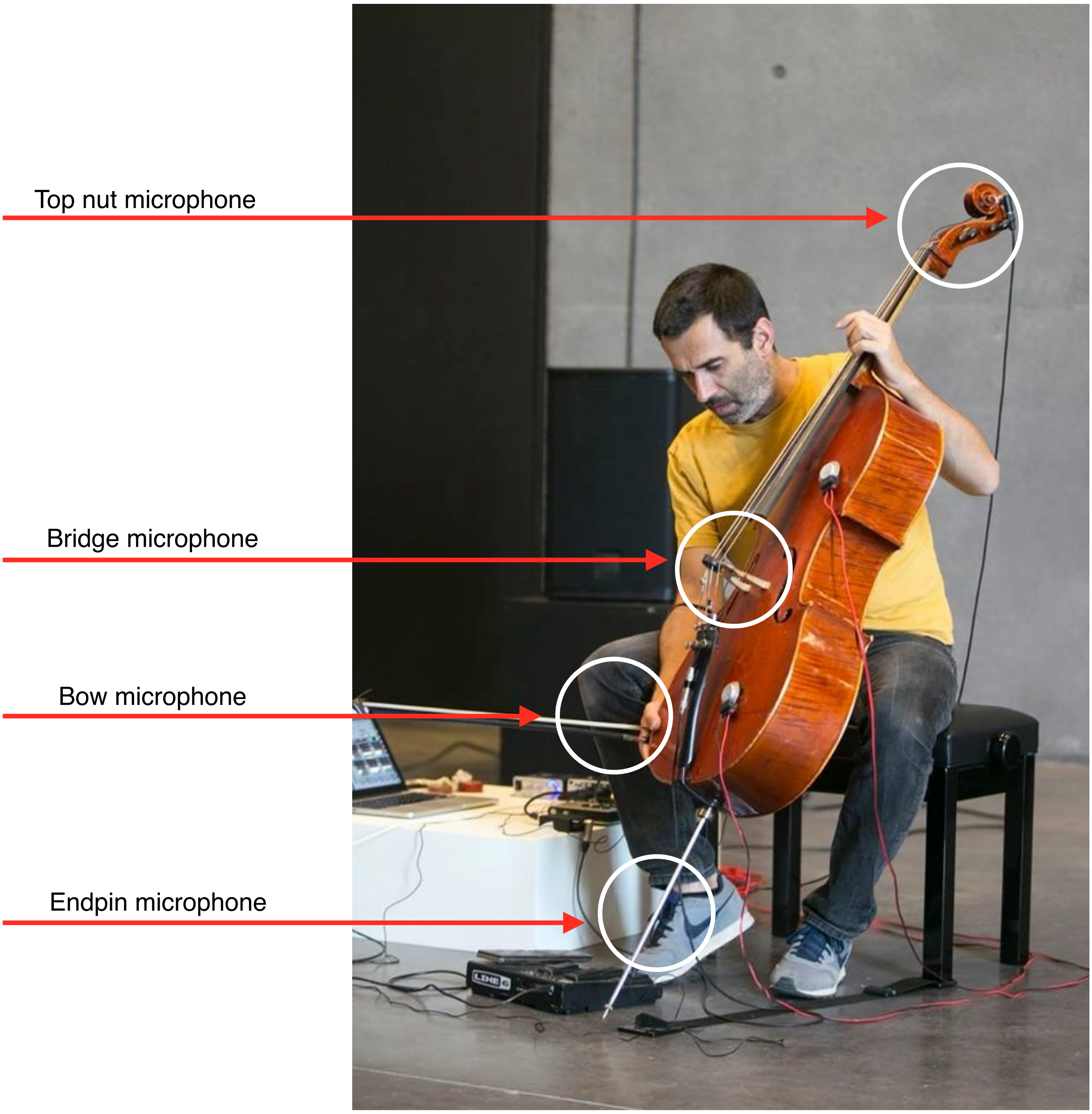


Figure 36: Photo identifying the microphones' positions

For each of the identified points, a specific contact microphone was selected and mounted on the instrument's body.

Top nut microphone: At the top of the fingerboard, the four strings run over a small ridge called the nut. The fingerboard is where the action of the left hand usually takes place: pressing specific nodes on the strings so that the right hand (plucking or bowing) can excite the subsequent portion of string, producing a

specific tone. All the classical left-hand fingering cello techniques are optimised to move quickly and silently between the tones the player can produce on each string. Nevertheless there is a lot of sonic activity beyond the acoustically optimised relation of the string and the bridge: from the percussion of the left hand tapping, to the tones produced by the length of string between the stopping finger and the nut, to almost silent frictions and rattlings of the strings.
If adequately excited, each pressed node on a string produces two tones: one on the length from node to bridge and another one from node to nut. Plucking or striking the strings between the nut and the node can produce high-pitched sounds, which are still relatively low compared to similar ones produced between the node and the bridge. Therefore, in order to increase the presence of this kind of sonic material, an “under-saddle Fishman strip” pick-up was placed under the nut. For this mounting a change on the cello’s body was necessary: the nut was detached from the cello’s arm and the strip contact microphone with the exact length of the nut was placed underneath it, in direct contact with the nut, kept in place only by the string tension. The use of this microphone made audible the mentioned sonic material (i.e. percussive tapping or bi-tones) and subsequently their sonic presence became equivalent to the acoustically amplified string vibration.

Figures 37: Top nut contact microphone

Bridge microphone: The bridge is the central resonant element supporting the strings' action and establishing the contact with the top plate of the sound box. Physically the fundamental role of the bridge is to transform the vibrations of the strings into excitation forces applied to the upper plate of the body (Henriques 2002). This is usually where cello pickups are placed and therefore a Shertler cello Stat-C was applied in a conventional way[27]. Although not as "clean" as a condenser cardioid microphone positioned at 30-40cm from the F-hole, this is the microphone that grounds the cello to its most "natural" amplified sonic identity.

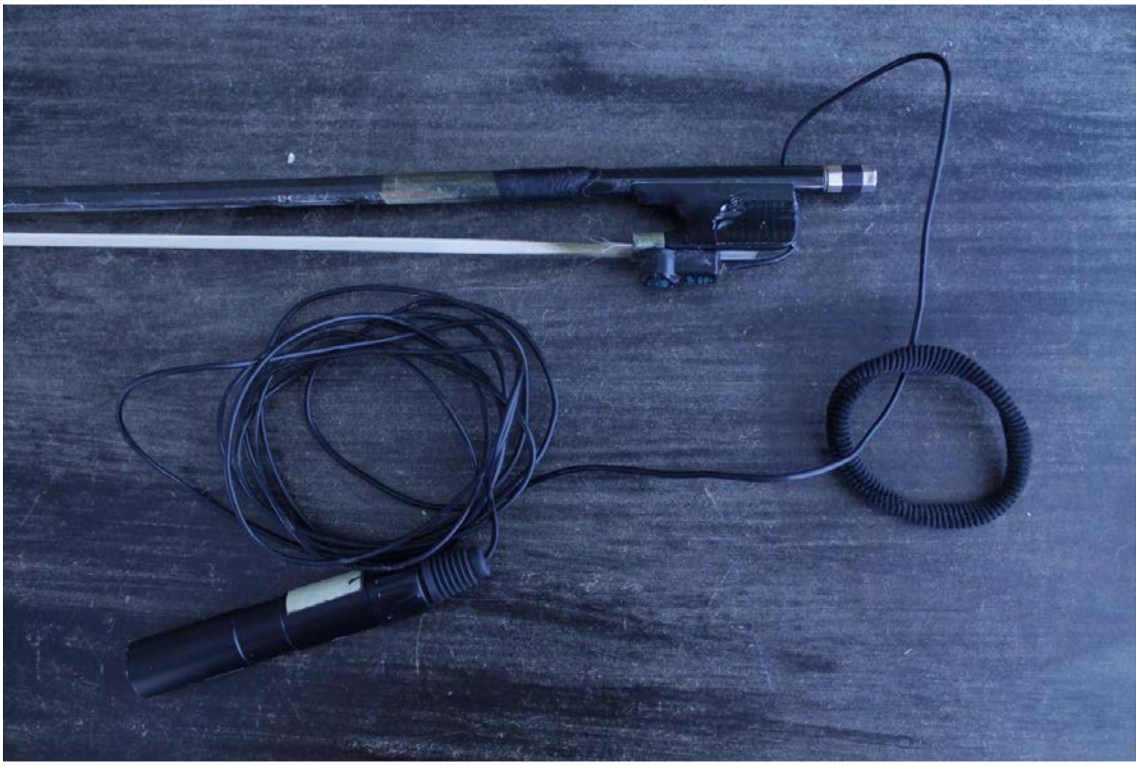
Figures 38: Bridge contact microphone

Bow microphone: The bow is the central excitation tool for the strings and is the most dynamic part of the cello's complex since it is detached from the cello's body. By mounting a contact microphone on the bow I could now "sense" and amplify its transitory contact with different parts of the body: strings, wooden body, endpin, etc. Since it is made of different materials (wood, horsehair, metal and rubber) I could manipulate it in different ways to explore different timbral

[27] https://www.schertler.com/en_IT/shop/pickups/stat-c-set

contacts. A number of new micro-sounds appeared within the amplified practice with the bow and new techniques started developing (see Chapter III).

When amplified, the bow has a particularly high frequency response. For example, all the harshness of the bow's hair creating friction with the strings or any other part of the instrument becomes a very distinct, abrasive sound. With very low pressures the pianissimo sonic result of the hair rubbing the cello's body (be it strings or any other point) becomes rather prominent. In this case an AKG C411 contact microphone was mounted on the frog's bottom: a central resonance node between the hair and the stick, and point of good weight balance so that it does not compromise performance. In order for the microphone and its cable to be less invasive to the extremely dynamic use of the hand and the arm, this microphone's cable was mounted along the arm.



Figures 39: Bow contact microphone

Endpin microphone: The endpin is a steel tube that establishes contact between the instrument and the floor. When the cello is played most of its weight is taken by this adjustable metal spike, which protrudes from the button. This the element specific to the contemporary cello (the baroque cello did not feature it). It holds the cello to the ground, usually with a sharp point that prevents the cello from sliding. Since the material is different from the rest of the wooden body and it’s relatively distant from the classical actions on the cello, placing a microphone here presented itself as a solution that would give a new “colour” to the amplification system, and at the same time “wake up” an inactive part of the instrument.

Figures 40: Endpin contact microphone

In the following audio demonstration we can listen to the same gesture recorded by each of the selected contact microphones.

DEMO 2_four contact mics alternated.wav

You will hear an open C string with each microphone alternated. Order of appearance: bridge, Nut, bow and endpin microphones.

[duration: 00:26]

File also accessible in USB pen drive in folder: CHAPTER II / DEMONSTRATIONS

The placement and selection of the type of pickups for these specific points on the cello was slow and needed constant testing. Although only six iterations of this project are presented in the portfolio, this electroacoustic device was integrated into a large agenda of concerts during the research period.[28] With a lot of traveling involved, the subsequent setting up and experimentation with the device produced a lot of empirical experience concerning technical knowledge, performance consistency and mounting durability of the microphones. Although in a future reshaping of the device some improvement might be achieved, the overall sound quality of the input signals is very satisfactory and justly serving the Exploded Cello system. All the signals have a strong, clean gain and their simultaneous use, adds a microscopic listening to the acoustic performance of the cello.

3. Outputs: speakers

The selected speakers and their distribution in space have specific functions in the overall device. They include two type of speakers: **conventional loudspeakers** (membrane speakers) and **vibrational transducers** (contact speakers). Their use has different functions in the overall system as they are activated differently in the concert and installation periods.

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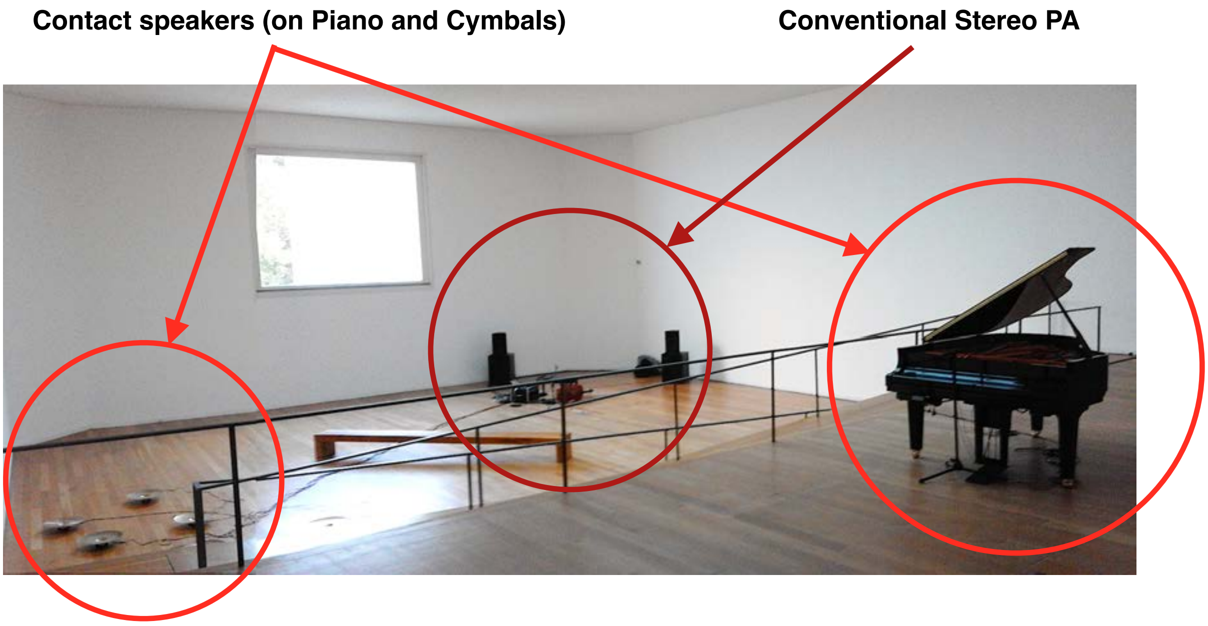
[28] See Appendix - Solo concerts and ensemble projects list



Figures 41: Example of distribution of speakers

3.1. Conventional loudspeakers

These are used in a stereo configuration (two tops and two subwoofers)[29], placed symmetrically behind me. This full-range stereo PA system is the central diffusion setup in the concert period and therefore fundamental for the fragmentation processes. This PA is used as the first and most direct amplification layer for the sound produced on the cello, but its positioning is chosen carefully so as not to completely mask the acoustic sound of the instrument while adding to it. Placing the PA behind is a way for myself to hear the same mix as the audience and to be much more aware of the impact of the sound in the room.

As result of several tests my usual setup position of the speakers is that their relative distance to the cello should be 2m back and 2m to the sides. The speaker tops should be placed at a height of approximately 1.5m. The distance between the speakers is supposed to be 3-5m, depending on the room dimensions. At less than 3m the microphone signal's distribution starts to

[29] In the technical rider for the project the example is: UPA Meyer Sound – Full Range / 1 SUB p/ TOP.

become ineffective and above 5m the projected sounds lose too much of their perceptual connection to the acoustic sound of the instrument.

Figures 42: Example of stereo PA setup

DEMO 3_four contact mics pan delay.wav

You will hear the signal from the four different pickups in each of their position in the stereo slightly delayed.

[duration: 00:47]

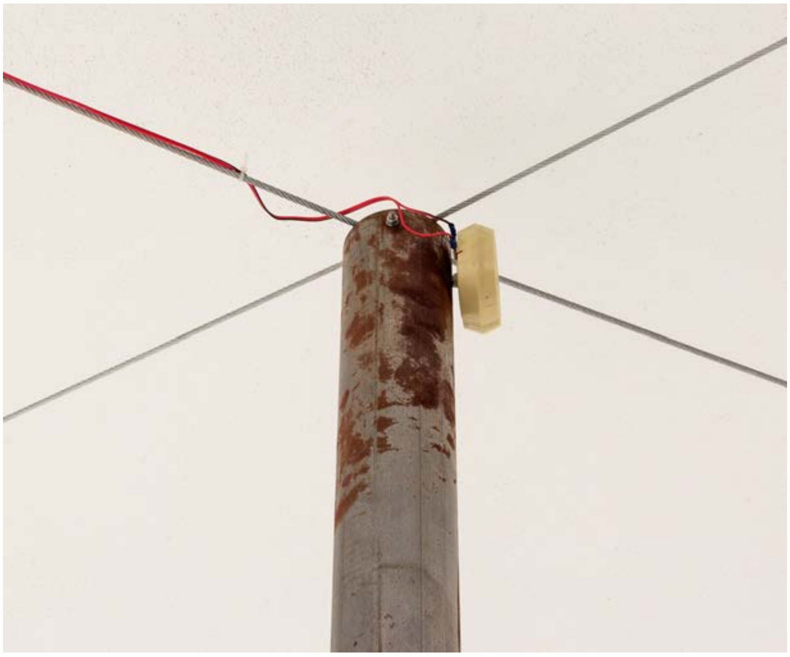
File also accessible in USB pen drive in folder: CHAPTER II / DEMONSTRATIONS

3.2 Vibrational transducers

These transducers work by exciting a typically planar surface at a single point. The panel material behaves like its own acoustic environment, with its own speed of sound. Achieving the most balanced and pleasing sound possible requires careful placement of the exciters on the surface. The material type, point of coupling and edge termination of the surface all affect the sound properties of a surface. Nevertheless vibrational transducers can give acceptable results when mounted on nearly any kind of surface.[30] The use of these contact speakers opened the possibility of filtering (i.e. colouring) the sound of the cello with the resonant properties of other objects with different designs and materials used in the installation setups. The distribution of these

[30] https://www.daytonaudio.com/index.php/exciters-buyers-guide

speakers in space is specifically adapted to the qualities and design of the resonant objects or architectural structures. Since these transducers were mainly used in the installation period, their performativity could be experienced by the audience in close proximity with the resonating objects. It was common to see audience members listening with an ear very close to the surface, or even touching it. This allows a very different mode of listening from the direct acoustic cello sound and the full-range stereo PA amplification. The multiple-speaker setup also allows a wider and less directional diffusion of sound sources with unexpected spatial orientations.



Figures 43 and 44: Vibrational transducers mounted in different objects/structures

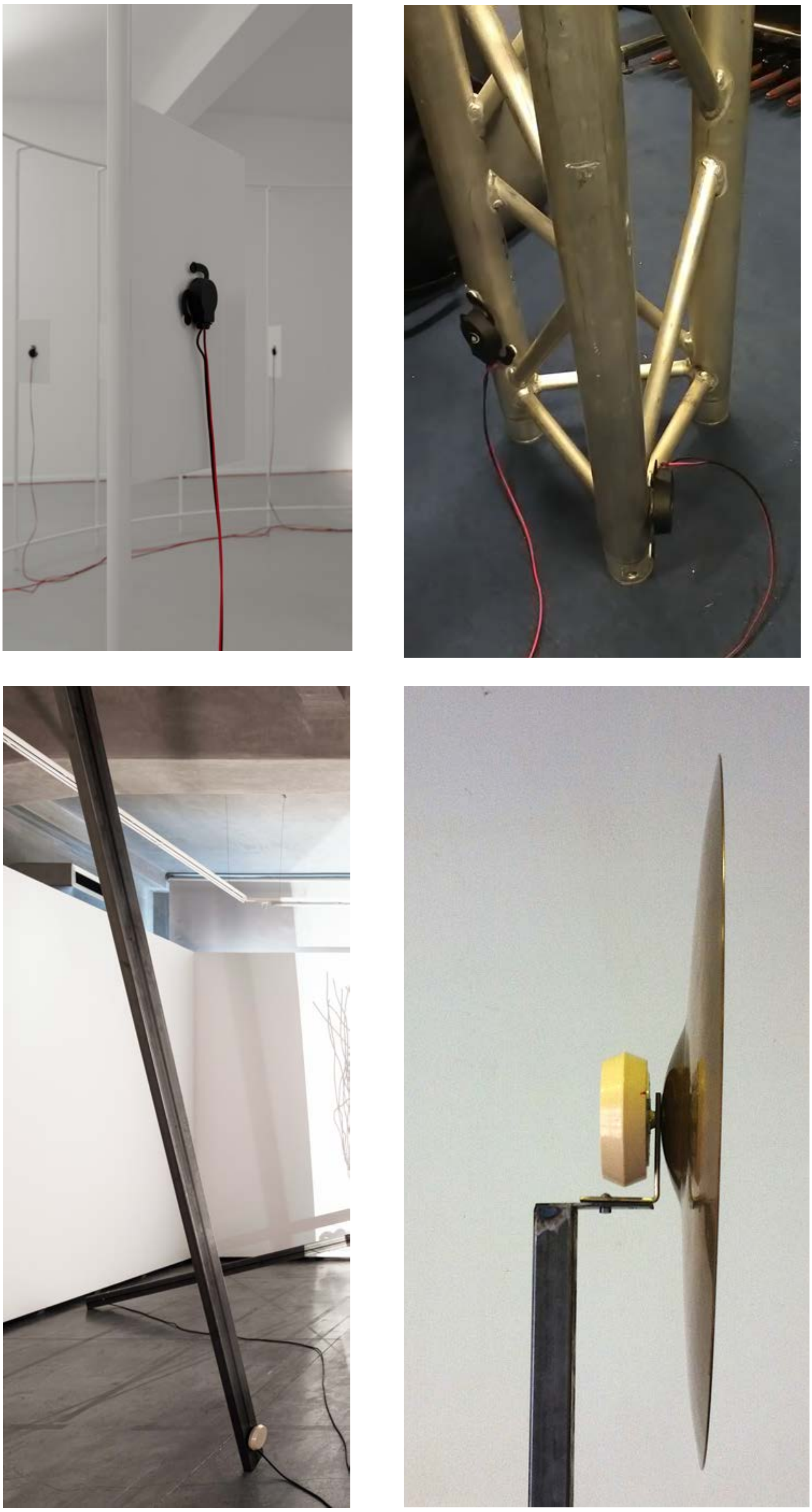


Figure 45 to 48: Vibrational transducers mounted in different objects/structures

Besides the external resonating objects, two of these speakers were mounted on the cello's top and bottom plate, feeding sound into the cello's resonating body.

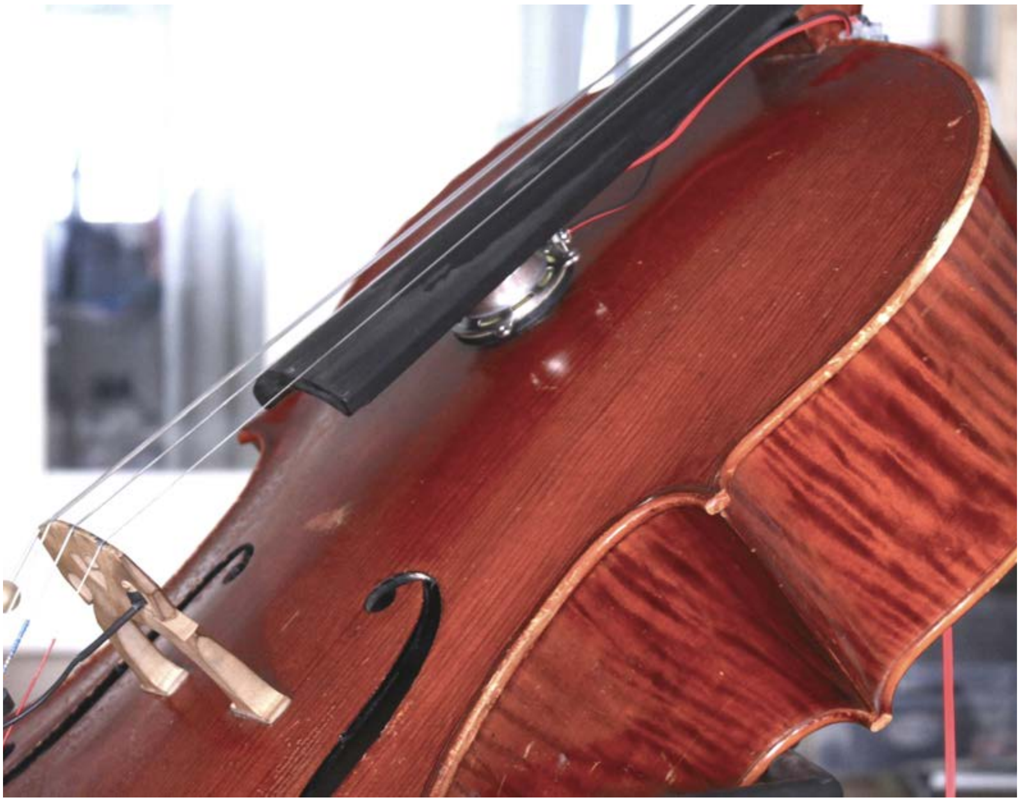


Figure 49: Vibrational transducer mounted on the top plate under the fingerboard

I will briefly describe the three models of vibrational transducers used in this research, which are now part of the system's hardware. The models differ in weight, handling power and type of mounting solution. The articulation of these parameters with the selected resonating surface is crucial for a good performance of the system.

