Capture and transformation of urban soundscape data for artistic creation

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ABSTRACT

URB is a research project designed to collect and store raw data from soundscapes analysis. This paper presents a survey about using URB based on the analysis of work developed by several artists, focusing on the description of their creative process and outcome. By comparing the processes and statements of each artists, the authors identified diverse systematic approaches to reinterpreting raw data provided by urban soundscapes, raising questions about the artistic outcomes vs original sound sources. Furthermore, some considerations are inferred about the artistic relevance of using this process in the creation process.

KEYWORDS

Soundscapes; Data Reinterpretation; Networked Music; Composition; Data Visualization.

1 | INTRODUCTION

The auditory system tends to have a cultural and social disguised importance when compared to vision. This issue called *The dominance of eye culture* was developed and detailed by Berendt (1992). Nevertheless, its importance is undeniable and it represents a vital action, not only in our survival (Middlebrooks and Green, 1991) but also in our daily life. Hearing is permanent, unlike vision that can be blocked. To cope with the overwhelming sound information a person is submerged in, humans have different types of listening related with levels of awareness. Most of the time, a person listens without regards to details, what is called casual listening (Chion, 1994). This leads to an increase detachment from the nuances of soundscapes [1] that surround us, a problem to which Schafer refers in detail (Schafer, 1977). This detachment represents a

problem, for soundscapes have been an important element defining communities, influencing them and imprinting them an identity. The same way a distinctive landmark defines a given place, sound has the same power. These soundmarks can be from natural sources, as the sound of a waterfall, or artificial such as a bell or a factory siren. When recognised as such, one easily understands the influence that they represent towards a community and their social importance (Cordeiro, 2013). Any person transforms and affects his surroundings, in a relationship that is shared among the community. However, how does the ambient sound transform Man? Does the ambient sound influence the artist's work, as a product of their time and space? The usage of the soundscape concept is increasingly relevant not only for acoustic ecology but also in artistic contexts. Using this premise, this investigation focus on increasing the awareness of ambient sound to creators.

> *After all, the soundscape is not an alien force but a reflection of ourselves. (Truax, 2001, p. 117)*

2 | FRAMEWORK

This section has the function to provide a good overall understanding of the scientific areas related to our research process. We are going to dedicate these next lines to explore, on the general topic Soundscape Composition, the Eco-Composition and Eco-Structuralism subjects in particular. Expounding the different perspectives and purposes that have been presented and discussed in specialized literature. Being a vast subject, during our exposure we are going to favor and taper the aspects that are more related to our agenda.

2.1 SOUNDSCAPE COMPOSITION

The generalized access to powerful audio technology boosted the use of soundscapes as a resource for composers and sound artists (Westerkamp, 1999), increasing the number of compositions using field-recordings. This possibility potentiated and democratized the trend Pierre Schaeffer had started, when he created *Musique Concrète*. However, according to Westerkamp (1999, p. 3) "the essence of soundscape composition is the artistic, sonic transmission of meanings about place, time, environment and listening perception". There are two main approaches: 1) only using unprocessed sounds and the composition process focus on selecting, editing, mixing and organizing 2) using audio effects on recorded environmental sounds. Truax (1994) remarks that for a given work to be considered a sound composition should have direct relations with the sound's original source, place, time, situation or context. This is because a "piece cannot be called a soundscape composition if it uses environmental sound as material for abstract sound explorations only, without any reference to the sonic environment" (Westerkamp, 1999, p. 4).

2.2 ECO-COMPOSITION AND ECO-STRUCTURALISM

The term Eco-composition term was used for the first time in 2004 by the art critic Robert C. Morgan referring to Keller and Adriana Capasso installation *Vivir sin despué* (Keller and Capasso, 2006). It is a more specific posture within soundscape composition. The term is used to describe the composer combining aspects of ecology with compositional processes. He does not work only with field recordings but takes into account the history, ethnography and geography of the sound that he is manipulating (Opie and Brown, 2006). The eco-composition definition does not involve only the creation aspect, also requires a new way of listening. The audience is invited to take the context of the sounds into consideration (Field, 2000; Keller, 1999).

Eco-structuralism is derived from the eco-composition framework. It is a new approach to music composition designed to maintain the characteristics and context of a sound, even if not using the original recording data directly. In eco-structuralism, patterns are derived from analysis of natural environmental sound sources that reveal structures within the material. This structural data is used as the dominant material for creating the musical composition (Opie and Brown, 2006).