Model 1: Dayton Audio HDN-8 Weatherproof Sound Exciter Transducer

This is the largest of the exciters, weighing 1kg, handling 50w power RMS and with a screw to attach to the surface or object. These exciters were used in large objects or parts of architecture.[31]

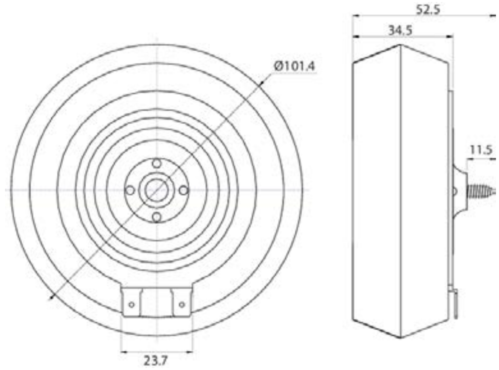


Figure 50: Diagram for Dayton Audio HDN-8

Model 2: Dayton Audio DAEX25 Sound Exciter

This is a very small and light exciter (70gr) handling 5W power RMS (8ohm). They are glued to the surface and are much more appropriate for lighter, thinner and more resonant surfaces [32].

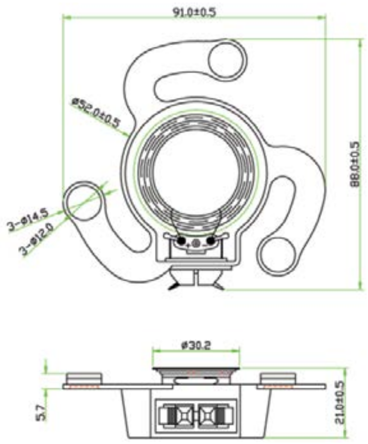


Figure 51: Diagram for Dayton Audio DAEX25

Model 3: On the cello I mounted two Dayton Audio DAEX30HESF-4 (40W-150gr). This was the best match for performing the aggressiveness of the Direct Feedback with a good balance between speaker weight, power and frequency range.

Figure 52: Image for Dayton Audio DAEX30HESF-4

31 Examples in portfolio: Iterations II, III, V and VI.

32 Examples in portfolio: I and IV.

4. Interface: software

The electroacoustic device's software is the central interface between the cello (inputs) and the spatial apparatus of the installation (outputs). It was designed in Max 7 environment and runs on a Macintosh with a RME Fireface 400 Soundcard. The programme was developed over the course of the research period and the submitted version is the latest one, which is used only to perform the technique examples shown in Chapter III.

Exploded Cello Max 7 application.maxpat

Max 7 patch can only be accessed inside USB pen drive in folder:

"Chapter II / MAX 7 PATCH"

During the research period I developed the Exploded Cello vocabulary in direct connection with the software design and always maintained that it should perform as an extension of my gestures, the acoustic conditions of the spaces and the resonating objects/structures used for the installation. Calibration of the software programme for each new iteration of the project is of much relevance. The patch interface has very easy access to the main parameters of each digital signal process. After this first step of setting up the installation and calibrating the patch, all the control needed during the performances is achieved using the right foot on a USB pedal with four buttons and a volume pedal.

4.1. Program structure

The patch shows four inputs (cello contact microphones) and eight outputs: two for the stereo (FullRange) PA system and six for the vibrational transducers. The latest version includes one output for a transducer mounted on the cello and five for other resonators. Each input has a specific equalisation filter if any calibration is needed. These signals are routed into two sub-patches: Sections 1 and 2. A third sub-patch manages the MIDI information from the pedal control hardware (with four buttons and an expression pedal) and is routed to several parameters inside Sections 1 and 2. These sections have different behaviours:

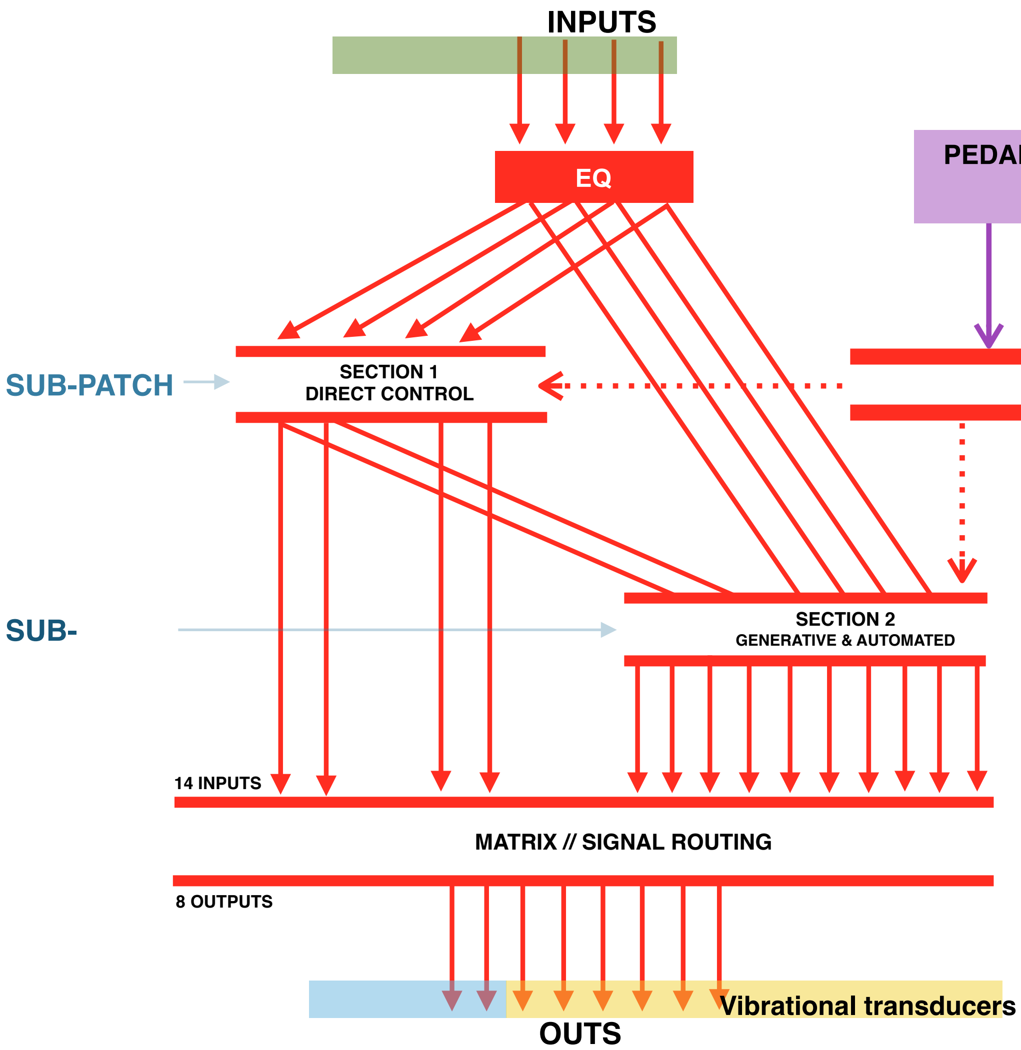


Figure 53: General Max/MSP patch signal-flow

Section 1 includes digital processes which are directly controlled by my manipulation of the expression pedal.

Section 2 includes the random automated digital processes, which are started and stopped using buttons in the pedal control.

Both sections receive signals from the four inputs and Section 1 feeds two inputs in Section 2. The outputs for each section can be assigned using the matrix~ object for signal routing to the eight available analogue outputs.

4.2.1. SECTION 1: direct manipulation

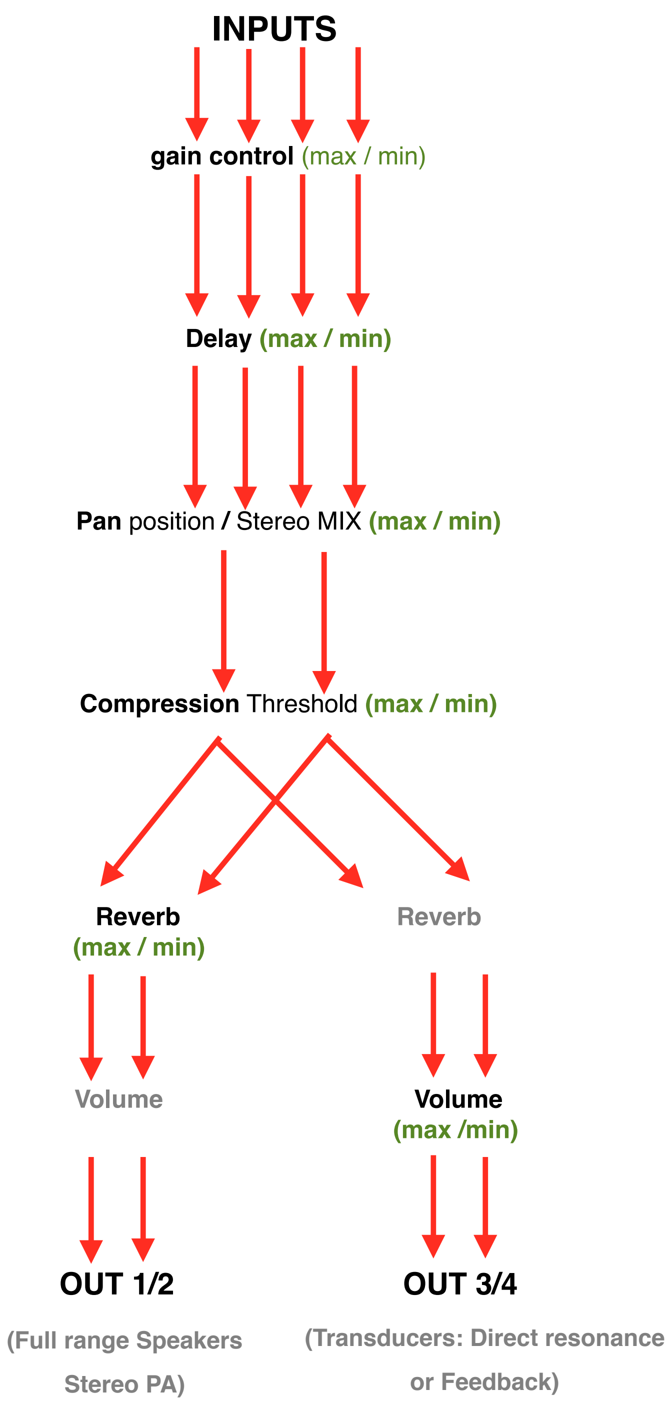


Figure 54: Section 1 signal flow diagram

This section of the software manages digital processes which can be directly manipulated by the use of the expression pedal on the MIDI pedal board. These processes are part of a sequence of digital signal processes ending in two digital stereo outputs:

1. Stereo 1/2 of Section 1 are usually routed[33] to the Full Range PA. (OUTS 1-2 in the sound card)
2. Stereo 3/4 of Section 1 are usually routed to all the vibrational transducers.

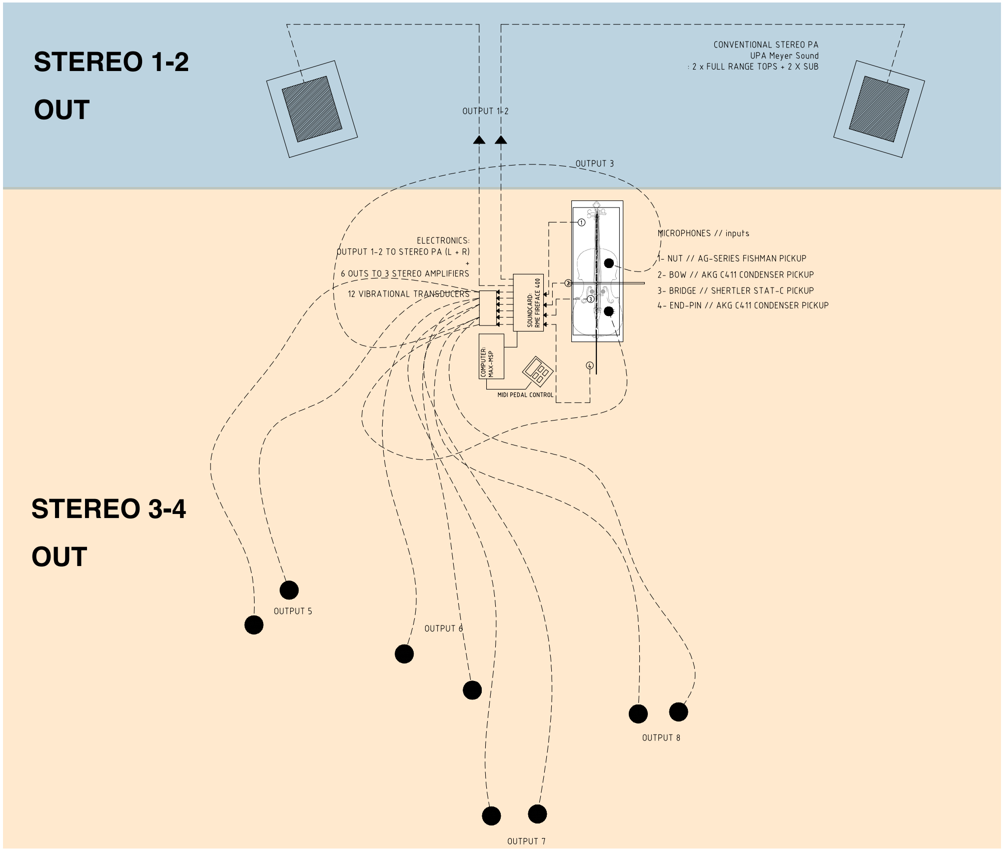


Figure 55: Section 1 outputs to speakers

Each process of this section's chain (i.e. gain, delay, panning, compression, reverb and output volume) have parameters which can be calibrated with a maximum and a minimum value. The variation control of some of these parameters' range is achieved by manipulation of the MIDI expression pedal. The variation of its range (0 to 127) affects the different digital processes in the following way:[34]

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[33] Other routing configurations are possible using the INPUT/OUTPUT matrix in the main patch window

[34] Each graphic shows the variation of each parameter according to the variation of the MIDI pedal

Gain: Controls the mixing of the contact microphones

Minimum pedal = just bridge microphone with lower gain level

Maximum pedal = four microphones in maximum gain

Delay: Each input has a separate delay~ with min and max range from 0 to 400ms.

Minimum pedal = zero delay

Maximum pedal = Each microphone has different maximum delay time, as a result of a different multiply value applied to the midi input value.

Dynamically changing the delay~ time will cause a discontinuity in the output signal at the instant when the new delay time is received. Therefore the pitch of the output signal will change while the delay time is being changed, emulating the Doppler effect. Due to its “deforming” aspect of the sound signal, the Doppler effect was introduced into the Exploded Cello vocabulary:

> (…) A pitch shift due to Doppler effect is usually less disruptive than a click that's caused by discontinuity of amplitude. More importantly, the pitch variance that results from continuously varying the delay time can be used to create some interesting effects. [35]

Panning: Mixes the four signals into a stereo signal and determines the position in the stereo pairs out.

Minimum pedal = central position for all microphones

Maximum pedal = four microphones in maximum designated position in the stereo.[36]

Compression: Calibrates the threshold level. Maximum = lowers the threshold / Minimum = raises the threshold

Reverberation: Calibrates the decay time of the plugin. Minimum value in pedal = maximum decay time

Maximum value in pedal = minimum decay time

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[35] https://docs.cycling74.com/max7/tutorials/15_delaychapter04

[36] The *pan2.maxpat* abstraction has a fade time that controls the duration of the movement between pan positions, usually set to 2000ms.

The range of decay depends on the venue’s reverberation and the installation setup. This parameter adjusts the acoustic perceptual distance to the cello.

Feedback and Direct Resonance: Calibrates the master for 3/4 outputs. Minimum value in pedal corresponds to maximum volume out, which should correspond to feedback. Increasing the value controls the feedback and just keeps the external object resonance open.

4.1.2 Section 2: Automated

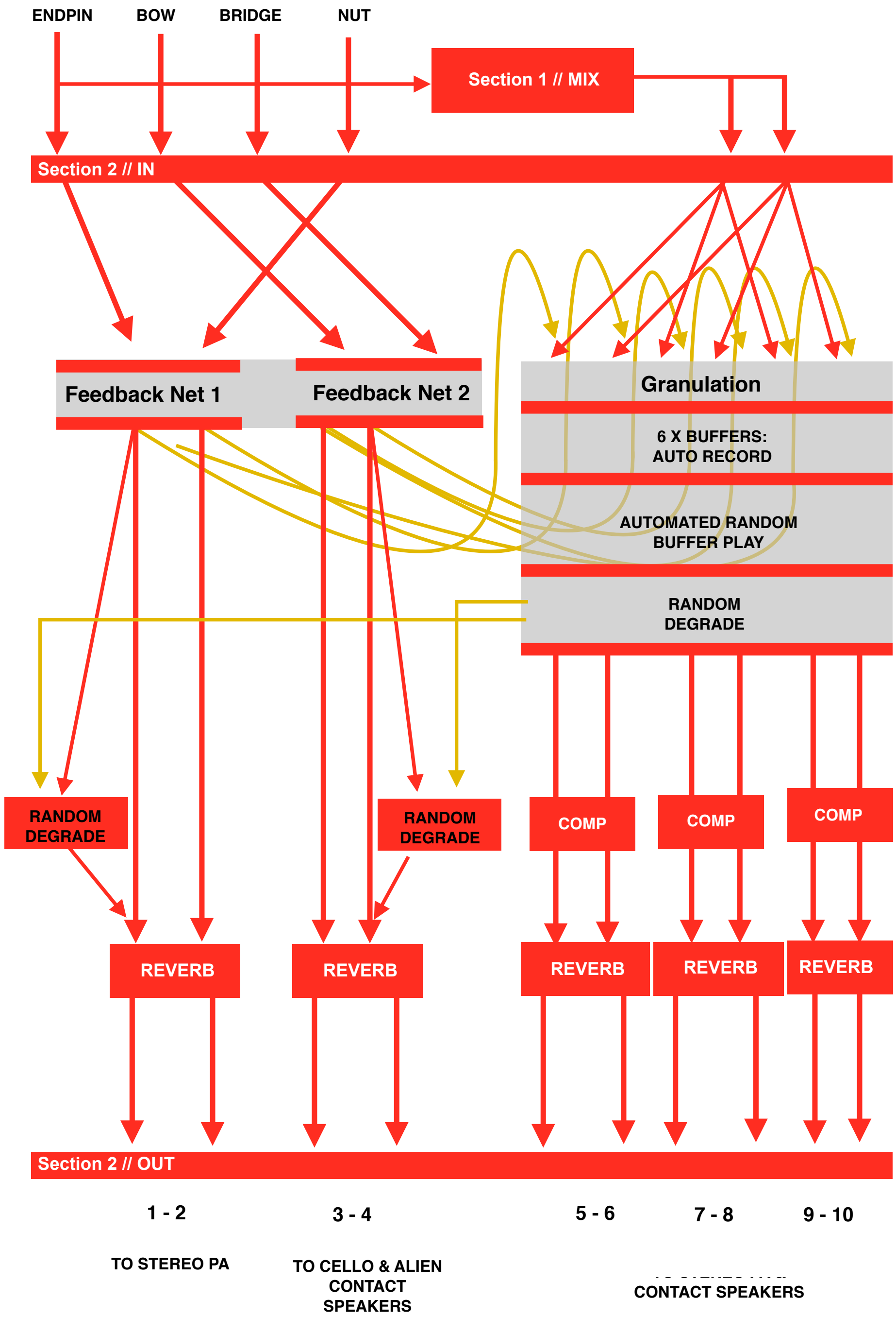

Figure 56: Section 2 signal flow diagram

From the beginning of the research I tested several procedures that would be able to generate a continuous flow of sound with a behaviour detached from Section 1-- an ambient, spatial polyphony, resulting from the improvised vocabulary but independent from its direct control. The associated image to this Section was the explosion’s dispersion result. This would be translated into a soundscape of debris (i.e. fragments): a debris flow. This material should have “fluid” properties, in the sense that it should have a sonic continuity but never repeat itself. It should occupy the complete speaker setup, including the stereo PA and the contact speakers (in the external objects and the cello), in order to have larger spatial distribution and an even stronger spectral transfiguration of the cello and generated sounds.The fundamental DSP would be granulation but used in a fragmented way, as micro-events spread in time and space. This would happen within a continuous textural background (in the latest version, a Feedback Network). These two processes behave independently but share some parameters.

Throughout the research several modifications were made to this section. Here is a chronological list of its development:

1. Feedback Delay (used as a Loop sampler)
2. Granulation + Feedback Delay
3. Granulation + SuperEgo (micro-sampler pedal from Electro-Harmonix)
4. Granulation + Feedback Network (live for Max plugin)

Both processes´ end signals will be processed using Compression and Reverb plugins. Both VST~ plugins will need calibration depending on the space, setup of the installation and resonating objects in use. Another addition to both processes was the Degrade~ object, a digital signal degradation process which, in this case, randomly changes the values of Sampling Rate and Bits definition.

4.1.2.1. Feedback Network

In the last year I started testing with a Max for Live Feedback Network plugin and the results were much more relevant, as it generates an ever-changing and never-repeating feedback texture. Two modules of Feedback Network receive the input signal from the four contact microphones and have four outputs which can be assigned to any of the available eight outputs of the audio interface.

> Feedback Network consists of five Feedback Units. Each one has an independent bandpass filter and delay line. The output from each Feedback Unit can be routed to any of the other five, at an independent volume. (…) Feedback Network features an Auto-Feedback mode that will gradually turn up the volume of all the Feedback Units until the volume level reaches a threshold, at which point it will turn them down a bit, and keep riding the volume controls to maintain constant feedback. At any point you can adjust the volume parameters manually to provoke the system into activity. [37]

The previously designed Max for Live plugin had small wiring and new objects added. Mainly the approach was to integrate the manually controlled parameters in the overall randomisation of the Section. A *metro* object may operate within the patch to automate the internal randomisation of the plugin. One of the output signals from each module is replicated and also passes through a randomised [degrade~] object. All of these outputs go through compression and reverb processing before being diffused through the speakers. One of the Feedback Network outputs feeds the four inputs on the granulation patch. Thus the feedback-generated sounds can be granulated with (or instead of) the manipulated cello sounds. The four digital outputs can be assigned to any of the available outputs on the audio interface and spread between the conventional loudspeaker PA and the vibrational transducers. This process is started or stopped by pressing button 1 on the MIDI foot controller.

4.1.2.2. Distributed Granulation

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[37] https://docs.cycling74.com/max5/vignettes/core/live_resources_pluggo.html

Six buffers, recording the mixed input signal from the four pickups and/or the four Feedback Network outputs, feed this part of the system. The random granulation is applied to this sampled audio material. Pressing button 4 (MIDI pedal) initiates the automated process of capturing or storing audio data by each buffer at a predefined rate/period of time. The granulation is randomly automated via [metro] objects changing: playing velocity, playing direction, pitch shifting, sample and bit rates. The density of the texture of grains is also possible to calibrate. Pressing button 2 opens or closes the granulation master output.

4.2. Interaction with the software

The interaction with the programme is divided into a graphic interface (monitor) and a MIDI pedal controller ("played" simultaneously with the cello).

4.2.1. Graphic Interface

The graphic interface is used for calibration of the system and therefore has an easy and direct way to access all the main parameters. It is also possible to store the calibrated settings to recall later. During performance it shows basic information about the system status and dynamic transformations if I need to visually monitor the system.

Figure 57: Complete Exploded Cello software interface

The interface shows three windows: a main patcher window on the left with visual monitoring of the foot controller and a matrix for output assignment for each Section. These sections (1 and 2) are presented in the other two windows.

4.2.2 Foot Pedal Control

The pedal controller has 4 buttons (1-0) and an expression pedal (1 to 127). These are assigned to different parameters in the overall patch. The keyboard has two assigned keys. Most dynamic control during a performance is made by just using the expression pedal. The range of this pedal controls the various parameters in Section 1. The four buttons turn ON/OFF several processes along the patch. Button 1 turns ON/OFF the feedback network. Button 2 turns ON/OFF the granulation (both processes by increasing or decreasing the output volume). Button 4 starts or stops the automated buffer recording in the granulation process. Button 3 turns ON/OFF the 3/4 output pair signal of Section 1 (usually used to send direct signal to the resonators).

With the exception of brief moments when I have to turn ON/OFF the automated processes (feedback or granulation), my right foot is constantly on the expression pedal. For this specific situation I find this interface extremely organic. Although it is an A to B potentiometer which can be completely mapped, its relation to my gestural approach to cello playing was embodied easily.

5. Final remarks

The thorough description of this chapter in terms of the device´s architecture and the decisions that were taken to follow its objectives, seemed relevant considering the increasing faster technological developments in this research area. From hardware to software, all the components used will surely be out-dated in the coming years but the conceptual intentions and technological solutions may be useful for further research (Nogueira, Pires and Macedo 2016). This description is also useful for the reader to understand the mechanics behind the four digital processes upon which the sonic vocabulary of the exploded cello was built.

Chapter III - Sonic Vocabulary

The electroacoustic device was developed over several iterations, which included both public presentations and laboratory research, and I can now address in a systematic way the Exploded Cello sonic vocabulary, incorporating performance techniques (i.e. cello + electronics), the automated performance of the software and both of these in relation to the installation setup (speakers and resonant objects). This chapter will be dedicated to presenting a summary of this vocabulary resulting from the current version of the electroacoustic device (as described in Chapter II). This vocabulary is highly dependent on the electroacoustic device and the Exploded Cello metaphor debated in Chapter I. Therefore in what concerns the cello's performance it will mostly focus on the implications that this electroacoustic transformation had on the adaptation or reinvention of previously embodied and instrumental techniques. This device allowed transformations of certain techniques as it had a large influence on the perception of the playing gestures, its relation to the instrument's body and its relation to the surrounding space. Improvising is, in this context, navigating between the cello's integrity and its perceptual disintegration. Classical and extended techniques[38] are included when their use in the context of this system is relevant for the development of my own "exploded cello" improvisation vocabulary. The scope of this research was not the explicit development of new techniques for the cello but the impact that this electroacoustic extension had on existing embodied techniques. Nevertheless, there are some techniques that I started to use only in the context of this device, as they were developed in direct relation to the device's specificities. The development of this research expanded the implications of these techniques in the context of a project that places them inside a hybrid presentation format (concert-installation).

Beyond this direct relation of embodied instrumental techniques, I also developed strategies concerning the automated processes of the software in articulation with the spatial audio diffusion systems, which were fundamental to

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[38] For further information on such matters I refer to these two projects, which are available online: http://www.moderncellotechniques.com and http://www.cellomap.com

the installation period. This includes the relation between the stereo membrane speaker configuration, the vibration transducer setup and the design or selection of resonant objects or structures. These strategies are also part of the vocabulary that feeds my solo improvisation within this device, informing the hardware installation in a given site attending to its spatial specificities. Therefore, I will also present examples of the installation period's sonic output where the automated section of the software feeds all the available outputs, thus using the total of resonant objects (external objects + cello) and the stereo PA.

In this chapter I will present the four different audio processes of fragmentation and dispersion which have become fundamental parts of the Exploded Cello vocabulary. For each of them I will describe the hardware and software setup and calibration, plus the related activation techniques (direct manipulation or automated):

1. Direct feedback
2. Four-signal pan delay
3. Direct resonance in external objects
4. Automated feedback network and granulation

The three first configurations concern only the concert phase (manipulated) and the last is fundamentally directed to the installation period (automated). Although these processes and their techniques overlap in the transitions between concert and installation, I decided to separate them in order to clarify their particularities and fundamental characteristics. The sequence of four device configurations is gradually more complex in terms of number and type of speaker outputs and DSP. This structure will give a more detailed overview on the specificities of the vocabulary developed around the articulation of the electroacoustic device and the conceptual model of the Exploded Cello system.

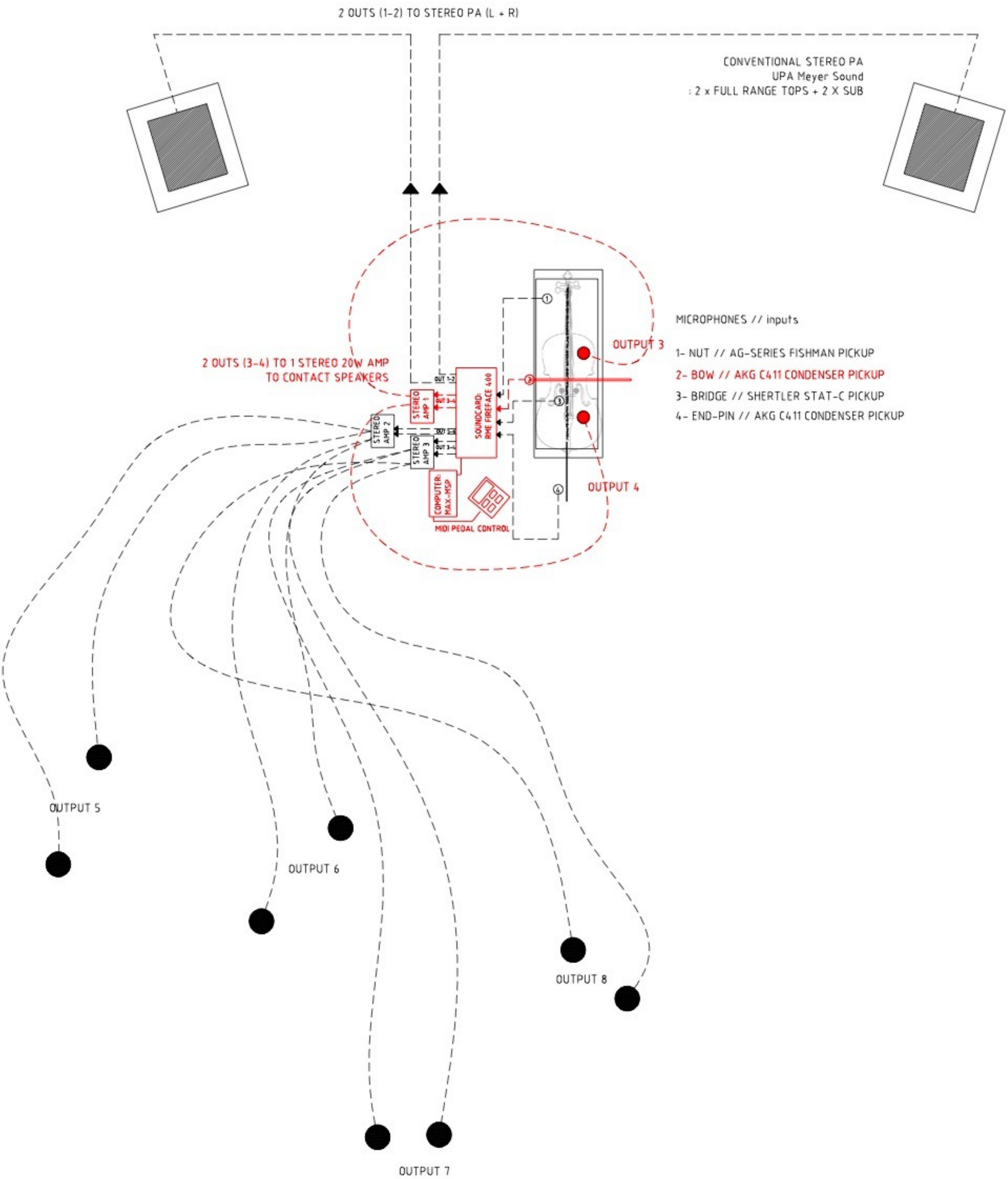
In each section I will debate and describe the hardware setup and software calibration, demonstrate the associated activation techniques and present short improvisation studies within the specified device configuration.

1. Internal feedback

Audio feedback is the expression of a system out of control and my relation to it is more of negotiation, rather than total control (Kieferand Eldridge 2017). In this particular case the frequency of the resulting sound is determined by resonance frequencies of the cello's body and the bow, the emission patterns of the vibrational transducer, the mounting point of the contact microphone on the bow and the amplifier used. The distance between transducer and point of bow contact is fundamental to shaping the feedback frequency and pattern. This last variable is the most dynamic when using the bow's microphone since I can place it in different points along the cello's body, playing the variation in distance to the mounted transducers.

1.1 Setup

This initial setup includes the bow's microphone and the two vibrational transducers mounted on the cello's top and bottom plate. This configuration allows the presentation of direct acoustic feedback performance techniques on the cello, which are dependent on the use of the bow's microphone in articulation with the two transducers mounted on the cello.
In this configuration I use Section 1 of the software. The only active outputs are 3-4 to the vibrational transducers. The only active input is the bow microphone.
The expression pedal can also be used as a tool for feedback control by increasing or decreasing the microphone signal to the amplifier. The expression pedal works as a second controller adding to the manipulation of the bow's contact with the cello surface.



Figures 58: Active components for the Internal Feedback

In this case, the minimum value in the pedal corresponds to a maximum gain level of the bow's microphone. The input gain level of the bow's microphone and the volume of the outputs amplifier needs to be adjusted in such a way that the feedback has a gradual dynamic development and that it's the different positions, points of contact and pressures of the bow that control the development of the ringing frequencies. To activate the feedback loop button 2 (blue) of the pedal must be on. The MIDI expression pedal will only turn up or down their output master volume.

1.3 Vocabulary

Demonstrations and improvisations

File also accessible in USB pen drive in folder: CHAPTER III / 1_Internal Feedback"

(Audio-visual documentation, presenting a group of relevant techniques and short studio improvisations with the process of Internal Feedback.)

1.3.1. Demonstrations

DEMO 1 - 01:25 : Exploring the contact between the hair and the bridge.
DEMO 2 - 02:39 : Exploring the contact between the stick and the bridge.
DEMO 3 - 02:10 : Exploring the contact between the tension screw and the bridge.
DEMO 4 - 01:26 : Exploring the contact between the microphone and the bridge.
DEMO 5 - 01:10 : Exploring the hair in contact with other parts of the body (C bouts and back plate).
DEMO 6 - 01:44 : Exploring the back plate with the screw, hair and microphone. Use of fast movements and articulation of feedback with bow friction.
DEMO 7 - 00:45 : Exploring the contact between the screw and the fingerboard. Articulate this action with a pizzicato played with the screw.
DEMO 8 - 02:17 : Exploring the contact between the screw and different points in the top plate. Articulating feedback with impact percussion.

These internal audio feedback demonstrations concern specifically techniques which imply the type and position of contact between the bow and the body of the instrument. They show the manipulation of the bow as an extremely sensitive device for controlling feedback. Bow point of contact and pressure in different parts of the cello´s body provoke the feedback system to react in different ways, and slight changes in the bow´s angle of contact are sufficient to shape the feedback pattern. This is a technique which extends and articulates the classical use of the bow in what it concerns the control of pressure, velocity and point of contact. In this case it extends the classical friction of the strings to the entire body. It is a technique which articulates very easily with a classical use of the bow which shows their potential articulation.

1.3.2 Improvisations

In these audio recordings of short improvisations the reader may hear the articulation possibilities of some of the presented feedback techniques. Each recording shows the development of a particular musical idea.

IMPRO I — 01:24 : Continuous feedback articulating different contact bow points for superimposition of different ringing frequencies, occupying different zones of the sonic specter: low, mid and high. The low resonance, which here is used as a bass-pedal, corresponds to a mechanical vibration of the transducer when the bow is touching a particular point in the C-bout. The higher frequencies are used as “feedback arpeggios”.

IMPRO II — 01:54 : Repeated short feedback notes, playing with reverberation decay. The very light friction of the bow changing the contact point is also used as part of the vocabulary. These movements are so strongly amplified that their presence within the vocabulary becomes very relevant to establish a strong connection between the listener and the performer´s movements.

IMPRO III — 02:24 : Several points of contact and techniques articulated. The start of the recording shows a feedback vibrato which is the result of fast changes in bow pressure in the same exact contact point.

2. Four-signal pan delay

This process is central to achieving the sonic fragmentation of my gestures on the cello. It corresponds to the first moment of the instrument's perceptual sonic disintegration and the diffusion of the four microphones' input; sounds for this process are limited to a stereo PA placed in close range of the cello.

This process had a strong impact on my previous cello-playing techniques, expanding their performativity, while also creating the context for the development of new ones. If the signals from the four microphones, distributed in different points of the cello, are slightly delayed in relation to each other and panned to different positions in the stereo, I can explore the possibility of a perceptual sonic fragmentation of both my gestures and the instrument's body. This is experienced through a superimposition of the different spectral qualities of amplification of each microphone but with techniques that enhance the "live" separation of my left- and right-hand actions on the cello. Usually the actions on the cello have a monophonic result; but this setup means this could change during the performance, to a situation where both hands could be playing with a certain degree of independence and with a more prominent sonic detachment. This system's section also proposed a shift in the understanding of the limits and position of the body of the instrument. When including the two stereo speakers in the background the sonic diffusion is unbalanced in a dramatic way: It introduces a slight temporal and spatial mismatch between the action on the instrument and the sonic outcome.

Adding to the previous setup, this one includes the processing of the four contact microphones and the conventional stereo loudspeaker PA, as a first outside electroacoustic extension of the instrument's acoustic sound projection.

This configuration uses Section 1 of the software with only outputs 1-2 active. These are connected to the conventional loudspeaker stereo PA. The expression pedal is used to articulate between full fragmentation and no fragmentation.

2.1. Setup

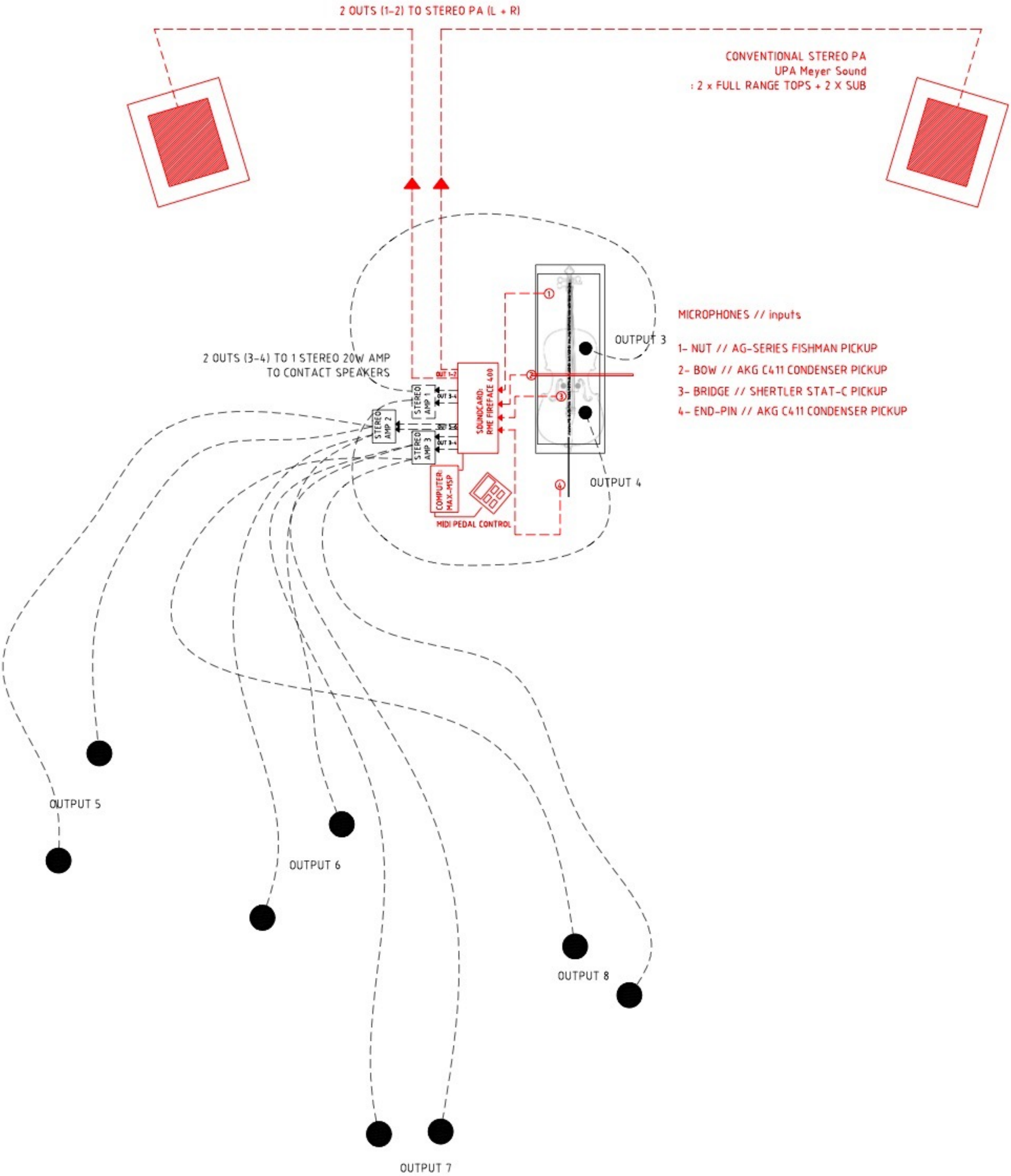


Figure 59. Setup diagram for active components in the Four-signal pan delay

When combining the four pickups, a thorough input gain calibration will be needed (each microphone preamp + the sound card preamps). Since the bridge microphone has a stronger input signal and a more even frequency response in relation to the acoustic sound of the cello, the other microphones need to have more input gain to ensure their performance is clearer. All pickups need to be perceived with “equal” output signal when the pedal reaches 127 (MIDI value). The output volume of the PA and the software output mix (maximum and minimum gain levels for each microphone and variation in threshold compression) should be calibrated in such a way that when the four pickups are active and spread in the stereo the acoustic sound of the cello is masked by the PA. When the pedal is in the minimum position (just the bridge microphone active) the volume of the PA should perform as an acoustic reinforcement, perceptually relocating the sound coming from the cello.

The direct feedback button 2 (blue) is off. The exact values for each of the parameters are adjusted in each location. However there is a basic preset from which I work the final site-specific calibration.

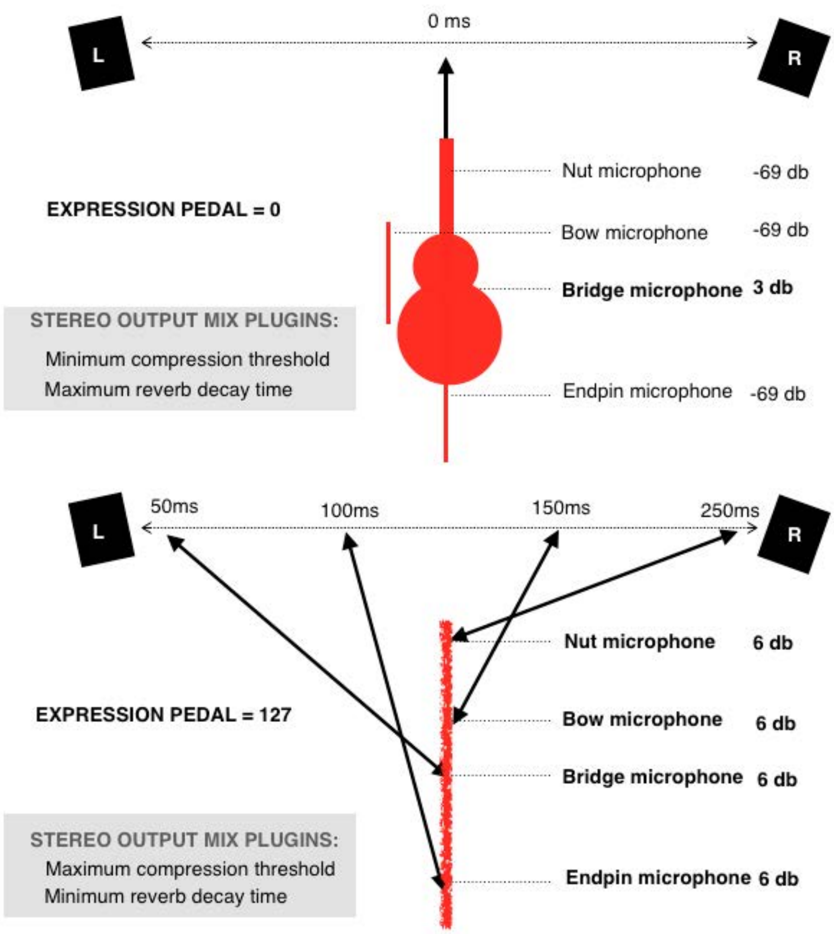


Figure 60: Minimum and maximum Four-signal pan delay diagram

With these relative input gain mixing, delay times, panning positions, compression threshold and reverb decay time, the developed playing techniques demonstrated a better accuracy in the perceptual fragmentation of my playing gestures. A central parameter of the fragmentation effect is the different delays applied to each microphone. Since we perceive anything above 50ms as a separate event (Wallach, Newman and Rosenzweig 1949) one important characteristic is that the maximum delay difference between each contact microphone does not dramatically exceed 50ms, so that the feeling of temporal disembodiment of the sound is minimum. These minimum delay differences, along with the equal volume output and the differences in pan position, all help intensify the perception of a fragmented sonic gesture.

As mentioned in Chapter II, dynamically changing the delay~ time will cause a variation in the pitch of the output signal, emulating the Doppler effect. This aspect of the sound signal was introduced into the fragmentation vocabulary, adding a “glitching” element to the performance.

2.3. Vocabulary

Demonstrations and improvisations

Files also accessible in USB pen drive in folder: CHAPTER III / 2_Four-signal pan delay

(Audio-visual documentation, presenting a group of relevant techniques and short studio improvisations with the process of Four Signal Pan-Delay.)

2.3.1 Demonstrations

DEMO 1 - 00:46: Horizontal bowing on open string while changing the mix from a single microphone to four microphones with changes in all the subsequent parameters (delay, panning, compression threshold and reverb decay time).[39]

DEMO 2 - 00:42: Playing with open string plus second string stopped. Full fragmentation to direct sound and back. Changes with expression pedal changing the pitch with different velocities.

DEMO 3 - 00:23: Open C string. Changes in bow pressure exploring the sound of the shaft touching the string.

DEMO 4 - 01:03: Single stop with vibrato and playing with the clearly heard overtones. The bow changes are much more audible and therefore they are used as expressive sounds. While full length bowing you can hear the overtones produced by the change of the moving node resultant of the contact of the string with the bow. Listen how the overtones produced superimpose to the friction sound of the hair touching the strings surface and the frequency of the string´s fundamental. Different stopped notes and their overtone qualities are exemplified. Vibrato is fundamental to “pull” (excite) the overtone.

DEMO 5 - 00:40: Bowing natural harmonics with full fragmentation parameters. The light and evanescent quality of this technique is here expanded to include the resonance of the top nut (privileging the higher harmonic content of these sounds) plus the sound of the bow hair scrubbing the string.

DEMO 6 - 00:35 : Continuous bowing using the bow stick (colegno) in contact with the open strings while exploring the space between the fingerboard and the bridge with a mix of horizontal, vertical and circular movements. Playing the stick and the hair at the same time can expand the texture of the bowing. The two contrary glissandi that we can hear when playing this technique of vertical/circular *con legno* bowing are now clearer due to the discrete amplification. Left hand mutes, opens or stops the strings. Try different bow pressures to increase or decrease the presence of the bow stick in the overall sound.

DEMO 7 - 00:56 : With the previous bow technique (stick bowing an open string) use the left hand to rebound the bow against the string. The right hand keeps the bow slowly moving up and down while the left hand performs a vertical “wave tapping” near the tip of the bow.

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[39] When bowed, un open string excites both the Bridge and Top Nut microphones with the same intensity. When playing stopped notes with left hand the Bridge microphone is more present. Therefore one can play with this notion exploring the relations between open and stopped strings.

DEMO 8 - 00:57 : Using the *Col legno battuto*[40] technique explore different points of contact between the bow stick and the strings in order to increase the variability of sounds that specially the nut, bridge and bow microphones can capture. While playing sounds with clear and short transients the fragmented perception of each action is very clear.
DEMO 9 - 00:41 : Placing the bow stick on the string and playing with the left hand an open string pizzicato letting the bow rebound on the string. Slow bow movements up and down and changing the pressure to control the rebound can add variability to the produced texture.
DEMO 10 - 00:07 : I pressure the bow hair against the string (close to the bridge), keep it in a fixed position and play pizzicato with the left hand releasing the upper portion of the string. If I change the bow stop to different positions, different muted pitches can be heard.
DEMO 11 - 00:36 : Just using the left hand tapping the fingerboard in chromatic patterns we can hear very clear the two distinct pitched sounds which are produced by the two lengths of the string to the bridge and to the nut. To mute the portion of string from the stop to the bridge pressure the bow hair against the played string (no movement) between the bridge and the fingerboard: now its the bow microphone that is more active thus changing the fragmentation image.
DEMO 12 - 00:29 : While performing the previous gesture I include the right hand with a fast pizzicato pattern. The detachment between the two resulting sounds is even bigger thus increasing the detached sonic result of the same gesture.
DEMO 13 - 00:24 : Right hand *pizzicato* plus Left hand tapping with *glissandi.*
DEMO 14 - 00:52 : Right hand pizzicato plus left hand pizzicato with glissandi. In the left hand finger 4 stops the string in a certain pitch while finger 1 performs the pizzicato, starting the glissandi.
DEMO 15 - 00:45 : Right hand pizzicato plus left hand tapping followed by pizzicato*.* In the left hand fingers 3 or 4 stop the string in a certain pitch while fingers 1 or 2 perform the tapping followed by pizzicato.

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[40] References: https://vimeo.com/204404782 // https://www.youtube.com/watch?v=ugG9I_WVB3s

DEMO 16 - 01:18 : Right hand *pizzicato* of open string plus left hand tapping.

DEMO 17 - 00:32 : Natural harmonics with pizzicato. Hear the natural harmonic content through the bridge and the nut microphones. They have the same fundamental tone but different spectral content. The Endpin microphone captures mainly the percussive action on the string.

DEMO 18 - 01:01 : Left hand soft stop fingering and pizzicato with right hand: the left hand finger does not fully stop the string but let it rebound against the fingerboard. This rattling sound is very well “heard” by the nut microphone. This rattle effect is more clear in the C and A strings.

DEMO 19 - 01:25 : Laying the bow stick in a string between the bridge and fingerboard and tapping with the left hand the string against the fingerboard. Control the rebound rattle of the bow by applying different pressures and changing the point of contact. Vertical bow movements imply change in pitch.

DEMO 20 - 00:46 : Holding the bow vertically and placing the screw between two strings. Hammering the strings continuously with the frog by bouncing it from side to side hitting alternately the two strings. The left hand can mute or open the strings which are being hit. When this action is performed very near the bridge the sound of the screw scratching the bridge is also overlaid.

DEMO 21 - 00:53 : Following the previous position of the bow I use the left hand to pull the open string and rebound the screw against different points of the string between the bridge and the fingerboard.