In this kind of musical practice, structures must be derived from natural sound sources but not all the structures from a sound need to be used. Small sections of the structure may be extracted and used separately. The approach to the data extracted can be very similar to the "classical" composition by using tools such as elongation, compression, inversion,

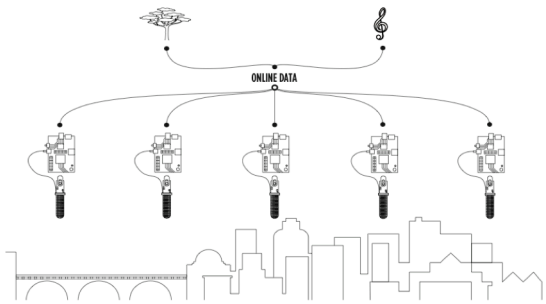

Figure 1 | URB system (illustration by Diogo Tudela).

reversing, scaling and offsetting (Opie and Brown, 2006).

2.3 URB

URB [2] is a system for automated analysis and storing of an urban soundscape based on available and inexpensive hardware and open source software. It complements the traditional sound maps [3], allowing the direct access of its features at any arbitrary moment since the system boot, thus facilitating the study of the soundscape evolution and the differences between specific timeframes, and facilitating artistic approaches to such data. It was developed to be used not only by environmentalists and urban planners, but also by artists with creative intentions.

URB (Figure 1) consists in a system for capturing and analyzing the soundscape in real time. The data analysis results in 12 different elements or descriptors of the sound; four listening points in the city of Porto that are capturing and storing permanently; a free access database with all the information resulting from the capture; free software to access the database.

The project also encourages spontaneous initiative for the multiplication of listening points and promotes artistic creation from different areas, with the data in real-time and non real-time. It also makes efforts to present approaches to data processing systems for artistic purposes (Gomes and Tudela, 2013).

2.3.1 Software architecture description

Sending and Storing Data

When sending and storing data on-line, URB relies on Python and MySQL to perform the tasks. The Python module works as an outside agent, responsible for building a query out of a float package put together by Pure Data, and sending it to a MySQL database.

The Database

It is well established for now that each location, each sound recollection point will have its own table on the database, being that each table will take the name of its actual urban location. The structure of each table is rather simple. Thirteen columns, one for each audio feature plus a first row that is using Unix Timestamp as a mean of identification and time localization of the event described in the row. URB database, a series of data visualization and retrieval tools are being designed in order to keep the dialogue sustainable even for the non-technical user. It is of the most importance that URB data remains relevant and useable for the musician, composer or citizen without computational expertise, furthermore, all records are intended to be cleared of any composition methodology. There are two different PHP scripts that play a small part on what is expected to be a stable and refined project of data visualization and retrieval. For now, these two scripts are responsible for the following outputs:

- Displaying the data of a specific table as an HTML table. Regarded as a production tool, this allows monitoring the data flux without needing to log in to the host control panel.

- Exporting the data of a specific table as a .csv file.

For now, the main intention is to keep URB as an inviting platform for the users of the so-called creative programming frameworks such as Max/MSP, Pure Data, Processing, ProcessingJS, openFrameworks, Cinder, Nodebox, Shoebot, among others.

2.3.2 Sound Analysis and information for the Data base

All the sound analysis is made in the Pure Data patch.

The patch analyzes 12 different elements or descriptors of the sound: Pitch, Amplitude (using the native Pd-extended object sigmund~ and avg~), Centroid, Kurtosis, Flatness, Flux, Irregularity, Mfcc, Roll-off.Skewness, Spread, Zero-crossing rate. (from the timbreID is a Pd external collection developed by William Brent.)

Every five minutes the patch calculates the main value of each feature of that time and sends that value to the database [4]. (Gomes and Tudela, 2013)

3 | CASE STUDY

In this section, present in detail a group of artistic applications of the principles and system introduced.

3.1 PROPOSAL

A call was open to the musical and sound art community to work in the challenge of using URB in the creative process. It could be an electronic piece, music for instruments, or a sound installation. The only requirement was that somehow the data from the URB had to be used in the composition of the work. Several artist from different backgrounds and with different aesthetic purposes responded to the call.

The main goal of this investigation, starting from the analysis of the pieces and of the feedbacks and opinions from the authors, is to assess the relevance of this approach to the ambient sound as gigantic sensor to be used in artwork and if this approach is artistically relevant and if it will contribute to approximate the sound ambient and the creator. This investigation also tries to understand if the aesthetic characteristics of the original sound sources that are captured within the structures will remain accessible in the final composition, and, from the comparison of the results, hopefully also to start to point a way to systematize the artistic approach from the comparison of the results between them.