DEMO 22 - 00:30 : Placing the bow hair on the strings and using the left hand to mute or open the four strings while applying a strong vertical pressure with the bow on the strings. The bow should not move neither horizontal or vertically but in a rotating motion around the point of contact. Changing the different contact points (between bridge and fingerboard) introduces a change in the noise pitch. Bow velocity can change and slow transversal bowing can be applied in articulation with this particular technique.

DEMO 23 - 00:32 : Place the bow parallel to the strings on top of the body, between the f- hole and tailpiece. Apply a strong, but varying, vertical pressure smashing the hair against the body´s surface and slightly rotating the bow around a center pressure zone.

DEMO 24 - 00:58 : Muting the strings with the left hand and using the bow between the bridge and the fingerboard with a soft pressure with up and down movements. After changing the contact of the bow to the edge of the C-Bout I explore the different

resonances along this corner applying variations in pressure. Return to the strings below the bridge and exploring the noise produced by an intense pressure of the bow.

DEMO 25 - 00:40 : Exploring the contact between the bow and the zone around the fine tuners (tailpiece and strings) apply variations in pressure.

DEMO 26 - 01:33 : Bowing up and down the endpin with light pressure while exploring long and continuous bowing using the bow stick or bow hair. Using different bow pressure, velocity and contact points on the pin will affect the overall resonance of the instrument adding changes in the noise pitch sensation.

DEMO 27 - 01:10 : The endpin is off the cello strap and in contact with the floor. Dragging the cello on the floor with the endpin will function as a “turntable needle”. Extend this action to the bow and combine them.

DEMO 28 - 01:36 : Place the cello in an horizontal position over the lap. The lap position provides a freer vibration of the instrument´s body and lower resonances can be heard. Bowing the tip of the pin exploring different pressures. Increasing the pressure in this point provides the exploration of low muted sounds. Bow the entire length of the endpin exploring different pressures and contact points for sound variations. Bow the tailpiece loop for high pitched sounds. Use the left hand tapping in the fingerboard for a combination of techniques.

DEMO 29 - 00:38 : Slapping along the endpin with thumb and plucking the tip of the pin. Using combined techniques: bowing the endpin while the left hand taps the fingerboard and slapping the endpin while tapping the fingerboard.

2.3.2 Improvisations

The previously described techniques are a central part of the “exploded cello” vocabulary and they were used in multiple improvisations (live and studio) along the research period. The following audio files include a selection of studio recordings where these fragmentation techniques were used in the context of short improvisations (i.e. studies) thus showing further vocabulary explorations around their specificities and articulations. These improvisations were done using only three contact microphones, excluding the endpin.

IMPRO I — 07:40 : Bow and left hand pizzicato in full fragmentation mode.
IMPRO II — 04:43 : Long drone with open C string plus chromatic variations in full fragmentation mode.
IMPRO III — 02:52 : Rhythmic patterns with frequent pedal variations.
IMPRO IV — 04:08 : Peg glissando varying the tuning of the C string.
IMPRO V — 06:52 : Transition from very soft to aggressive bowing.
IMPRO VI — 04:27 : Vertical bow pressure plus aggressive high pitched noise bowing.
IMPRO VII — 04:04 : *Ostinato* with bow screw plus rebounds.
IMPRO VIII — 06:53 : Natural harmonics in full fragmentation with pedal variations.

Along these short improvisations the reader may experience an orchestral approach to their development. The use of this process (pan-delay) has allowed me to expand a simple technique of, for example: tapping, into a powerful “orchestral” approach to cello playing. Both hands and bow are suddenly separate, with some perceptual independency, but complementary agents of sonic production. This is very interesting from the performer´s perspective as it provokes my listening into different sonic outputs from a same source (i.e. cello) and therefore widening my own listening of the instrument.
This process has proved to be very playful and responsible for a considerable part of the exploded cello vocabulary.

3. Direct resonance in external objects

This is the first process in the Exploded Cello´s vocabulary of Dispersion. It is still a manipulated process as it is an effect caused by the direct sound of the cello resonating through a transducer in external objects. This was also a very important part of the research and I experimented with this setup in several contexts including solo and ensemble concerts.[41]

Most materials and forms resonate with the use of vibrational transducers, but one needs to find the correct transducer and mount it appropriately and the referred spectral changes to the sound of the cello will occur. Nevertheless, there are objects with designs and materials which can potentiate the spectral encounter with the sound of the cello. Throughout the research period I explored this process with different kinds of objects: painted metal structure, rusty metal staircase, long metal beams, cymbals, piano, cello, aluminium structure, styrofoam box and panel, ceramic jar, wood beam, alveolar polycarbonate sheet and cardboard box. As an example in this chapter I will concentrate on the techniques resultant from activating the natural resonant frequencies of two types of external objects: cymbals and a light metal structure.

Cymbals are very rich and non-linear resonating bodies with a lot of inharmonic partials, the complexity of which depends on the amount of energy inducted to the cymbal. The research undertaken by Scott Mc Laughlin was very informative for the development of the vocabulary for these particular objects [42]. Playing different pitches with varying dynamics on the cello would activate different cymbal overtones and colour the sound of the cello in different and unpredictable ways. Pitched cello material for each of the used cymbals derived from pre-analysis of the resonant frequencies of the specific cymbals. The improvisations include playing with the set of derived pitches, along with careful testing of dynamics (i.e. range of amplitudes) that keep the system (i.e. cymbals) between silence and the threshold of non-linear vibration. Both video

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[41] See Appendix: List of solo and ensemble performances

[42] Scott Mc Laughlin, "Resonant Systems: multiphonic resonance complexes in sine-wave excited cymbal clusters" 2015 http://lutins.co.uk/ResonantSystems.html

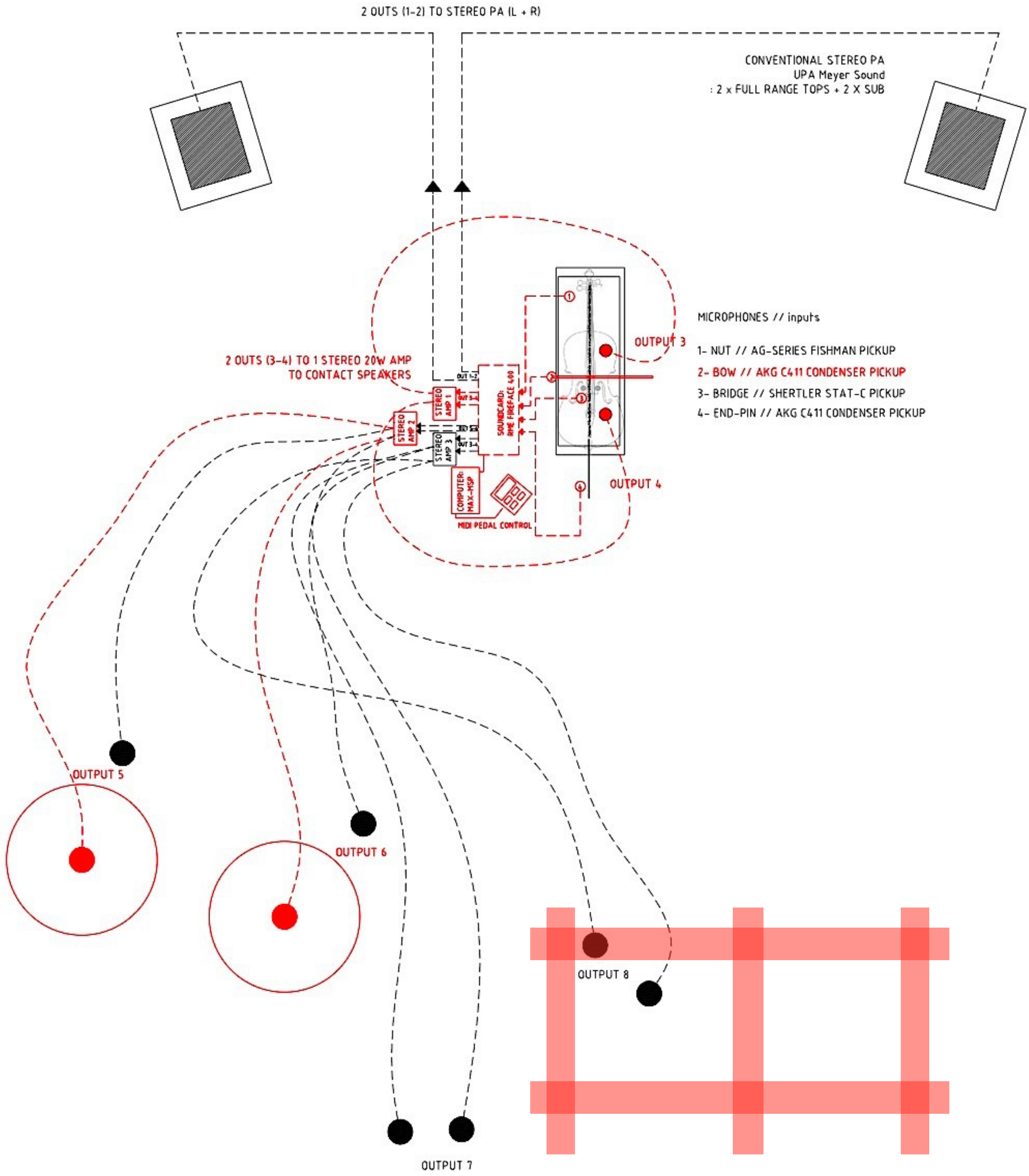
demonstrations and audio-recorded improvisations explore the audible pattern generation of the system through performance, locating frequencies that excite different forms of periodic oscillation. Playing with dynamic variation near the bifurcation points of the system (from periodic and quasi-periodic to chaotic instability) creates a situation where the reaction between the cello performance and the resulting resonance of the cymbals is very unpredictable but clearly dependent on the excitation frequency (pitch) and playing dynamics.

The **light-metal structure** used in the following demonstrations show the character of rattling noises, produced by the vibrating parts of the structure, in articulation with its harmonic resonance properties. These types of resonating structures, plus the acoustic projection of the vibration noises, are relevant to the extension of the dispersion Exploded Cello vocabulary since it introduces a direct sonic performativity of the external object.

The selection of external resonating objects poses different questions regarding my choice of cello vocabulary to perform their resonant specificities. It is important to mention that all these objects reveal a large degree of inharmonicity, which introduces very unpredictable “distortions” to the sound of the cello.

3.1. Setup

More vibrational transducers outputs were added to the previously discussed setup. These were used on two cymbals and the light metal structure. The only active input is the bridge pickup direct sound with a final mix compression and reverb DSP. This setup uses Section 1 of the software controlling the variation of the microphone gain from just the acoustic sound of the cello to the extreme resonance of the objects. This is performed with the use of the expression pedal.



Figures 61: Active components for the direct resonance in external objects (RED)

3.2. Software Calibration

Transitions will be managed by a slow ramp. Linear variations will also occur in the decay time and threshold compression values. It's very important to calibrate the amount of reverb decay and threshold compression in the output mix so that the object performs the cello resonance as if another space was being presented inside the objects.

3.3. Vocabulary

Demonstrations and Improvisations

Files also accessible in USB pen drive in folder: CHAPTER III / 3_Direct resonance in external objects

(Audio-visual documentation, presenting a group of relevant techniques and short studio improvisations with the process of Internal Feedback.)

3.3.1 Demonstrations

Explorations around the natural harmonic resonances of three objects (two different cymbals and a light metal structure).

[Cymbal A]
DEMO 1 (01:18) Long bowing an open string. The continuous bowing with slight changes in dynamics has different results in the activated partials.
DEMO 2 - 00:49 : Microtonal and chromatic variations around a central tone.
DEMO 3 - 01:06 : Articulation of four tones trying out microtonal inflections and dynamic variations.
[Cymbal B]
DEMO 4 - 02:10 : Slow scale in the full arm length testing the resonances of the different notes in different octaves.
DEMO 5 - 01:21 : Testing three pre determined resonant notes separately and then superimposing them to explore the beatings of the activated partials
DEMO 6 - 00:31 : Testing resonant note in four octaves.

DEMO 7 - 00:51: Upward microtonal changes searching for resonance differences. [Light-metal structure]

DEMO 8 - 00:49 : Exploring the resonances around a central very resonant tone. Changing the octave.

DEMO 9 - 00:21 : Continuos bowing articulating two notes with microtonal difference.

DEMO 10 - 00:38 : Starting with extreme bow pressure with indefinite pitch, very noisy and harsh sound. Transiting to clear pitch. Changing to slow downward glissando.

DEMO 11 - 01:20 : Upward glissando on each string. Moving from open string to end of fingerboard.

DEMO 12 - 01:20 : Short phrases with pitch and dynamic variations exploring the different rattling resonance.

3.3.2 Improvisations

Studio improvisation between the cello and external resonant objects.

[cello + cymbal]

IMPRO I — 02:58 / Fast continuos microtonal trill playing with dynamic and velocities.

IMPRO II — 02:26 / Pizzicato patterning around a limited group of (resonant) tones.

IMPRO III — 02:23 /Right hand uses the bow to produce a soft noise between the bridge and the tailpiece, while left hand performs and “thumb” pizzicato melody.

IMPRO IV — 00:59 / Aggressive bowing and fast noise changes to natural harmonics.

[cello + light metal structure]

IMPRO V — 01:53 / Continuous bowing with glissandi variations.

IMPRO VI — 01:18 / Free pizzicato patterning.

IMPRO VII — 00:52 / Rebound with bow´s screw and resonance imitation.

IMPRO VIII — 00:57 / Pizzicato and bowing dialogue.

Both objects (cymbals and light metal structure) were highly susceptible to tonal excitation keeping a sympathetic resonance with the melodic development. Dependignon the object, material and design there are stronger and weaker resonant tones which in the course of the improvisations are fundamental to establish the played patterns and the melodic development. Once again this process of Direct resonance in external objects reveals a strong connection to the a myriad of techniques while introducing a second color to the cello which thickens the spectral control of the instrument: bowing and pizzicato actions are conditioned by the direct resulting resonance, and therefore my playing adapts directly to this relation.

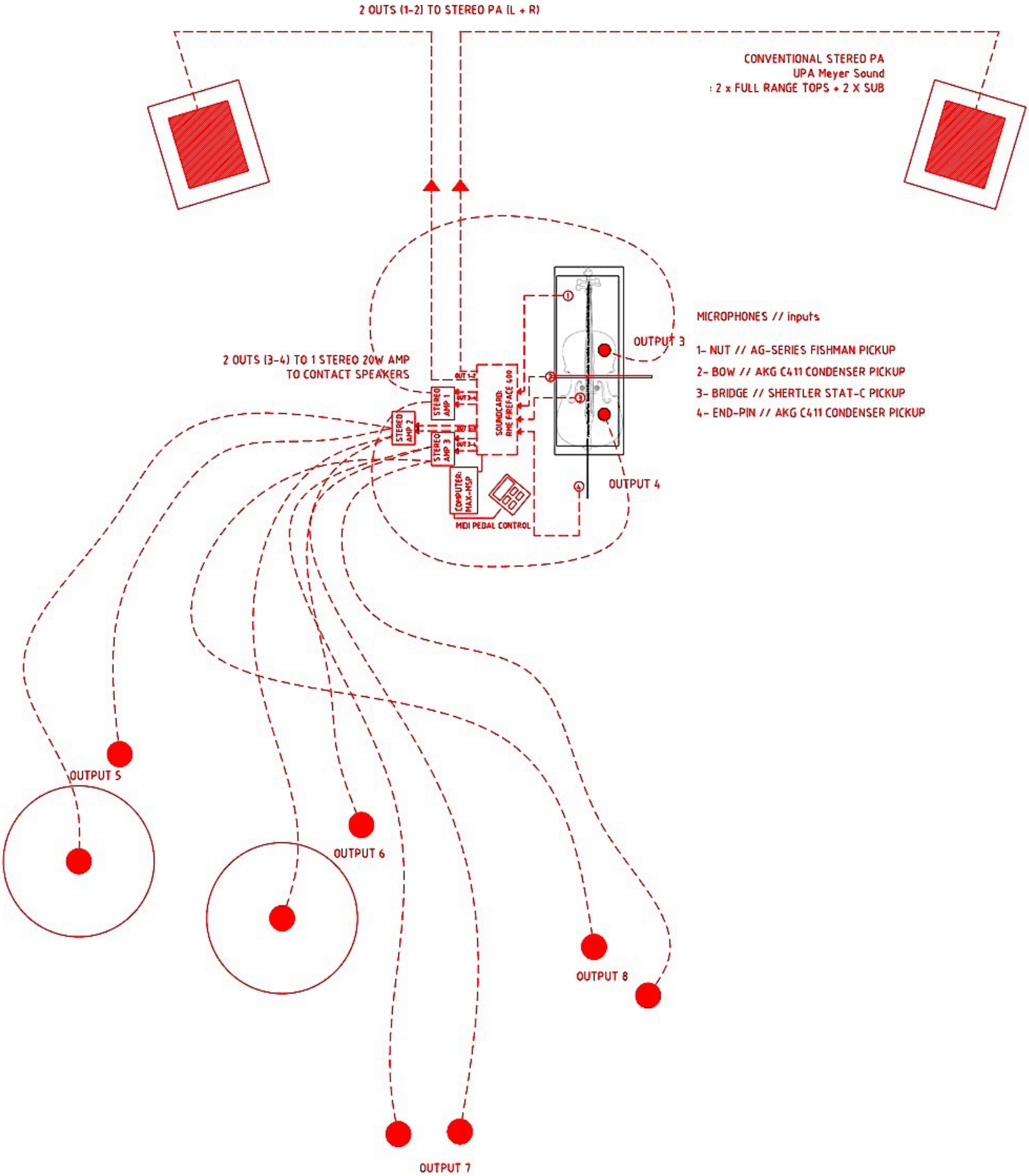
4. Automated and distributed feedback network and granulation

These processes are the basis of the sonic output of the installation period. Their internal processes of feedback auto-regulation and continuous automated granulation of periodic sampling of the cello's manipulation (during concert) or the feedback network's outputs, create the sonic vocabulary which occupy all the outputs in the electroacoustic device. These processes may be independent from my presence as a performer (manipulating the device) and therefore the device slowly transforms itself into a permeable space that the audience can experience as an installation.

Although both processes are integrated in an interactive internal system they can operate independently. This is a feature that is mostly used in the transition period from concert to installation. Nonetheless, in a situation where the intervention's macrostructure assumes a comeback from installation to concert, then these processes can assume different interactions during the installation period, reflecting also the type of improvisation development.

As in the previous setup, these processes will be presented with the total of the system's device hardware functioning without any direct manipulation. This configuration introduces the use of Section 2 of the software. This includes the two mentioned processes (feedback network + granulation), which are automated with a limited amount of unpredictability . In this period Section 1 is also active in full fragmentation (expression pedal at 127), thus interacting with the automated results of Section 2 in the spatialization process. The demonstrations and improvisations for this setup use a pair of cymbals as resonators.

4.1. Setup



Figures 62: Active components for the automated and distributed feedback network and granulation (RED)

4.2. Calibration

As discussed in Chapter II, this section of the software sends a maximum of ten discrete signals to all the physical outputs connected to vibrational transducers[43], widely distributing the generated sonic material. The two processes of feedback network and granulation work independently but may also be integrated, as the granulation process can be applied to the generated feedback network.

4.2.1. Feedback network (FBN)[44]

Besides the plugin's native parameters the calibration involves three other parameters:

1. Maximum value to outputs 1-2 and 3-4: This depends on the overall mix of the installation and is dependent on the amplifier's output volume and the resonance of objects. Once the maximum value is set, this fader is controlled by button 1 in the foot pedal.
2. A periodic triggering of the patch's internal randomisation can be automated by pressing ON in the toggles next to the trigger bang. Then the interval of the [metro] objects in each FBN plugin can be set independently. If these are activated with the same interval then a pulse will be recognisable in the overall unpredictability of the feedback network texture.
3. Below each FBN plugin there are reverb plugins where one can adjust the perceptual distance of the signal for each of these outputs.
4. A volume fader for general randomised signal degradation is also available. This sub-process can be adjusted to have more or less presence in the general output.

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[43] In this recording session there were only four transducers active.

[44] The Feedback Network used here is based in a native plug-in from Max 7 with slight transformations described above.

4.2.2. Granulation

In this context the granulation process aims at the impression of a “flow of sonic debris”, an image of continuous dispersion. The unpredictable nature of this dispersion is due to a random automation of several parameters of the electroacoustic device’s dedicated software. It is based on 6 buffers which are continuously recording a 2000ms sample of input signal from the cello or from the feedback network. These buffer samples are then played in different starting points with different durations at different speeds, direction and pitch. All of these are randomized and there is a main density control. This control affects the maximum amount of time between each playback of the same sample, thus resulting in more or less denser clouds of grains. The randomization of the granulation process starts once the patch is loaded. Main calibration involves setting maximum input volumes when the process starts, selecting the number of buffers in use for the granulation, determining the interval between each sample recording and adjusting the different decay time of the reverbs and compression threshold. The control of the distance perception of the sounds is important: There should be a sense that the sounds diffused by the contact speakers are positioned within a larger architecture, contrasting with the haptic and proximal resonances of the object’s surface. It is important to evenly adjust the output volume of the speakers according to their position in space and the resonance properties of the used objects/architecture.

4.3. Vocabulary

Demonstrations and Improvisations

Files also accessible in USB pen drive in folder: CHAPTER III / 4_Automated feedback network and granulation”

Audio-visual documentation, presenting a group of relevant techniques and short studio improvisations with the process of Automated and distributed feedback network and granulation.

4.3.1 Demonstrations

The following videos show different modes of interaction between the cello, the stereo PA and a couple of external objects (i.e. cymbals) with the software in installation mode.

DEMO 1 - 01:35 / Just the feedback network active.
DEMO 2 - 02:12 / Just the granulation process working.
DEMO 3 - 03:07 / Both processes interacting.

4.3.2 Improvisations

Articulation of the manipulated cello with the automated processes of the software: Feedback networks and Granulation.

IMPRO I - 02:31 / Articulation between the internal feedback and the feedback network operating with fixed pulses and auto-feedback off.
IMPRO II - 01:23 / Articulation between the four signal pan-delay vocabulary with automated granulation and feedback network processes.
IMPRO III - 01:54 / Articulation between direct cello (low register) and granulation automated processes.
IMPRO IV - 00:58 / Articulation between direct cello (natural harmonics) and granulation automated processes.
IMPRO V - 02:06 / Articulation between direct cello (bow starts in spiccato motion and transits to soft bow hair noise) and granulation automated processes.

Both processes establish different but strong connections with both manipulated processes (Internal feedback and Pan-delay).
For obvious reasons (sonic similarity) the manipulated Internal Feedback performed against the automated Feedback Networks create a texture which is very dense, with the cause of the sounds being very difficult to distinguish. At

the same time my improvisation seems extremely consequent with the randomly automated material.

The last three studies show how the automated sampling of the material I play influence the granulated texture. The material I use during the improvisation transforms the background fragments and the improvisation is developed around the the expectation of the transformed grains. At the same time the resultant sonic material creates new perspectives on the soundscape thus establishing fast interactions between the outside and inside acoustic horizon.

In order to have some control over the overall resulting texture I need to maintain certain limits to the material I use (Improvisations III and IV) are good examples of this.

Chapter IV - Spatial and Temporal Strategies

The previous chapters introduced: the metaphorical and conceptual premises of this research, the description of the system hardware and software setup, the precepts for its activation (including calibration, performance and installation techniques) and a review of the developed Exploded Cello vocabulary. This systematic approach gave the reader a clear overview of the of the system's development, lacking only the variability of musicking aspects (Small, 1998) and installation procedures of site-specific live concert-installations.

This system was designed to explore a particular approach to the relation between a solo cello performance and the site where it takes place. This approach extends the aspects discussed in the previous chapters with installation practices (with architectural and sculptural dimensions) where the spatial design of the site is an integral part of the system. These aspects reflect and are reflected in the temporal development of the musical performances and it is their intersection that configures a portrait of a particular and specific relation to a here and a now. In all the selected iterations the Exploded Cello system assumes an instrumental character adapting the relations between the electroacoustic device, the cello improvisation performance and the specific designed or selected external objects. In this portfolio we can track its development through contact with different contexts and sites (among them gallery spaces, industrial spaces, stages and open-air public spaces) and see how site influenced the different setup configurations (spatial) and activation modes (temporal).

None of the presented iterations use the system exactly as presented in its final and revised version of the previous chapters. Each iteration presents a developing version of the system (hardware and software) and its musical and installation strategies. While keeping the fundamental structure of the electroacoustic system, each project had specific software and hardware design adaptations and developments which resulted in distinct outcomes, both in the performance and the installation realms, as well as in their intersection.

Particular results from each of the iterations informed the current version of the electroacoustic device presented in the previous chapters. While presenting the relation of the system with different sites and contexts and its capacity to play with their specificities, this portfolio also documents the history of the system's developments and upgrades.
The documentation for each project includes a written commentary alongside photos and drawings. As in the previous chapters audio and audiovisual documentation can be accessed online (http://www.osso.pt/derivas/explode_cell/) or in the documentation folders inside the USB pen drive.

In the written commentary the following topics are addressed:

SITE: description of the commissioned project or invitation including characteristics and particularities of the architectural and geographical environment and details regarding the approximation methodology.
SETUP: the adaptation of the device to the site's specificities, including the choice of resonant objects and the spatial plot of the device, plus the hardware and software upgrades and specifications.
ACTIVATION: performance precepts, structural description and analysis of specific relevant moments of the documentation (audio and video). The last project included in the portfolio (MEDUSA) will have a more detailed description of these aspects as it represents the most complex version of the research.

These four topics will structure the analysis of the selected six public iterations of the Exploded Cello system:

I – CASCA (Rind): Colégio das Artes de Coimbra
II – EXPLODIDO (Exploded): Antiga CUF, Barreiro
III – SEGMENTOS (Segments): Vera Appleton Gallery, Lisbon
IV – LA HALLE (The Hall): Ferme du Buisson, Paris
V – REFLEXO (Reflection): Public art circuit / Sao Miguel, Açores
VI – MEDUSA: Performing the museum / Museu de Serralves, Porto

CASCA

Concert-Installation for cello, electronics and resonating structure
Location: COLÉGIO DAS ARTES DE COIMBRA
Date: 27th JUN – 26th SEP 2014

Figures 63: Installation view of "CASCA" (2014)

1. Site

1.1. Intervention context

This proposal was curated by the students of the Masters Programme in Curatorial Studies at Colégio das Artes, Coimbra University in 2014.

> Curatorial Lab #1:
> The curatorial Lab is a collective project of the students of the Masters in Curatorial Studies, inserted in the Seminar of the Course. It presents itself as a space of curatorial experimentation in close collaboration and dialogue with the invited artists. The cycle of interventions of 2014 was titled "Try the next step" and was developed in three moments with interventions by Fernanda Fragateiro, Ricardo Jacinto and Francisco Tropa.
>
> *(Presentation text of the project)*

Each invited artist based their intervention on a pre-existing architectonic structure designed by Architect João Mendes Ribeiro. This object was originally used as a room to exhibit a group of drawings by the same architect.

Figures 64 and 65: Pre-existing structure by Arch. João Mendes Ribeiro

> Exhibiting this set of drawings in a room of the College of Arts, former Hospital of the University of Coimbra, brought the confrontation of scales from which the exhibition project was thought. The delicate size of the drawing, on the one hand, and the large space of the old hospital space, on the other hand, forced the exercise of space within the space, which resulted in an expository structure capable of large-scale screening and of approaching the observer. A light metal structure suspends the twenty-two drawings in a circular enclosure, enclosed by a white curtain, invoking the memory of the old hospital both functionally and visually: the curtain used to compartmentalise the large infirmary in spaces of comfort and intimacy is supported, in terms visual, by the approach to the white, metallic and aseptic universe of medicine.
>
> *(Architect João Mendes Ribeiro / Descriptive report of the exhibition project)*

The presence of a curtain hanging from the white metal structure presented this scenographic memory of what once was the “comfort and intimate” space of the infirmary. At the same time the curtain was an element of theatrical presence, which turned that interior space into a stage, transforming the spectators into characters. The central column had also been decontextualised and, in losing its functional relation to the building structure, became scenery in itself.

Figure 66: Interior view of pre-existing structure

1.2. Spatial morphology and aural conditions

This scenographic object was built around a column in the centre of a large room on one of four aisles around a 2000m^2 cloister. The plan of the building shows a series of large rooms connected by 3m-wide door openings. These rooms functioned as the University exhibition gallery. The ceilings were high and there were four windows in the south corner (so you could listen to the street noises down below). These rooms were very resonant and had an overall reverberation time of around 4.5 seconds. The room designated for the presentation was situated in the corner of the building. The opening on the north wall let the sounds escape and reverberate in the adjacent empty rooms.

Figures 67: Building plan with gallery area

In a first visit to the intervention site I did a series of sound recordings and photographs to document the venue. These recordings helped to document the resonant character of the room and the character of the outside soundscape, including the church bells. The character of this repetitive sound, marking the passage of time, was later incorporated as a reference for the piece’s structure.

2. Setup

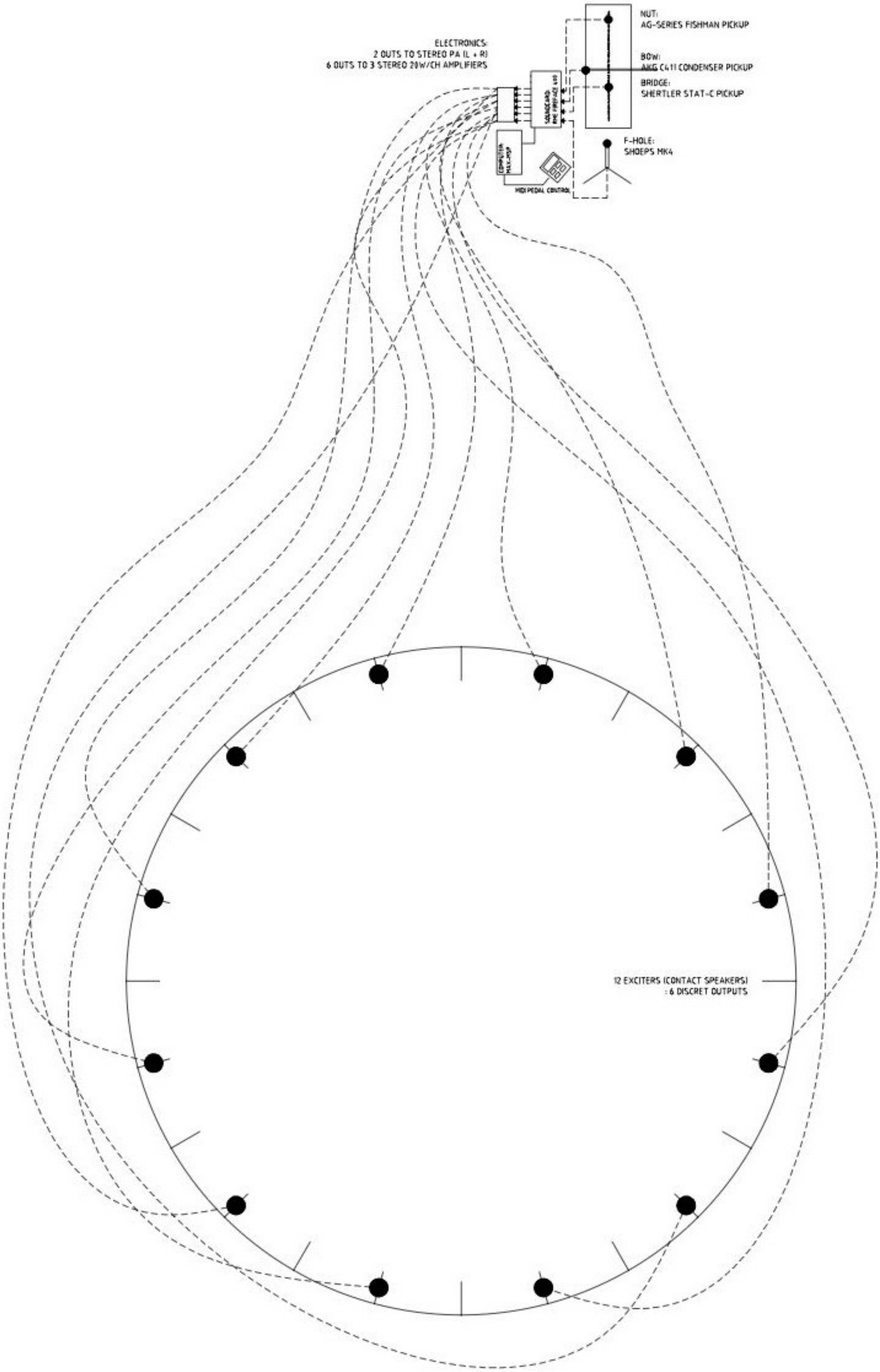


Figure 68 “Casca” setup plan

2.1. Resonant objects and spatial plot

The first step of my intervention consisted of taking the curtain from this “room” and using just the metal structure as the resonating object for the performance sounds. The small architecture lost its function of clearly creating an interior exhibition space inside the building and its new configuration revealed a much stronger degree of abstraction: a circular metal structure around a column— an echo of the column’s geometry. The cylindrical space kept its borders but they were much more “transparent”. The overall spatial configuration was now much more present.

The sounds were diffused by transducers attached to the metal sheets, which previously held the drawing frames. The room’s configuration and the position of the metal structure around the column of the first room informed the plot for the performance-installation because they led me to the identification of two possible sound trajectories for this piece:

1. Longitudinal: The sequence of large empty rooms right beside the performance room added a particularly long reverberation and distant resonances to any sound produced. The room where the piece was installed and performed was located in one of the corners of the building, and adjacent to it there was a sequence of connected rooms with similar scale. The sounds produced in this corner room echoed through these spaces and “died” far away in the building.

2. Circular: The circular and equidistant distribution of the transducers around the metal structure defined a multi-speaker sonic geometry which could be used with rotating motions of sound around a central architectonic object: the column.

Figure 69: Diagram for the main sound trajectories

These trajectories defined this iteration both spatially and temporally. The identification of these two “movements of sound” was very important in informing both my improvisation and the Max patch behaviour. On one hand we have the resonances of the cello’s sounds in the adjacent rooms, and on the other we have the circular transducer distribution around the metal structure. These correspond to different acoustic horizons with different characters, which in turn corresponded to different sonic material and improvisation approaches.

2.2. Hardware and Software

Although the metal structure was heavy and not extremely resonant, I used the Dayton DAEX25 transducers. They were easy to attach (glue) on to the surface of the structure. The larger panels were used for that and the transducers were equally distributed around the structure. For this iteration I developed the first version of the Max programme. By then the software was a sketch of its current form (as described in Chapter II).

Eight short buffers managed the outputs for the transducers attached to the metal structure. The short differences in length of each buffer gave the repetitive textures a continuous difference. The eight sequenced transducers were initiated in an additive circular motion.

3. Activation

3.1. Documentation

I - CASCA (2014)

: click for photos, videos and audio files

Files also accessible in USB pen drive in folder: CHAPTER IV / I CASCA”

CONCERT PERIOD: Audience enters the room and positions itself freely in space. A group occupies the floor in the interior of the structure and the rest sit or stand around it. The lights go down in the room and there is only one spot projector on the cello. The concert initiates.

CYCLE I.wav ________________________ 12:03
CYCLE II.wav________________________ 09:46

INSTALLATION PERIOD: After about 23 minutes the acoustic cello playing fades out and I start adjusting the mix of the eight samples. Performance ends. Audience starts exploring the resonances of the metal structure by walking around it and through it, listening in close proximity to the sound source. For two hours the audience could drift freely in the space. After the night of the concert the installation was opened to the public for a month, diffusing in sequence the recorded buffers from both cycles.

CASCA_TRANSITION.mov ______________ 12:03

3.2. Temporal macro structure

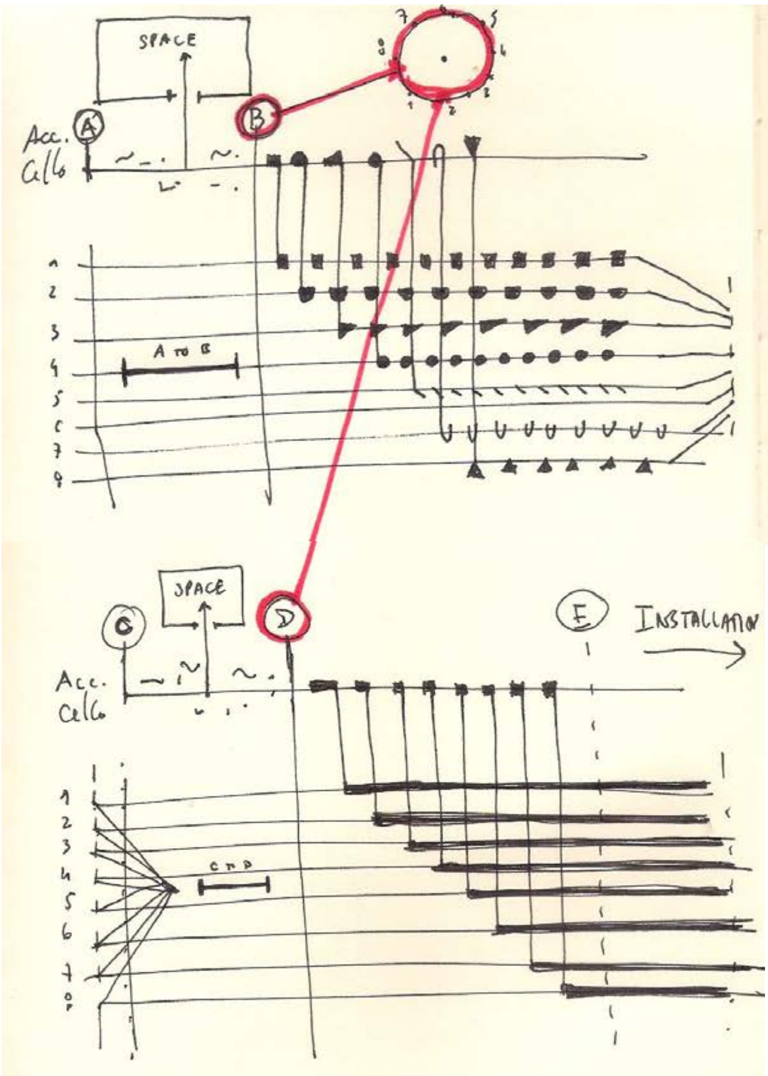


Figure 70: Sketch of temporal macrostructure

The concert was divided in two cycles, making a similar use of the interface but with different results. Both explored the two previously identified “horizons” but with sonic material that differently explored the resonances of the structure material and its impact on the architecture.

Each cycle included an acoustic improvisation, exploring the room resonances and the space reverberation. The second period of each cycle followed the recording of samples in eight buffers (with different time lengths) which were looped during an unplanned period of time, each outputting to one of the eight transducers attached to the structure. This was followed by a period of improvisation with this new sonic ambient. A foot pedal toggle faded out this group of sounds.

In Cycle I the sampling occurred with short, transient, pizzicato sounds. The different sampling durations create a polyrhythmic effect. It is relevant to notice the relation to the previously recorded church bells and the similarity in the opening sample of the piece.

In Cycle II, continuous bowed sounds were the selected material for creating a more static and polyphonic texture. Improvisation happened within this texture, changing it along the melodic and noisy development of the cello soliloquy. In this cycle the sampled loops acted has “continuous echoes” of the improvisation.

The Installation period was occupied by the sounds of the last sampled long bowed notes creating a dense polyphonic and organic ambient sound contrasting with the static and geometric presence of the metal structure.

EXPLODIDO

Concert-Installation for: cello, electronics and resonating structure

Location: PARQUE INDUSTRIAL DA ANTIGA CUF // BARREIRO

Date: 13th SEP – 11th OCT 2014

Event: DA FÁBRICA QUE DESVANECE À BEIRA TEJO // curated by CLAUDIA RAMOS

https://dafabricaquedesvanece.wordpress.com/about/

Publication: Catalogue of the exhibition // Ramos, Claudia // Sistema Solar 2018

Audio CD edition // OSSO #1

Figure 71: Installation view of “EXPLODIDO” (2014)

1. Site

1.1. Intervention context

This iteration is the consequence of an invitation for an artistic residence to prepare a site-specific intervention in the territory of the former *União Fabril*, now *Baía do Tejo*, an semi-abandoned industrial area in the city of Barreiro (Portugal). According to the curator Claudia Ramos "(…)the project does not seek to restore memories or legitimize a past (…). We are mainly interested in studying, discovering, launching ourselves into a vast territory full of signs and marks of a history."[45] Since the beginning of the 20th century this was an industrial territory and around 1950 it had over 8,000 workers working there everyday. Nowadays this is mostly an abandoned area with some of the old buildings loosely operating with different transformation activities.

Figure 72: Intervention territory

In my first visits to the site this landscape evoked a temporal suspension expressed in the abandoned buildings in ruins with fragments of objects scattered in the ground, inside and outside. This was a large, flat land area marked by a matrix of degraded asphalt streets with empty old warehouses in between them. The difference between the buildings still in use and those abandoned was unclear. To prepare the intervention I walked around collecting bits of objects and taking photographs. The streets and empty blocks covered with leftovers, old objects, and suddenly the carcass of a four-story building

[45] https://dafabricaquedesvanece.wordpress.com/about/

erupts from the industrial flatland. A ruined staircase in one of the facades evoked the a notion of a “dead” passage, of a “ghost” in motion, of an architecture of fluidity in suspension. This staircase was marked as the resonating object for this iteration.

Figure 73 and 74: Intervention territory

1.2. Spatial morphology and aural conditions

Each invited artist had to choose a location for their intervention; in my case an old, empty warehouse was the selected space for the concert-installation. With an open plan of 30 x 20m the warehouse was an extremely resonant space with a reverberation time of about three seconds.

Image 75: Interior of assigned building to present the work.

After an initial period of site recognition the previously spotted metal staircase was detached from the abandoned building and fragmented into three parts; these were transported to the warehouse for later use as resonating objects in the concert-installation.

Image 76: Fragmented staircase placed inside building

2. Setup

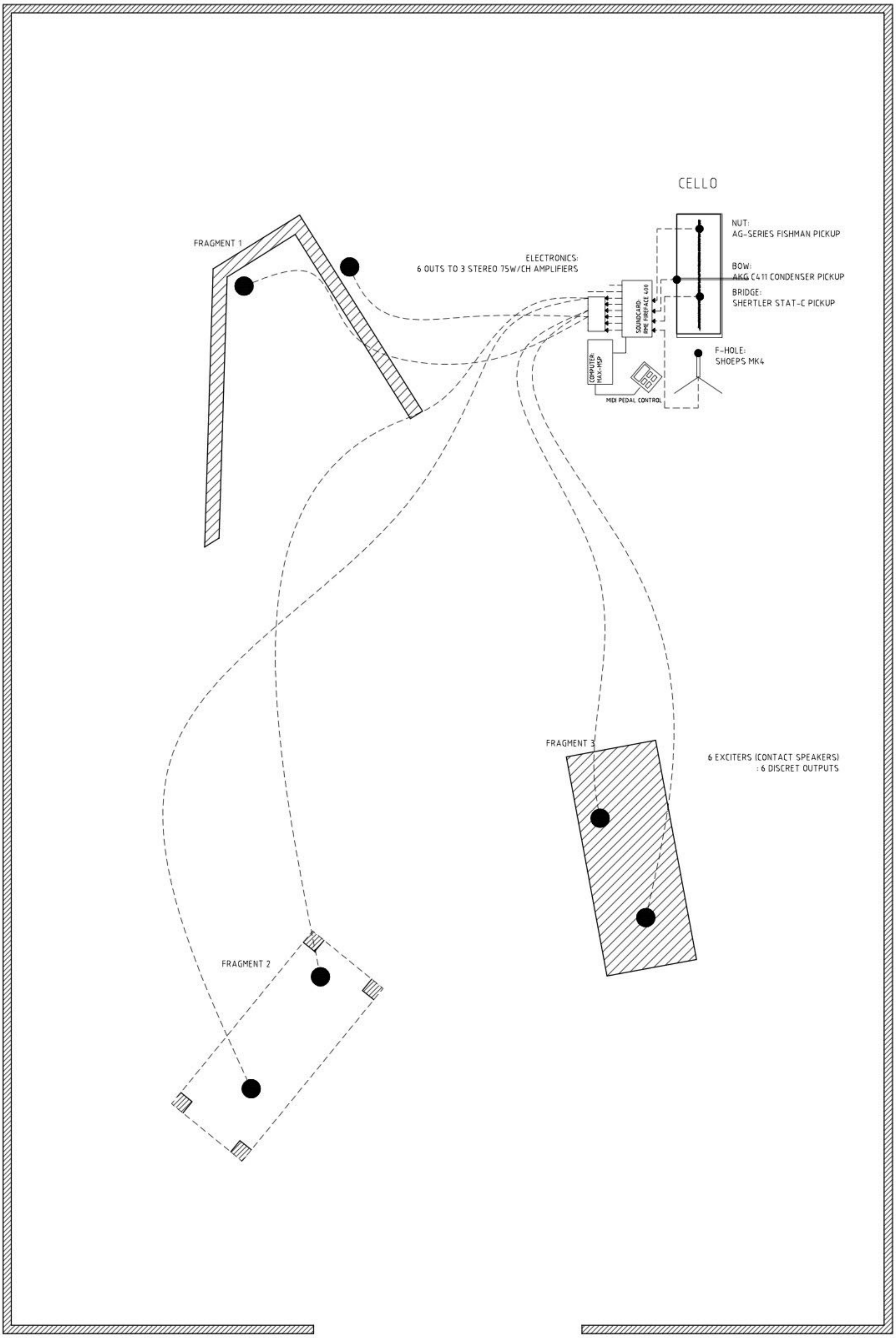


Image 77: “Explodido” setup plan

2.1. Resonant objects and spatial plot

The electroacoustic device was therefore connecting these three large metal objects to the cello. They were placed in the warehouse space in a way that the audience would have to move around in between them and myself (cello), continuously establishing different relationships between their bodies and the surrounding architecture.

The position of the staircase parts assumed different relations to the ground. The first one on the left assumed a straight position while the other two were placed more off-kilter. This strategy complicates the identification of the objects as part of a same structure, as they each take on an independent formal identity. The cello was positioned in the far right corner. The spatial distribution of the three fragments created new trajectories in the open space, and the whole device setup assumed an archipelago configuration, which in the installation period would be very important so that the spectators could drift among them in fluid motion, adding spatial unpredictability to the random sound granulation.

Figure 78: Installation view

The different positions of the staircase pieces were also relevant to changing the spectator's body position towards the resonant surfaces. The audience would be free to move during the performance or place themselves wherever they wanted. There were light projectors attached to each of these metallic fragments, defining areas of visibility corresponding to a particular “interiority” of each fragment, thus reinforcing the fragmentation.

2.2. Hardware and Software

At this stage of the research the electroacoustic device included three pickups on the cello and six outputs: two transducers per staircase. The improvisation developed between the acoustic sound of the cello and the electroacoustic sound diffused with the amplified transducers resonating in the metal staircase fragments. The Max patch established this relation in three ways:
1. Routing with very short latencies the sound of each pickup to each of the staircase parts: bow to part 1 // bridge to part 2 // nut to part 3.
2. Six buffers with different recording lengths for repetitive patterns or textural polyphonic drones/chords (similar to the previous iteration behaviour)
3. Six buffers with four-second recording length, to play sparse sound grains with random activity in velocity, duration and pitch reading.
This was the first attempt to clearly articulate fragmentation and dispersion.

3. Activation

3.1. Documentation

II - EXPLODIDO (2014)

: click for photos, videos and audio files

Files also accessible in USB pen drive in folder: CHAPTER IV / II EXPLODIDO

CONCERT PERIOD: Audio recording of the concert and transition (EXIT.wav) to installation period.

ENTRY.wav ________________________02:52
CYCLE I.wav ______________________ 04:51
CYCLE II.wav ______________________05:33

CYCLE III.wav____________________07:16

CYCLE IV.wav____________________05:44

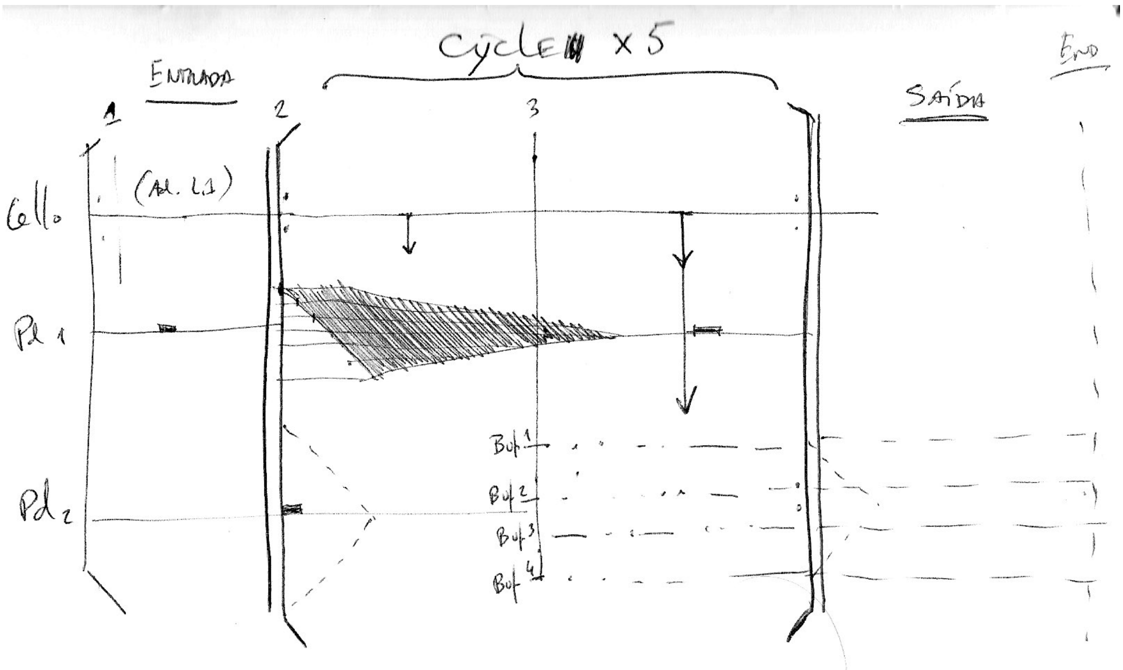
CYCLE V.wav ____________________04:23

EXIT.wav ________________________04:39

INSTALLATION PERIOD: For two hours after the concert the audience could drift freely in the space to experience the installation. Afterwards the installation was operating for one month, playing the automated buffers from the last granulation (fifth cycle).

II EXPLODIDO TRANSITION.mov _________ 02:52

3.2. Temporal macrostructure



Figures 79: Sketch for Explodido´s structure (before its presentation)

The concert started with the acoustic cello dialoguing with the space resonances and the soundscape, plus five Cycles of a sequence of harmonic drone elaborations followed by automated granulation. These sequence were followed by a transition to the installation period where the acoustic cello fades out in between the granulated samples.

The five repetitions of the same structure were fundamental to introduce a temporal circularity, establishing a very slow transition from concert to installation mode. There was also a circularity in the way the improvisation used limited sonic material and musical gestures that appeared and were developed along the the five cycles.

In this particular iteration there was no place for the clapping act in the end of the concert. The spatial conditions, the cycle repetition and longer duration of the concert were strategically articulated to make the transition from concert to installation harder to notice. There was no clear ending in the performance: audience came in and out, the playing of the cello “melted” with the distributed cello grains.

SEGMENTOS

Concert-Installation for: cello, electronics, resonant objects and light projection

Location: VERA APPLETON GALLERY // LISBON

Date: 13th NOV – 6th DEC 2014

Event: FRANCISCO FINO ART PROJECTS

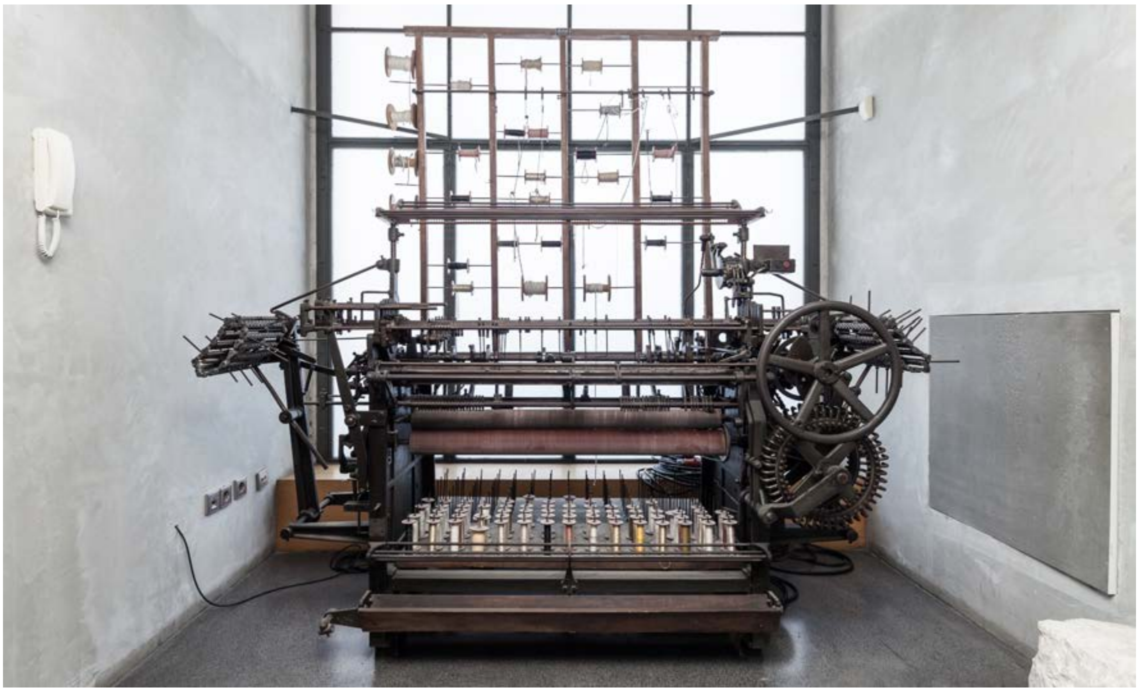
Publication: http://www.franciscofino.com/web/?fluxus_portfolio=ricardo-jacinto

Figures 80: Installation view of “SEGMENTOS” (2014)

1. Site

1.1. Intervention context

Created in May 2012, Francisco Fino Art Projects aims to become a platform for collaboration with contemporary practitioners within the visual arts. The strategy of this independent project is not based on a physical exhibition or event space, but on a mission of establishing national and international partnerships and alliances with the potential to provide the conditions and resources needed for artists to present their work. This presentation took place at Appleton Square, a Lisbon gallery mainly focused in “site-specific and contemporary art” interventions.



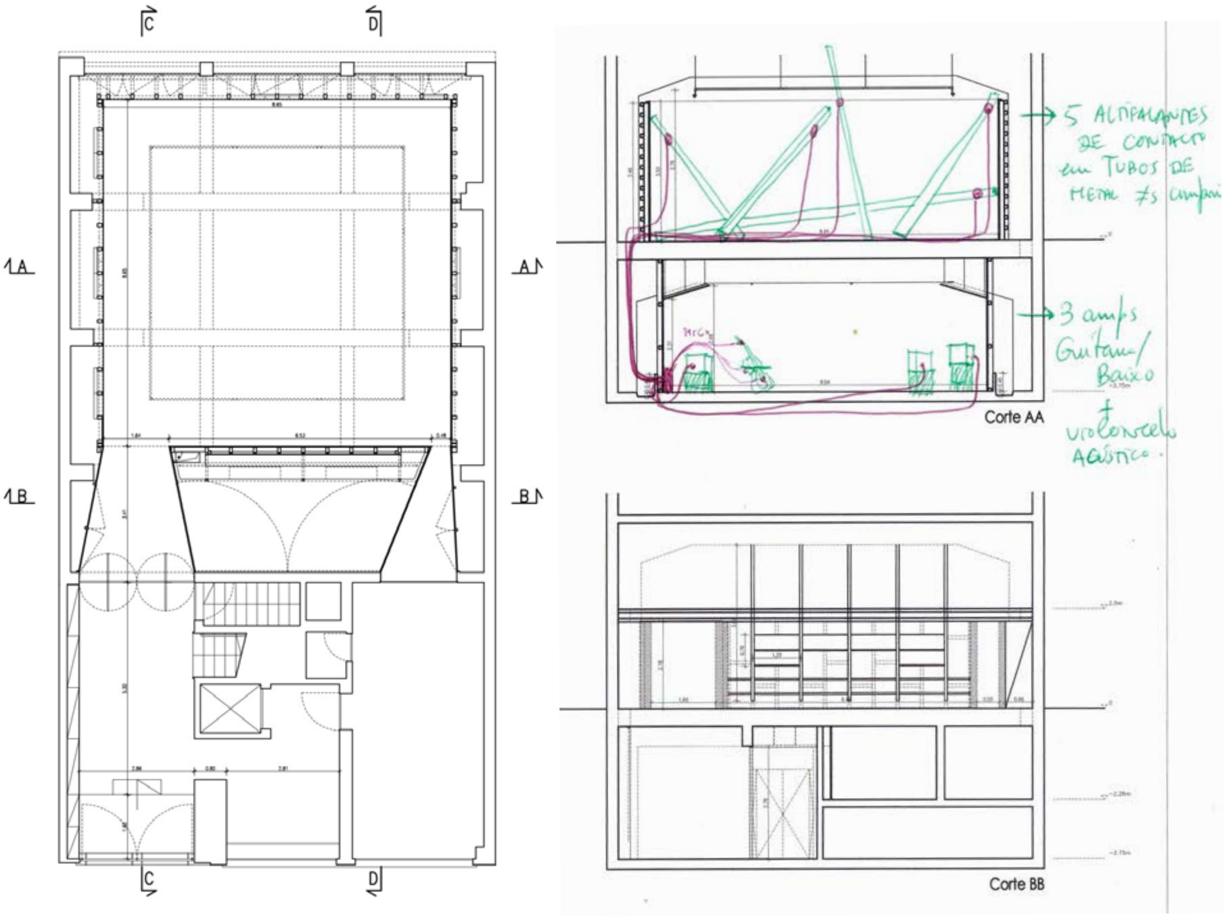
Figures 81: Pre-existing sewing machine

On my first visit to the gallery I was impressed by an old industrial sewing machine which sat quietly in the gallery’s foyer, and therefore inquired about its presence. The gallery occupies a building in Lisbon that was once a decorative fabric factory. When in the 1970s the factory ceased to exist in this building, one of its machines was kept by the new owner as a memory of this past activity.

1.2. Spatial morphology and aural conditions

The gallery occupies the lower floor and the basement and therefore has two “white cube” spaces. Some preparatory sketches included the basement as a possible space for the concert and the upper floor for the resonant objects. In the end just the first-floor room was used.

The new architectural design of the gallery has the particularity of distinguishing the usable painted white plaster gallery walls from the superstructure of the building, thus exhibiting the ceiling’s concrete-beam structure more dramatically. The gallery walls are a kind of an interior skin of the building: a room inside a room.



Figures 82: Gallery plan

On my first visits to the gallery I recorded some impulse responses in the room to familiarise myself with its acoustic character and spent time listening to the soundscape and tracking the acoustic horizon’s dynamics inside the room. On a second visit I took the cello and an amplifier to directly explore the space with the instrument. Besides this direct strategy of testing the spatial resonances, my interest in the old sewing machine led me to track down a previous factory worker. I found him still working in this same business outside Lisbon’s centre, making the same type of objects, using the same technologies. When visiting his present factory, I made a series of field recordings to recapture the dynamics of the old soundscape of the current gallery space.

Figures 83 and 84: Audio recording of old sewing machines

After recollecting the sounds of the machines working at the factory, a Max patch was programmed to randomly play a continuous sequence of different clicks, recalling the sound of machines at work. Some fragments of the produced fabric decorations where also collected for possible use in the concert-installation. The idea of incorporating an object made up from “threads” was very important for “putting in place” this past activity, and making a connection to the memorabilia machine at the gallery. These physical and conceptual traces led to an approach that was supposed to collide a sonic and visual fiction concerning an older activity of that space with its current one: a white cube gallery.

2. Setup

2.1. Resonant objects and spatial plot

In this iteration I aimed for the creation of a “textural place”, with several “times” and “spaces” evoked. This “image” led to a specific formation/installation of the Exploded Cello, incorporating a group of objects that can be interpreted as spatial drawings of a proto-architecture or something close to a drawing of a ruin. Segmento’s spatial strategy developed around the materialisation of four abstract lines. These were presented as metal beams with lengths corresponding to two horizontal and two vertical distances between points in the room: floor to ceiling, floor to top of the plaster wall, back and front walls and distance between side walls.

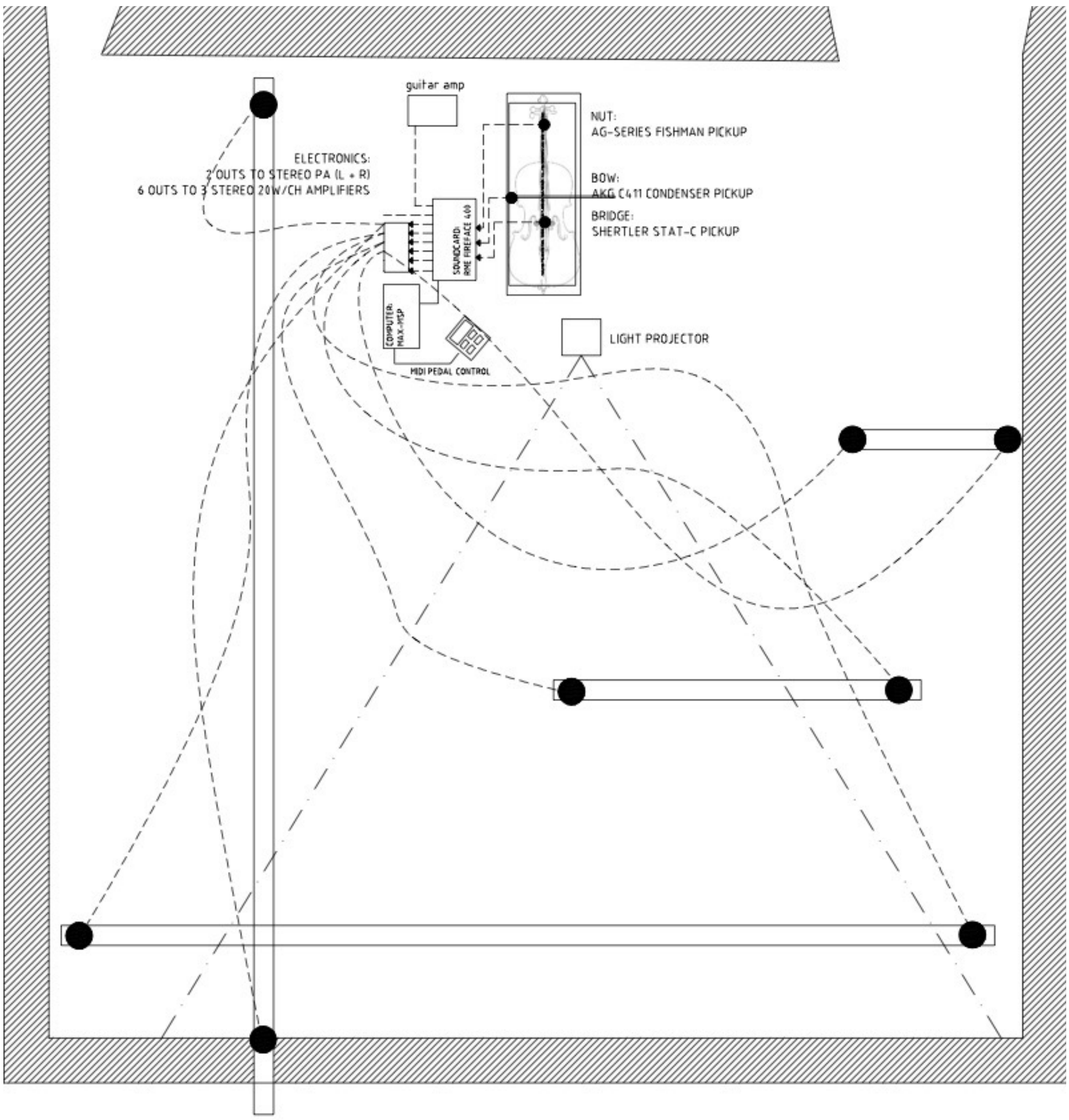


Figure 85: “Segmentos” setup plan

A light projection on one of the walls showed another cluster of lines, these corresponding to a visual augmentation of the type of fabric produced in that space prior to its use as a gallery. These fabric lines were therefore subjected to an abstraction and dematerialisation process.

2.2. Hardware and Software

As described, three types of elements are present in this Exploded Cello setup: the metal beams, the retro-projection and the cello + electronic hardware. The electronic paraphernalia was connected to transducers placed on the metal beams and sounds from the cello were diffused through them.

The cello was placed facing the projected shadow on the wall and the beams occupied the space with three-dimensional lines, in such a way that the audience (in order to move in space) needed to readjust their verticality and therefore swing around, under or over the leaning beams. The projection was displayed as if a moving image was expected.

The software managed four types of processes: direct resonance in the external objects, granulation, additive drone and randomised click sequences. This last process was a way of referencing the ancient soundmark of that location by adding a randomised sequenced of eight different repetitive clicks to each of the outputs, cloning the mechanical bruits of the working machines.

3. Activation

3.1. Documentation

III - SEGMENTOS (2014)

: click for photos, videos and audio files

Files also accessible in USB pen drive in folder: CHAPTER IV / III SEGMENTOS

SEGMENTOS_FIELD RECORDINGS.mov __ 01:23

Images and sounds recorded during the preparation of this exploded cello iteration.

SEGMENTOS.mov__________________22:37

Full recording of the concert and transition to installation period (20:00).

3.2. Temporal macro structure

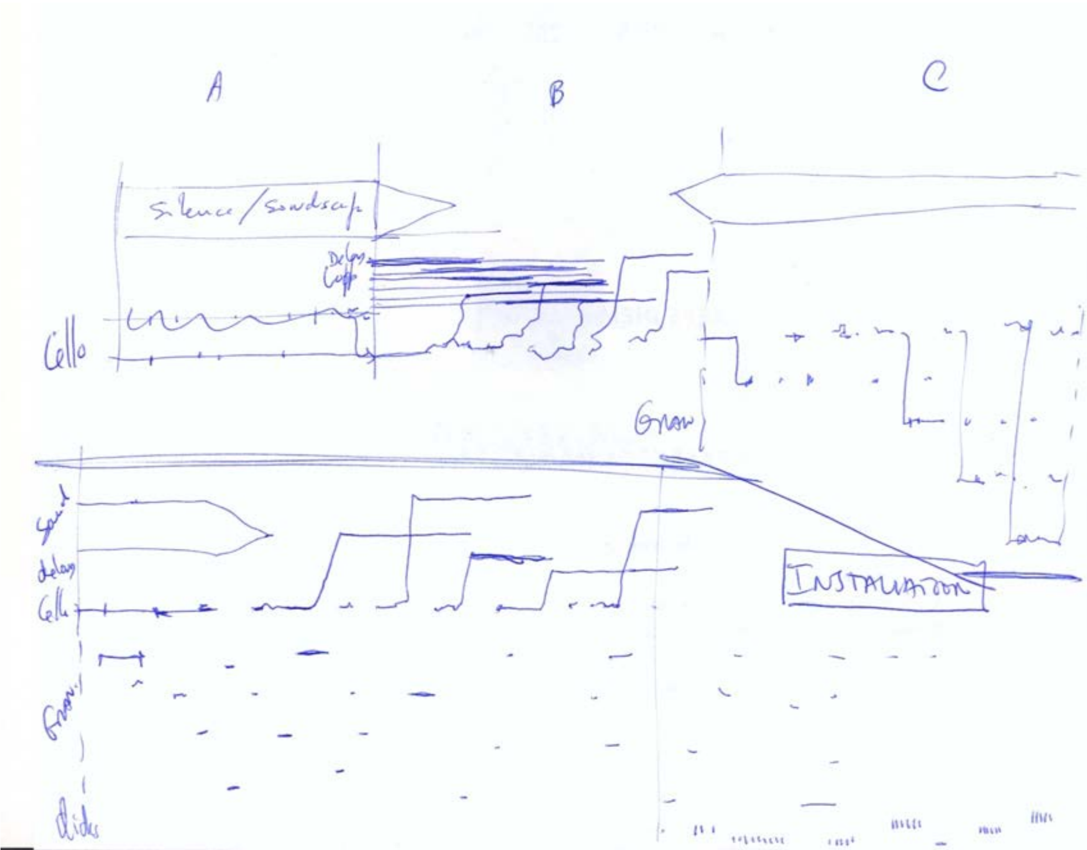


Figure 86: Sketch of temporal macrostructure for “Segmentos"

Segmento´s temporal structure introduced a new approach to the transition between concert and installation. The cycle form that structured the concerto period of the first two iterations were substituted by a continuos cello improvisation against different sonic backgrounds corresponding to a sequence of electroacoustic processes gradually superimposing and disappearing. After 20 minutes of the cello performance, a final calibration moment of a couple of automated processes (granulation and randomly generated percussive impulses) became the sonic material for the installation period.

This temporal structure proposes gradual changes in densification of the sonic material. The initial listening period involves the people gathering in the room, finding their place, sitting down on the aisles and not interrupting the “apparent dialogue” between myself and the projection. During the performance the metal beams become resonators and diffusers for the sounds produced on the cello or synthesized sounds (clicks) played by the computer. The final soundscape resembled a forest inhabited by machines, voices and animals.

LA HALLE

Concert-Installation for: cello, electronics, light and resonant structure

Location: Ferme du Buisson, Paris

Date: June 3rd 2017

Event: Performance Day 2017: The Museum Performed

Figure 87: Installation view of “La Ferme”

1. Site

1.1. Intervention context

In 2016 La Ferme du Buisson inaugurated Performance Day, an annual performance festival interested in creating an interspace between visual and performing arts, with a variety of projects involving the entire site: theatres, studios, outdoor spaces and the media library. In this fundamentally multidisciplinary context these hybrid practices, using performance as an active force in the transgression of boundaries, find unequalled scope for experimentation. This time the six curators were looking into the question of the museum performed.

Figure 88: Photo of “La Ferme”

Ferme du Buisson used to be a chocolate factory complex, built in the end of the 19th century in the suburbs of Paris; it was recently transformed into a cultural centre with several stages for performance, dance and music, plus a cinema and an exhibition area. Traces from its old occupation were completely erased apart from the Industrial-era façades of the buildings. New infrastructures now occupy the old factory’s architectural layout and the traces of the chocolate industry are now hidden behind contemporary black boxes for theatre, performance or musical events.

1.2. Spatial morphology and aural conditions

The chosen venue for the concert-installation was La Halle, a large warehouse transformed into an open-space performance venue. The new room kept the factory plan, the metal roof and the brick and cement walls. Inside is a generic retractible audience seating area; a large suspended light grid and dark fabrics to control the room acoustics. My approach was to explore this setup with very subtle alterations and a minimal presence of the system.

Figures 89: Interior of “La Halle”

Prior to the festival, I made a visit to the venue in order to get acquainted with the room’s architecture and acoustics. Checking the light grid was also a priority, given that it struck me as an interesting part of this stage setup, due to its massive presence while being an eminently functional object. Behind the dark curtains, large brick walls surrounded a 400m^2 open space with a retractible audience plateaux. These walls, if uncovered, could expose the space its original aural character, and that was something I was looking for in order to intensify the contrast between the stage paraphernalia and the container architecture.

2. Setup

2.1. Resonant objects and spatial plot

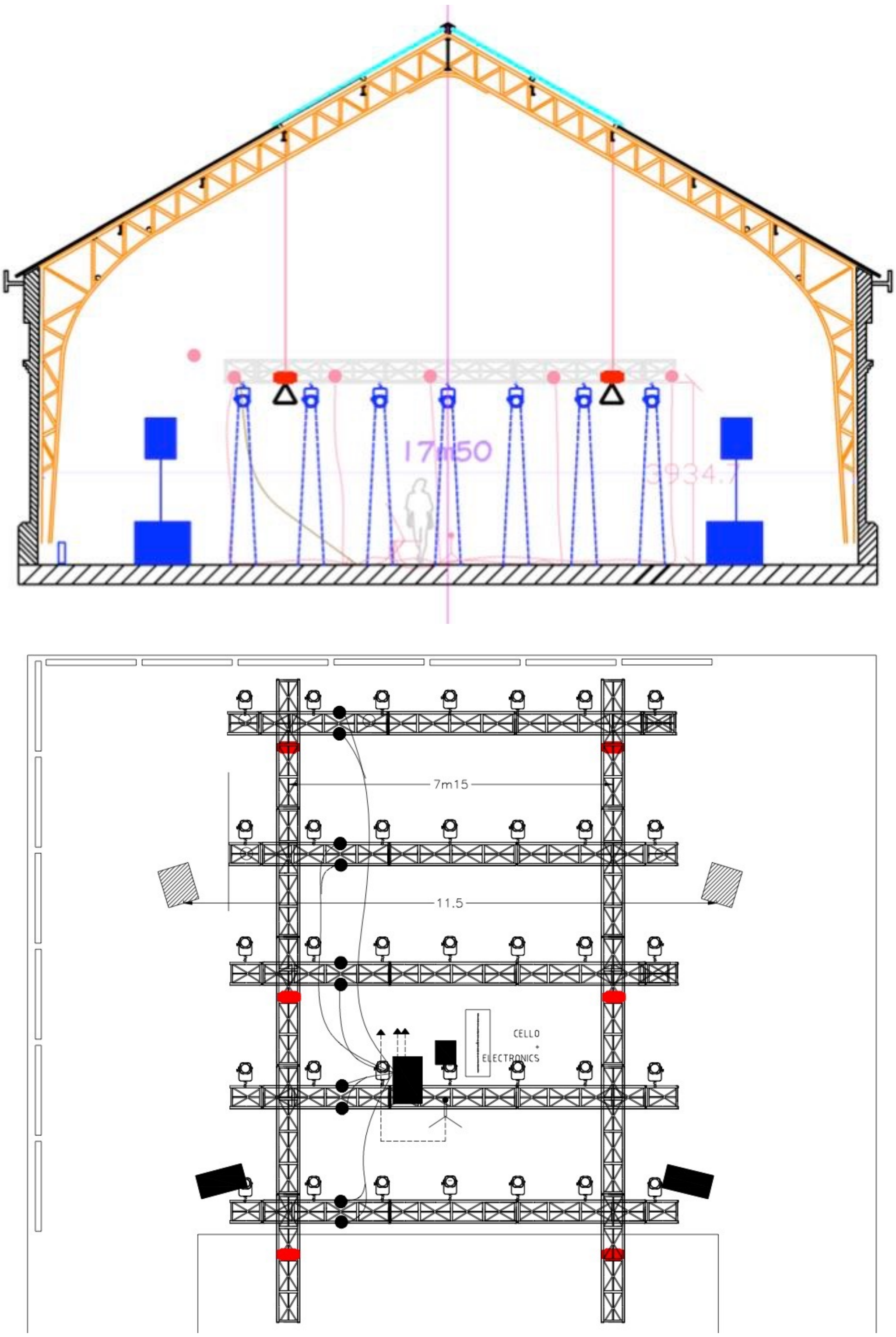


Figure 90: Plan and Front view of setup

I took all the dark fabrics from the walls, restoring the “natural” reverberation of the room, and decided to explore the resonance of the aluminium light grid. Since this object had a specific use in the space I decided that it would keep its usual function during the first part of the performance and that it would gradually become a “sculptural” presence in the room. Taking away the black curtains gave this structure more prominence in the space, as it became the only theatre device to be used in this case. The height of the light grid was also set lower than usual in order to give it a stronger spatial presence and better performance in terms of sound projection. The stage plot included the stereo PA setup placed behind me, facing the audience. A front fill reinforcement on the ground near the audience was needed. The transducers were placed in pairs on each of the five transversal beams. An eleventh transducer was for the first time coupled to the cello. As detailed in the following plans the sound projection was distributed in different vertical plans: ground (cello), standing horizon (PA system), and ceiling (light grid).

The decision to use the light grid as a resonant structure led me to invite a stage lighting designer to work with me on this project (Frederico Rompante). I briefed him on the idea that, besides this appropriation of the technical apparatus, there should be distinct moments of fixed lighting and in each of them a different “visual horizon” should be presented: from a concentrated focus on the cello to the presence of the walls and ceiling. There should be a sense of “playing the space” and the distance between the audience and the performer, knowing that during the first part of the event the audience would be seated and in the second part a sound installation would be activated, which would “invite” the audience to freely walk on stage. This sequence of light “portraits” of the space structured the musical narrative in the sense that they introduced new visual environments during the concert. They also followed the idea of a gradual change in the sonic dispersion of the Exploded Cello along the performance period. This lighting strategy helped to slowly guide the audience into the installation period.

2.2. Hardware and Software

In this iteration the four-microphone system input was already performing correctly. The outputs included the stereo PA and small vibrational transducers coupled to the light grid and cello. In the grid each beam corresponded to one output channel, using two contact speakers in parallel.

The software managed two types of processes: manipulated four-signal pan delay and automated granulation. The Max patch was the 2017 version where the variation in the expression pedal was also assigned to the reverberation time and reverberation mix of a VST plugin. This particularity of being able to control the full fragmentation mode of the four-signal pan delay with almost dry reverb signal and the increased distance of the wet mix with longer reverb time (up to 4 seconds) was a new introduction in the vocabulary of the Exploded Cello: extreme distance to extreme proximity.

3. Activation

3.1. Documentation

IV - LA HALLE (2017)

: click for photos, videos and audio files

Files also accessible in USB pen drive in folder: CHAPTER IV / IV LA HALLE

LA HALLE.mov____________________ 33:02

Video recording of the concert period including the beginning of the transition to the installation period.[46]

LA HALLE_TRANSITION TO INSTALLATION.wav____________________ 05:37

[46] For technical reasons this concert-installation is not fully documented in video.

Audio from the last moments of the concert period
and transition to installation period.

3.2. Temporal macro structure

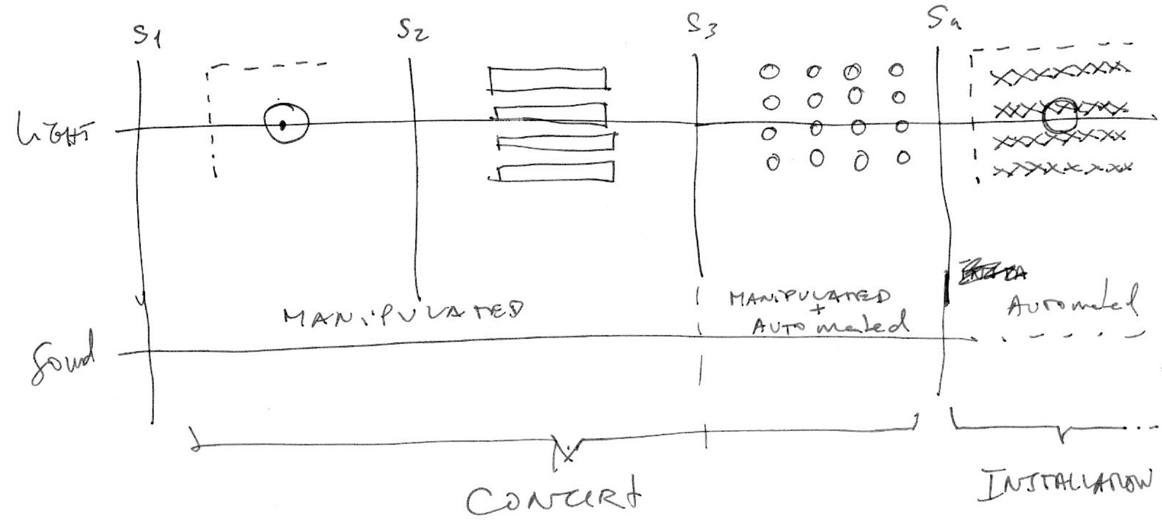


Figure 91: Sketch for temporal macrostructure

La Halle’s concert period was divided into three sections corresponding to changes in the stage lighting. The musical improvisation was completely free, in the sense that no sequence of material was predetermined. Nevertheless the three fixed light presets would determine a drastic change in the environment, and this had an impact on determining the development of the music. Stage 3 served as a transition period between the concert and the installation. The automated processes started in this section and gradually developed to the full automation of the installation. The final installation period lasted three hours after the concert.

Section 1 [00:00 - 20:00] : 30 x RJ Solo lights marked the limit of the “stage” area, illuminating the walls and its textures. A powerful Fresnel HMI 2.5kw was lighting the floor behind me, reinforcing the “space around the performer”.

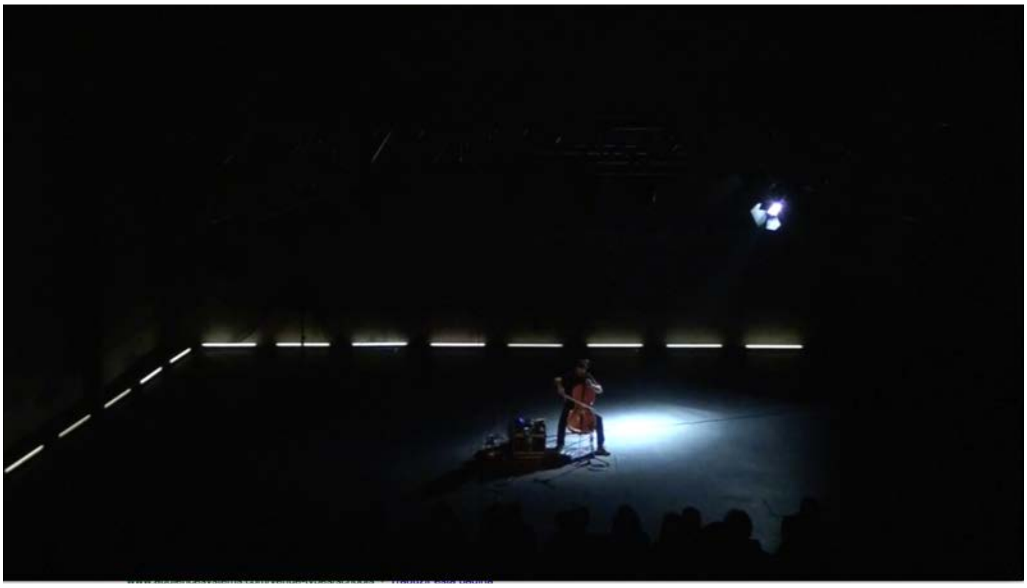


Figure 92: Light design for section 1

Section 2 [20:00 - 29:00]: Four projectors placed along on the left side revealed the cellist inside a row of “light windows”, evoking an interior space.

Figure 93: Light design for section 2

Section 3 [29:00 - 40:00]: Twenty-four projectors pointing down from the grid lighted a circular matrix on the floor. This light was set during the period when the buffers were being “fed” and started activating the multichannel sound installation. The centrality of the cellist was secondary towards the multiple sounds which were being distributed around the grid, PA and cello transducer.

Figure 94: Light design for section 3

Section 4: The performance gradually transformed into a sound and light installation that reorganised the room and “opened” the stage to audience drift. The grid was also lighted from within and the stage was now transformed into an “installation” space where people could move around and have a closer experience of the resonating objects.

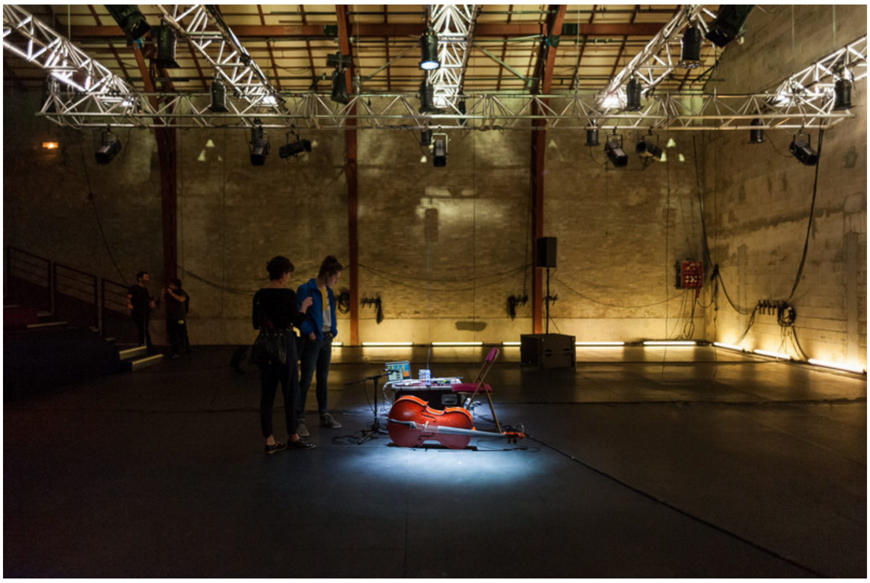


Figure 95: Light design for section 4

REFLEXO

Concert-Installation for: cello, electronics and suspended resonant objects

Location: BANDSTAND IN CAMPO DE SÃO FRANCISCO

Date: 15th-29th JUL 2017

Event: PUBLIC ART CIRCUIT / FESTIVAL WALK & TALK // SÃO MIGUEL

web info:

http://walktalkazores.org/MEDUSA_reflexo

http://www.k-w-y.org/filter/Walk%26Talk/Medusa-reflexo

http://confluir.pt/projects/ricardojacinto/

Figure 96: Installation view of “REFLEXO” (2017)

1. Site

1.1. Intervention context

This iteration of the Exploded Cello follows an invitation from Walk & Talk Festival (São Miguel, Azores [2017]) to create a public art intervention on the bandstand of Campo de São Francisco in Ponta Delgada. This was the first time the Exploded Cello system would be used in an outdoor location.

Figure 97: Bandstand at São Francisco Square

Besides staging the local philharmonic bands this bandstand has a special use in the Festas de Santo Cristo, when it is used as the central architecture for this square, supporting the light adornments which radiate from it. This centrality and the echo of its “footprint” on the floor’s design is evident and it is clear that the bandstand´s footprint geometrically structures this square. Although the plan shows the bandstand’s apparent centrality, the main day-to-day attractions of that site are the churches which surround the square and the benches under the trees where the romantic Portuguese writer Aquilino Ribeiro took his life. The bandstand rests most of the time as an empty, sleepy piece of architecture. Its location on the limits of the city centre makes it a less eventful place.

1.2. Spatial morphology and aural conditions

The soundscape is not dense and it's populated at times by car motors, the ringing of church bells, a beggar, a group of people that gather around and the steps of passing tourists. The acoustic horizon reaches the streets that surround the square. Although not a vast acoustic horizon, it is a site where you can listen to the space around you and situate the sound sources particularly well.

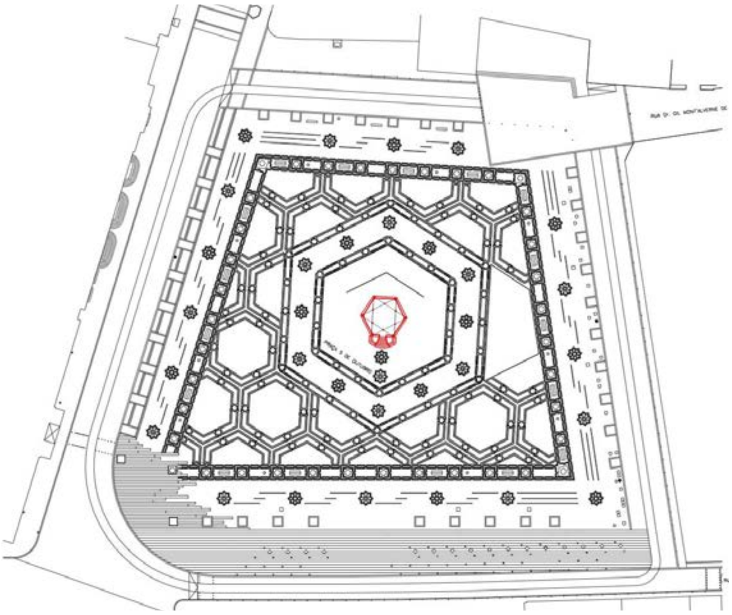


Figure 98: Plan of São Francisco square

The bandstand is a small, 360º open-air stage with a roof. Elevated 1m above the square, it hides an underground space used mostly for storage of technical apparatus. Although the bandstand area is open it is not a useful or oft-experienced space by most of the people who walk by . I witnessed the use of the stairs as another sitting spot in the square. In this area there was an invisible place: the underground room beneath the bandstand. One short door and two very small windows partially revealed what seemed to be a cavern-like space, closed to the public.

Figure 99: Door to basement

2. Setup

2.1. Resonant objects and spatial plot

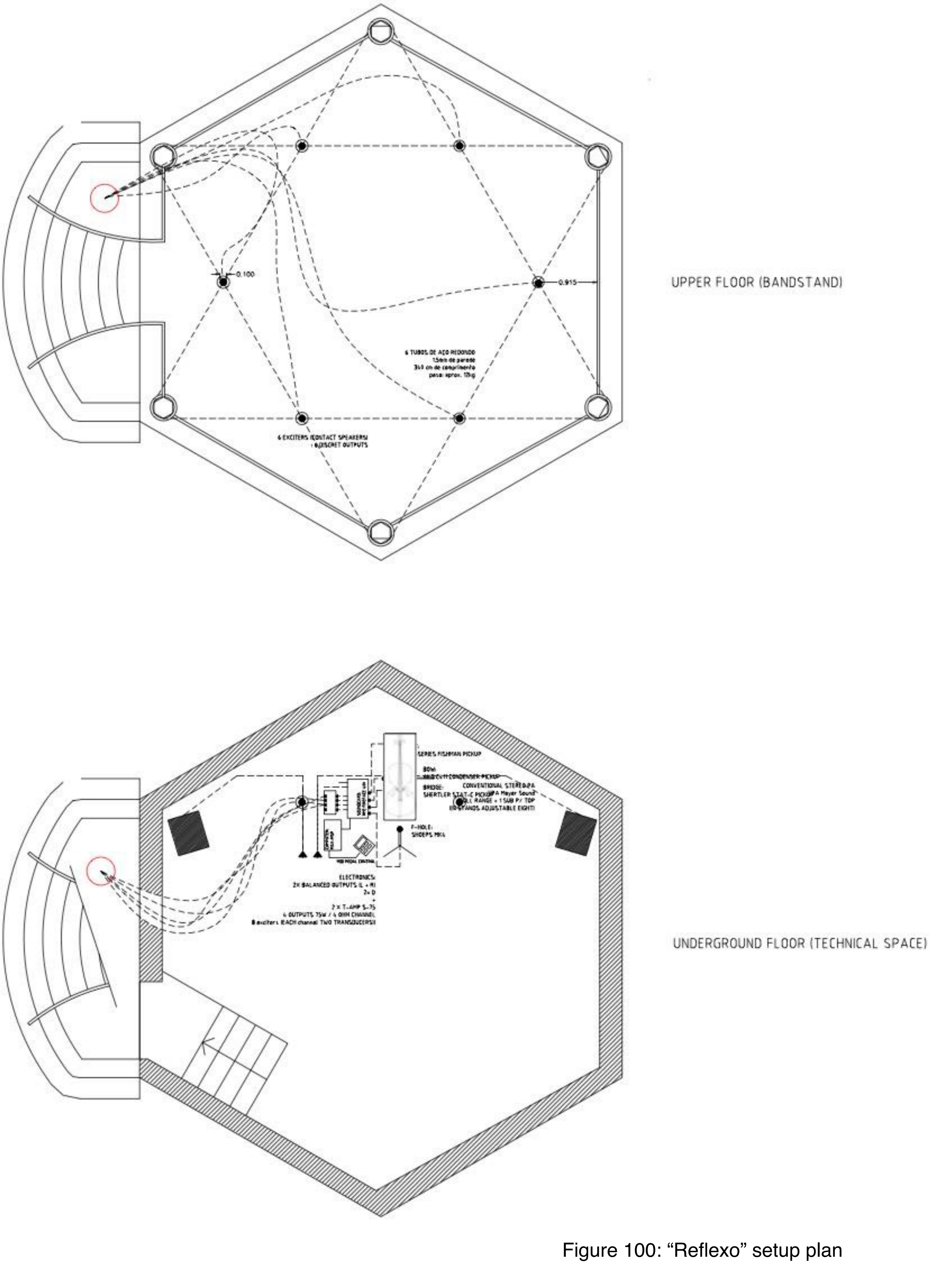


Figure 100: “Reflexo” setup plan

Reflexo's spatial strategy developed around the idea of using two very contrasting spaces within the bandstand: the enclosed, interior underground room (where the concert took place) and the wide-open top floor opened to the square (where the installation remained).

In this public area six metal tubes were hung from the ceiling, positioned as a replica of the geometric footprint of the bandstand. The six columns holding the rooftop had now parented geometric objects on the inside. The tubes were used as resonating objects, and in the basement the stereo system was placed facing an area where the audience could sit and listen to the concert periods. By echoing the bandstand's footprint, the hanging tubes become simultaneously an architecture of sound and also a music box— a standalone, urban musical instrument. The suspension of these metal tubes in such exposed open-air conditions is expected to induce a subtle sense of disorientation, as the wind would make them move .

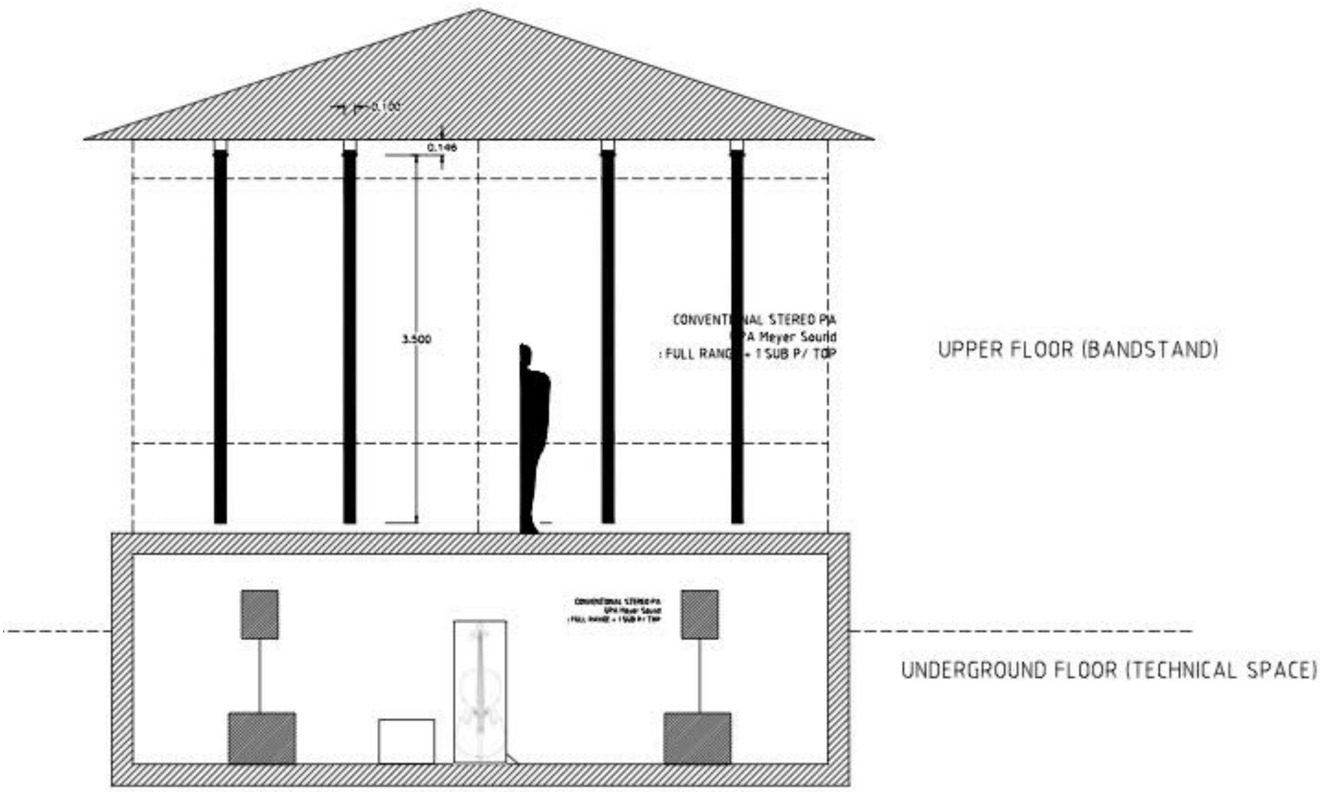


Figure 101: “Reflexo” setup front view

2.2. Hardware and Software

The setup included the large vibrational transducers Dayton Audio HDN-8 (50W) coupled to 2.6m steel tubes hung from a mesh of steel cables. The suspension was very effective for creating a good resonance of these large and heavy objects. In this iteration the DSP used were only the four-signal pan delay, direct resonance in external objects and additive drone (in this case using a Frieze pedal - Electro-Harmonix Superego). The pan delay was diffused only in the stereo system in the underground room and the direct cello plus the additive drone (i.e. frieze pedal) was diffused in the stereo system as well as in the suspended tubes (external resonant objects).

3. Activation

3.1. Documentation

V - REFLEXO (2017)

: click for photos, videos and audio files

Files also accessible in USB pen drive in folder: CHAPTER IV / V REFLEXO

REFLEXO_CYCLE I.wav______________________ 20:18

REFLEXO_CYCLE II.wav______________________ 20:10

REFLEXO_CYCLE III.wav_____________________ 25:24

Recordings of the three concert periods.

REFLEXO_TRANSITION TO INSTALLATION.mov__ 25:24

Edited videos of the installation periods.

3.2. Temporal macrostructure

The concert was divided in two cycles which included a 20-minute performance period and a 30-minute installation period. Each new performance interacted with the previous sonic content of the installation, transforming it throughout the improvisation. In this iteration the substitution of a Frieze pedal (Superego) for the “drone” patch was critical in the overall outcome of the piece. The Frieze pedal loops audio samples of 20ms, which gives the acoustic sound a “synth-like” character. The static textures slowly being transformed by an additive drone process was the basis for both the concert developments and the subsequent installation periods.

The focus in this process was on the acoustic arena of the installation. The central position of the bandstand within the square was susceptible to having a sound installation that proposed a “dive” into a static, textural harmonic sound once the audience gradually approached the bandstand. The “natural” performance of the wind rocking the metal tubes was important for the sonic performance of the piece. The static sonic textures, which were the output from the performance periods, underwent very subtle transformations when diffused by the “swinging tubes”, due to a minor Doppler effect. Some frequencies appeared while others were masked, coming back again. Moving in between the tubes also changes the sonic hierarchy of the harmonic content of the drone.

MEDUSA

Concert-Installation for: cello, electronics and resonant objects

Location: MUSEU DE SERRALVES / PORTO

Date: SEP 9TH 2017

Event: MUSEUM AS PERFORMANCE 2017

Figure 102: Installation view of “MEDUSA” (2017)

1. SITE

1.1. Intervention proposal

Organised by the Serralves Museum of Contemporary Art, ‘The Museum as Performance’ is a platform for new practices in performance within the field of the contemporary visual arts. Its third edition featured recent works by artists and artistic collectives from Portugal, United States and different European countries, crossing disciplines such as music, dance, theatre, visual arts and performance. The programme included new commissions and site-specific adaptations of existing pieces. These works were presented throughout two days within the unique architectural context of Serralves.

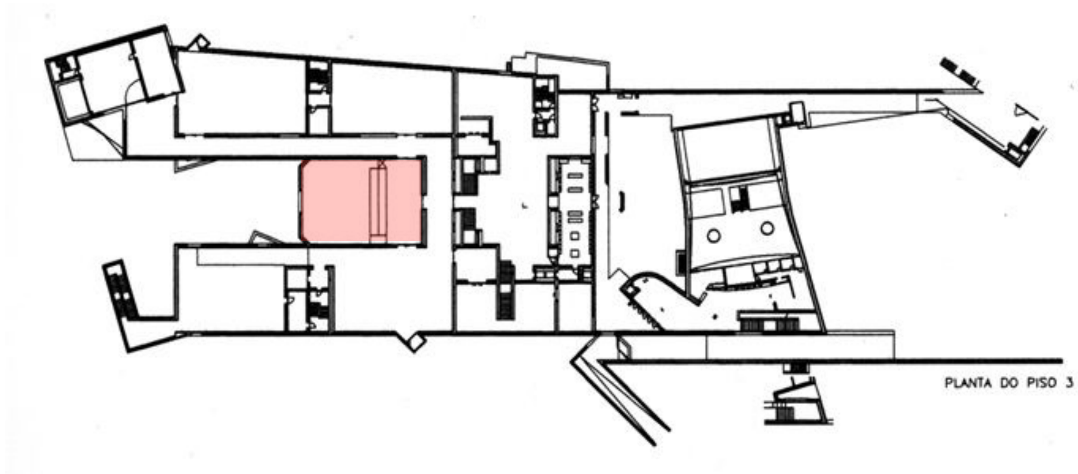


Figure 103: Serralves museum plan with intervention area

The Serralves Museum is an extraordinary piece of architecture designed by the Portuguese architect Álvaro Siza Vieira. It is a museum in which the exhibition spaces privilege the idea of spatial fluidity. One can identify different rooms in the plan but their limits or overall form are always contradicted by unexpected spatial interrelations, mostly achieved by the succession of long perspectives through the building and to the exterior in the form of visual “escape routes” to the gardens. Adding to this visual fluidity, the “promenade” in the museum rooms is comprised of gradual inclination ramps, which induces a continuous walking, permitting audience drift.

1.2. Spatial morphology and aural conditions

My intervention was placed in a room with a declared centrality in the building plan. The room presents itself as a large square container, with a very large central window to the garden and two floor levels. This centrality is drastically transformed by a ramp that connects the upper and lower floors.

Figure 104: View of the intervention room

The ramp introduces very clearly an “architectural promenade” in the experience of the large, square white room, dramatising the descent to the lower floor. The large window is level with the upper floor, which makes the descent more pronounced . These characteristics, and the subtle geometry of the corners, were taken into account when occupying the room and building the installation’s spatial plot. A preliminary visit to the space, during the preparatory stages of the creative process, was very important, allowing me to experience the room’s acoustics and the building’s scale. A reverberation of up to three seconds strongly characterised the room. The acoustics of the room reinforced the fluid and dynamic character of the architecture. In this particular iteration I decided to focus the structure of the installation on the way the audience would move inside that architecture, following the visual attraction points of sculptures, paintings or any other objects framed by the white walls and the pristine wooden floors.

Figure 105: View of the intervention room

2. SETUP

2.1. Resonant objects and spatial plot

Figure 106: Installation view with distributed objects

The resonant objects used were selected musical instruments (10 cymbals and a grand piano). Both the cymbals and the piano have extremely interesting resonant properties when coupled with a vibrational transducer. A tone on the cello would easily excite both the piano harp and the inharmonic partials of the cymbals, adding their qualities to the natural reverberation and resonances of the room.

These selected objects (i.e. instruments) were intended as a dispersed musical ensemble of cello, piano and percussion. This approach introduced a spatial fragmentation and dispersion of objects which, in this particular context, are understood as belonging to a same group. Their position in space presents from a first relation to the installation, a “body” which is spread, thus introducing the notions of fragmentation and dispersion in the installation realm.

The grand piano welcomed the audience to the upper floor, right in front of the entrance door. In the middle of the ramp the audience had a bird’s-eye view of the cymbals placed in the lower floor, providing a particular vertical sonic perspective. The cello and the stereo PA occupied the left corner of the room, thus accentuating a diagonal relation with the square arena. A large bench was placed facing the cello and the stereo PA for a closer positioning of the audience to the main source, leaving the resonators behind them.

2.2. Hardware and Software

In this setup I only used three microphones (bow, bridge and nut) in the cello and the large vibrational transducers (Dayton Audio HDN-8 [50W]) distributed on the cymbals and piano. The software managed three types of processes: manipulated four-signal pan delay, direct resonance in the external objects and automated granulation. In addition to the software DSP, I used a Frieze pedal for additive drone. The expression pedal moved between the full fragmentation of the four-signal pan-delay to direct resonance in the external objects, thus changing the sound distribution from the PA to the array of vibrational transducers.

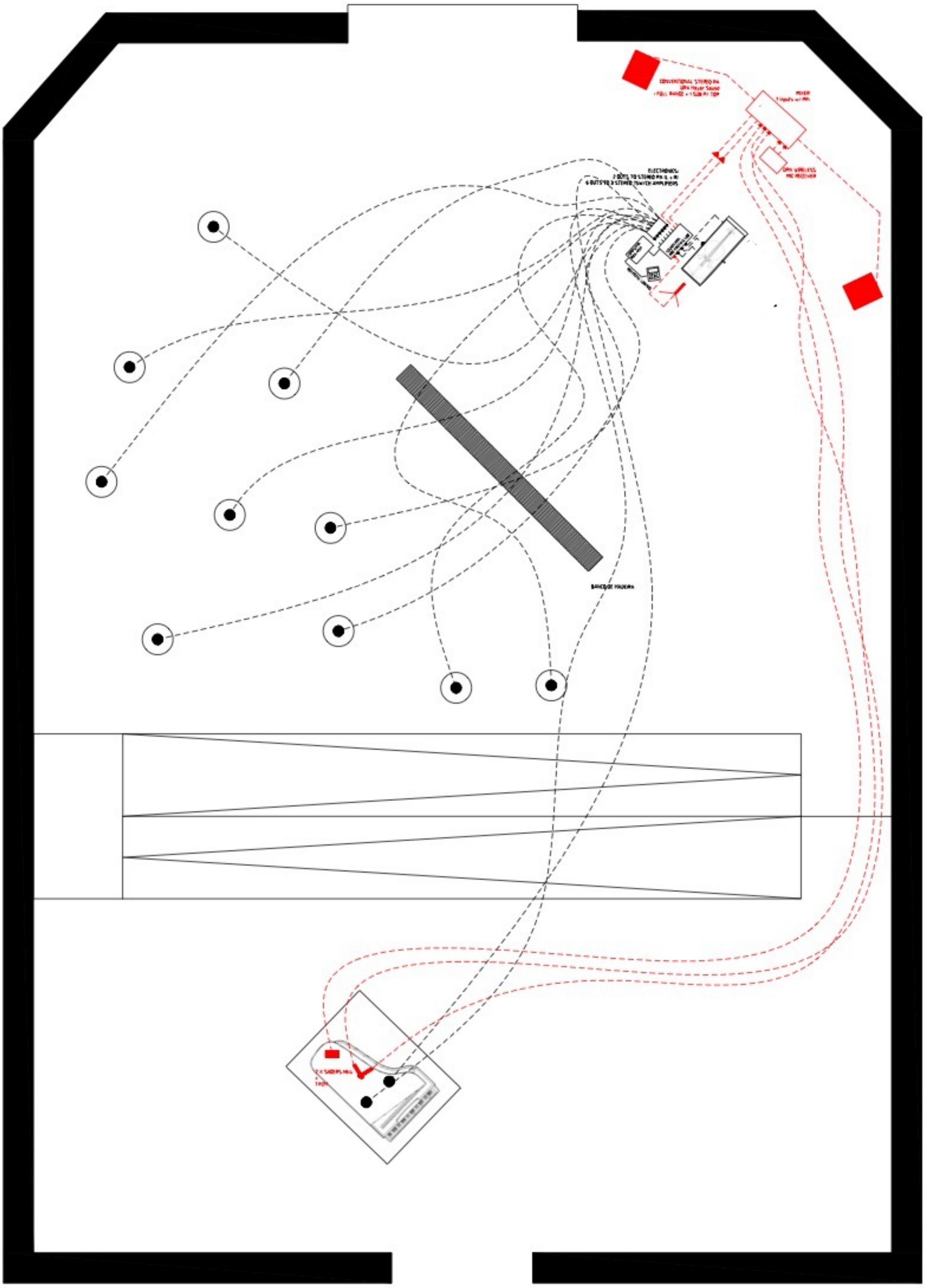


Figure 107: “Medusa” setup plan

3. ACTIVATION

This is the only iteration of the Exploded Cello project where an extended comment on the temporal development of the intervention, will debate the articulation between the conceptual approach presented in **Chapter I** and the possibilities presented by the electroacoustic device which shaped the exploded cello vocabulary.

3.1. Documentation

VI - MEDUSA (2017)

: click for photos, videos and audio files

Files also accessible in USB pen drive in folder: CHAPTER IV / VI MEDUSA

MEDUSA_CYCLE I.mov_______________ 27:11
MEDUSA_CYCLE II.mov_______________ 31:28
MEDUSA_CYCLE III.mov_______________ 12:58

3.2. Temporal macrostructure

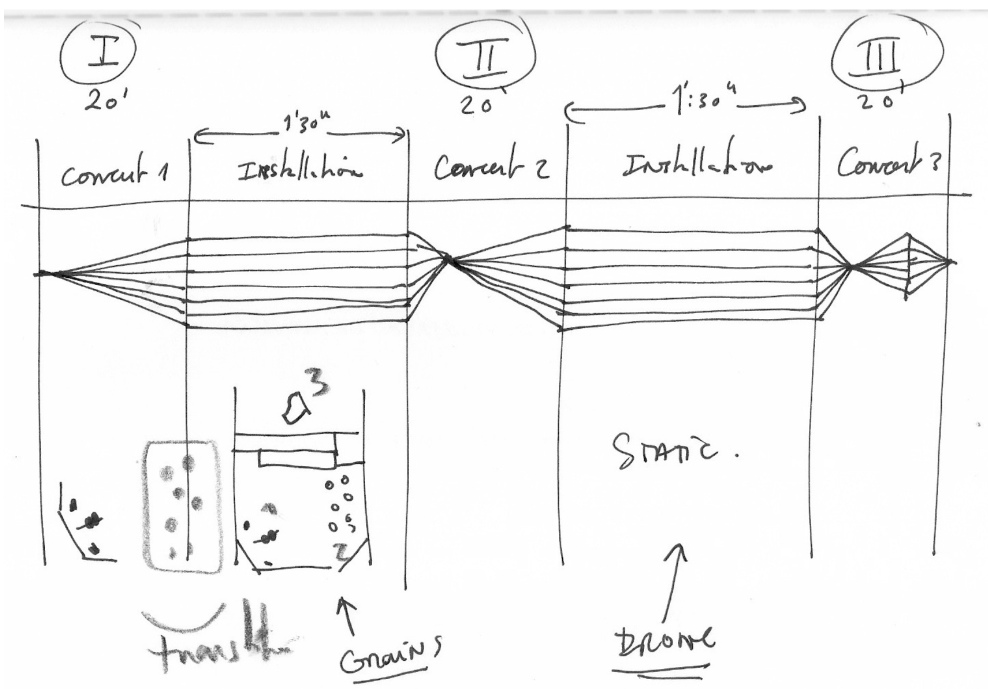


Figure 108: Sketch for temporal macrostructure

This four-hour concert-installation was divided into three cycles of around 20 minutes of performance and a one and and a half hour installation. The third cycle included only a concert period, as a closing performance for the event. Each performance developed from the sonic material of the previous installation period. The piece started in silence and from there the first cycle was performed. Each installation period had a different approach, installing a different sonic dispersed ambient in the room.

Installation period 1: Granulated material from the previous concert period
Installation period 2: Harmonic drone using the “Superego” micro-sampler loop pedal.

Each concert period developed from the sonic qualities of the previous period. The overall composition structure (three cycles of concerts with intervals of installation) was an integral part of the overall piece’s development, influencing the short improvisations. The transitions between each cycle followed a different path. In the transition to the second concert period, while the automated granulation was operating I used the cymbals as a percussion instrument rather than just a resonant object.

One very relevant characteristic of this iteration was that the chosen resonant objects (piano and cymbals) were highly susceptible to tonal excitation. Both had a sympathetic resonance with the melodic development of the improvisation.

3.2. Analysis of the MEDUSA first concert period

To better fulfill a more detailed analysis of this last work in the portfolio, I propose to identify the main changes in the improvisation thread of the First cycle articulating it with the Sonic Vocabulary presented in chapter III. Reflecting on the material used and its articulation with the setup, will be fundamental to reflect the way the explosion metaphor was present in Fragmentation and Dispersion processes.

CYCLE I: first concert period

: VIDEO File accessible in USB pen drive in: CHAPTER IV / VI MEDUSA / CYCLE I

00:00 - Pedal in full **Pan-Delay mode.** Improvisation starts by placing the bow hair on the strings and using the left hand to mute or open the four strings while applying a strong vertical pressure with the bow on the strings. This gesture **introduces a sonic image of fragmentation**. (this gesture will be recurrent along the improvisation).

01:41 -:. Just using the left hand tapping the fingerboard in chromatic patterns we can hear very clear the two distinct pitched sounds which are produced by the two lengths of the string to the bridge and to the nut. **Focus on the actions of the left hand**. Bow in pause. First understanding of the sonic independence of the actions on both the fingerboard. **Concentration on the micro-territory** of the cello.

02:15- Muting the strings with the left hand and using the bow between the bridge and the fingerboard with a soft pressure with up and down movements. **The focus is on the soft friction of the bow** which is very amplified. The movements of the left hand slightly touching the strings sometimes press the strings harmonic nodes thus "releasing" high pitched harmonics which become more and more prominent.

02:50 - Playing natural harmonics on open strings while opening the output to a **direct resonance in the external objects** (cymbals and piano)

03:30 - Melodic development with direct resonance in objects. **Dispersing the cello in the room** while exploring the different resonant partials. Cello has new colors; new spectral content due to resonance of objects and room. Dispersion (focus on the **macro-territory** of the room/architecture) is now obviously **contrasting with the introduction where the actions on the cello were the focus.**

05:57 - Fast continuos microtonal trill playing with dynamic and velocities. S**trongly exciting the cymbals** (which in the case of this setup had a stronger presence than the piano).

07:08 - Back to natural harmonics. Short phrases with pauses for **listening back to the room and resonance decay**.

08:39 - Sudden dynamic change with the short and strong rebounds of the tip of the bow on to the C string. **Strong inharmonic resonance** in the cymbals.

09:25 - **Back to the vertical pressure of the bow hair against the strings.** The use of the pan-delay puts me **back into a fragmentation process (pan-delay) and the focus is again on the body of the cello.**

09:45 - Soft bow with almost no definite pitch. Change to a near silence situation. **Sudden dynamic change** from *forte* to *pianissimo*. Focus on minimal actions on the cello.

11:00 - Soft bowing; just hearing the hair fractioning the string. Starts a pizzicato performed with the left hand pulling on the 4th string. Simple melodic pizzicato voice takes the lead. **Moving the attention from noise to melody**.

12:15 - **Back to direct resonance** in the external objects and Pizzicato repetitions strongly excite the cymbals. Melody develops. **Dispersion is obvious again.**

13:42 - Right hand frictions the top plate producing a noise squeak: short **noise happening intersecting the pizzicato melody**, which keeps a stable development.

14:21 - Percussion with right hand in the body and plucking the strings between the bridge and the tailpiece are used as a final articulation with a pizzicato melody in the left hand. Seems that I **reached the end of a first part of the improvisation.**

14:42 - **Back to the vertical pressure of the bow hair against the strings.** The use of the pan-delay puts me back into a fragmentation mode and the focus is back on the body of the cello. **(the repetition of this gesture is used as a punctuation in the macro structure of the improvisation)**

15:00 - **Starts the additive drone process** of recording micro samples. I prepare my right foot to press the button while playing.

15:20 - Back to the natural harmonics material and **start recording the micro samples.**

16:00 - At this stage I can star hearing clearly the presence of the drone occupying the room. **Strong dispersion image as recorded sounds occupy the whole room.**

16:25 - Pause the playing for a little while, to listen to the static drone. Slowly I **start building an improvised relation with this static harmonic background.**

17:10 - Long dense bowing on open C string, adding low material to the drone texture.

17:30 - While keeping the bow active on the open C-string I use the left hand to rebound the bow against the string. The right hand keeps the bow slowly moving up and down while the left hand performs a vertical "wave tapping" near the tip of the bow. **While the static harmonic drone fills the background this action (using pan-delay) conducts the sonic focus to that particular action of the right hand tapping the tip of the bow**. Noisy fast pattern appears on top of the harmonic drone.

18:20 - This gesture is intensified by pressuring again the bow against the strings. Irregular movements change slowly to fast short regular bow movements.

18:35 - fast bowing on strings changes to the C-bout and the pitched material changes to the soft sound of the bow hair touching the body of the instrument. **Superimposition of Dispersion and Fragmentation images.**

19:45 - **Stop playing** and increase the static harmonic drone. **Listen to the resonance changing in the cymbals, piano and room.**

20:32 - Open C string recording on top of the drone. **Reflected decision: action which somehow does not belong to improvisation stream of consciousness.**

21:22 - **Start preparing the granulation sampling process**.

21:49 - **Recording the bow pressured on to the strings. Same gesture as the beginning.**

22:05 - Recording bowed natural harmonics. Granulated material starts appearing in the background. **Dispersed fragments become audible within the static harmonic drone resonance.**

23:30 - The granulated material becomes more present. The fading out of the drone continuous.

24:30 - **Transition to installation** sonic material is done. I put the cello down.

25:00 - **Installation period starts.** I still calibrate the sound of the drone and the granulation.

25:53 - Audience claps and starts moving.

Following the reversibility of the explosion narrative this first improvisation period explored shifts between the **direct resonance in external objects** and the use of the **pan-delays**. This first period moved between one and the other, exploring slow and fast transitions between fragmentation (expressed in the stereo PA) and the more dispersed approach of the direct resonance of the cymbals and piano. This dialogue lasted around 25 minutes and was used to build a transition to the first installation period.

To these initial manipulated processes, were later added the automated processes of **additive drone** (using the superego pedal) and **granulation**, potentiating a macro change between fragmentation and dispersion vocabularies: moving from the concert period to the installation

.

Conclusions

This research project is at the crossroads between music and sound art, focusing on the development of a concert-installation vocabulary. This thesis (portfolio + written commentary) marks an end to a process where I systematically explored a conceptual model that integrated practices and ideas coming from music (free improvisation), soundscape studies and installation art (site-specificity).

The Exploded Cello metaphor, which is the basis of this research on site-specific improvisation, promoted an expansion of my role as a performer/player/improvisor to that of a sound or installation artist. This process drastically extended my notion of the limits of instrumental playing and improvisation processes, as it included temporal and spatial shifts that made me think of the concert and installation as presentation categories that are not exclusive but can be experienced as a continuum. The otherness of the environment became more diffused and even the common limits of my musical actions were somehow shredded, as the musical (performative) territory needed to include practices which were perhaps foreign to its common boundaries (installation). The relation to this metaphor also indicated that the cultural expectations concerning the musical language of this specific instrument might be addressed with the expansion of a sonic vocabulary articulated with the spatial processes of the “explosion” image. In this case the musical improvisor might be an extension of the architect or sculptor, as the instrument (cello) is understood as a micro-territory — a small piece of architecture. Maybe this disciplinary distinction is not relevant at all inasmuch as this creative system incorporates the larger scale of the environment and the micro particularities of the cello, thus establishing between them a less clear differentiation. All the limits between interiors and exteriors (disciplinary, symbolic or material) are now permeable, and the metaphor of the explosion becomes a personal reflection on illuminating a “here and now” based on the dissolution of these boundaries.

This portfolio and commentary give an insightful view on the process of building a vocabulary for an “instrument” which is at the same time a technical device that produces and situates sounds and a particular conceptual and material manifestation of the intricacies of a musical approach that wants to question its situated practice. The sonic vocabulary portfolio showed how the deduction of fragmentation and dispersion processes from the explosion metaphor were expressed in the instrumental practice of the cello within the developed electroacoustic device. The process of systematizing this sonic vocabulary also presented the limits of this analytical approach, as these techniques are always situated in time and space: both inside the improvisational flow and the installation’s spatial apparatus. Nevertheless, the portfolio of the six selected concert-installations helped to present the articulation of part of this sonic vocabulary with spatial and macro temporal strategies, therefore clarifying its interdependency and presenting them as strategies for future implementations of the project. The expanded notion of acoustic horizon, which initially structured the Exploded Cello metaphor, is now present in a diverse range of specific situations that compound this hybrid articulation of concert and installation.

A vocabulary is an evolving organism which, although presenting a certain number of constants, is also very susceptible to mutations. These mutations usually arise from its contact with different environments; this portfolio presents a fundamental yet transitory moment of the Exploded Cello vocabulary. By the end of this research a large number of musical vocabulary constants could be identified and are thoroughly presented in Chapter II, both in the Demonstration videos and the texts that accompany them. Their application and situated use can be heard in the documentation of the six concert-installations portfolio.

Therefore the main contributions of this work are:

- further understanding of the notion of acoustic horizon (Truax 2001) as a conceptual tool to articulate the instrument with architecture and soundscape;
- Detailed presentation of a performance vocabulary corresponding to the use of this specific electroacoustic extension of the cello;

- Detailed presentation and discussion of a group of six concert-installations presented in a professional context;
- a comprehensive study of vocabulary which sits between instrumental performance, electroacoustic manipulation and spatial design in installation art.
- the design of a performance and installation system that encompasses a conceptual framework (based on the unifying metaphor of the Exploded Cello), an electroacoustic device, a sonic vocabulary and spatial and temporal strategies for performative and installation presentation in site-specific contexts.

Although not included in this portfolio, since 2018 the Exploded Cello Project has been presented in different places, mostly in professional contexts from Contemporary Art Centers, to Galleries to Experimental music festivals. Curators and organizers have shown considerable interest in integrating the hybrid format of the exploded cello into their programs, specially when they happen in non-conventional places.

New installation setups, with different materials and designs for the resonant objects, have been tested. The performance vocabulary presented in this document has been used and developed in different contexts, from solo concerts to participations in other improvisor´s recordings or ensemble projects, and its practice over time has strengthened its articulations.

A previewed development for the Exploded Cello approach is its development into an ensemble context where the system articulates different instruments.

In what concerns the technology involved in the elaboration of the electroacoustic system, experiments with accelerometers as pickups is a constant challenge, and the use of actuators and sensors is a way to experiment with new developments for the Exploded Cello metaphor.

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Appendix

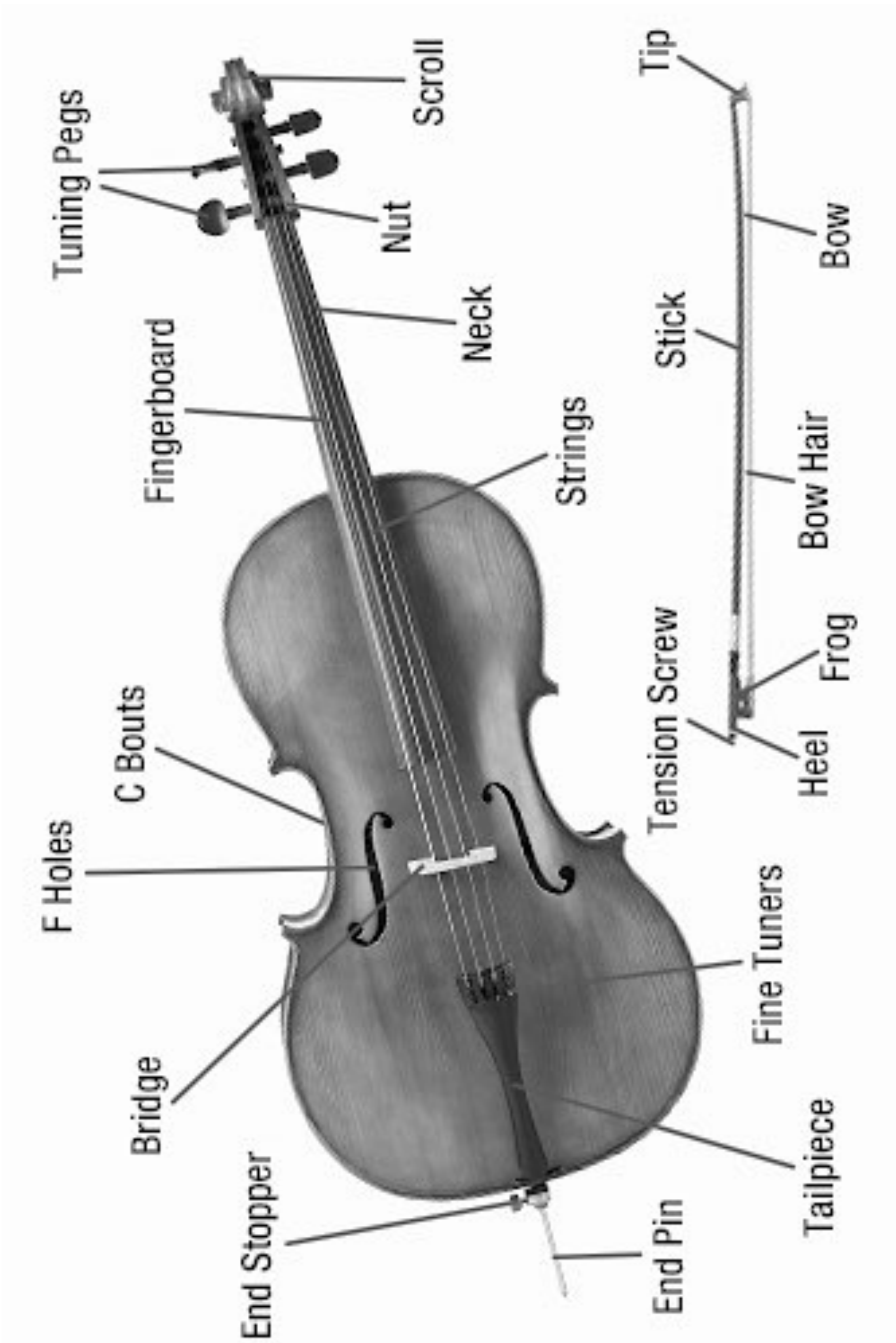

Figure 109: Cello parts diagram