3.2 PIECES DESCRIPTION AND ANALYSIS

3.2.1 ...URB to B...

Composer: Nuno Peixoto

For: 2 Percussionists (timpani, vibraphone, and multi-percussion set)

The composed work was commissioned by the Portuguese group *Talea et alaia* [5] to be premiered in a Brazilian tour on January 2014. This provided the perfect setting for the composer to create a piece entirely related and inspired by characteristic Portuguese sounds. Envisioning this, Peixoto decided to accomplish it through a representation of Porto city. To do so, URB became the essential tool that granted the necessary data for the elaboration of

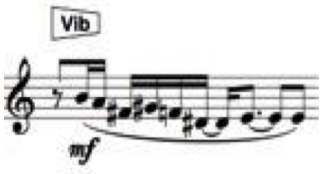

Figure 2 | Excerpt of ...URB to B... musical composition (bar 84).

...URB to B..., allowing the transition of urban sound to the musical piece.

The entire musical material used on this piece derives from the extraction of data provided by URB software. This tool is used by the composer not only at a structural level, but also in pitched notes and rhythmic sequences. Through the arrangement of all these elements, Peixoto intends to capture the particularities of each listening point that will characterize and describe the different times of the day in Porto city.

Structure-wise, the composer uses solely data belonging to three listening points (of the four possible ones in URB Software): Casa da Música, Oliveira Monteiro/Rua da Boavista and Sá da Bandeira/Mercado do Bolhão. So we have the following structure:

A–Casa da Música (b.1 – 22)
Bridge I (b. 23 – 24)
B–Oliveira Monteiro/Rua da Boavista (b.25–100)
Bridge II (b. 101 – 106)
Development (b. 107 – 128)
C–Oliveira Monteiro/Rua da Boavista (b.129–

Table 1 | The following table depicts the rhythmic and melodic cell values (Figure 2).

Soundscape pitch from URB analysis	Reading Mode process to chromatic scale	Reading Mode process to rhythm
493.128Hz	= B3 (493.9Hz)	attack time
440.734Hz	= A3 (440Hz)	attack time
369.360Hz	= F#3 (370Hz)	attack time
414.962Hz	= G#3 (415.3Hz)	attack time
349.419Hz	= F3 (349.2Hz)	attack time
310.825Hz	= D#3 (311.1Hz)	attack time
417.578Hz	"incorrect value"	
330.471Hz	= E3 (329.6Hz)	attack time
308.012Hz	"incorrect value"	
298.537Hz	"incorrect value"	
462.870Hz	"incorrect value"	
235.322Hz	"incorrect value"	
330.471Hz	= E3 (329.6Hz)	attack time
358.298Hz	"incorrect value"	

150/end)

The Sá da Bandeira/Mercado do Bolhão listening point has a very brief part in the *...URB to B...* composition, in comparison with the remaining two. Its sole purpose it is to provide a vibraphone motif which is repeated several times, as can be seen in bar 38, 60, 84 and 127. The second assemblage of the city's characteristics is done through the obtainment of pitch levels (musical notes) and rhythmic sequences. For this purpose, the composer applies a strategic "*reading mode*" (Bernardes et al., 2012) over just two table indexes (same number of instrumentalists): *pitch and centroid*. The first one is designated for the timpanist (percussionist 1), due to the low frequency range of the *pitch*. Lastly, the second percussionist that plays several instruments such as the vibraphone, is directly related with the frequencies presented on the *centroid* index table. For the translation from numerical values to musical notation Peixoto developed a process termed *Reading Mode*.

Reading mode: The different values presented on the *pitch* and *centroid* tables were divided into two categories. Firstly, we have what we consider as "correct values", meaning all the frequencies provided by the chromatic scale, such as: 73.4Hz = D1, 440Hz = A3. We also consider as "correct values", frequencies that are 1Hz above and below the ones presented by the chromatic scale. This means that values such as 329.052Hz are equivalent to the E3 (329.6) note. Other examples of this process are: 83.2682 = E1 (82.4); 92.2924 = F#1(92.5); 104.436 = G# (103.8). (The values that result from this two sound features are within the scope F1 to B3. As such the fact of frequency being a logarithmic is not a problem because this process is only applied in a section of low frequencies. The high notes are achieved through octave transposition but always respecting the note.) Secondly, we have what we call "incorrect values", which are the ones that don't fit the "correct values" standards. For example: 90.4796Hz, 94.9886Hz, 95.5805Hz, etc. This category has the task of identifying the duration of a certain "correct value". Therefore, the more "incorrect values" we find associated with a certain "correct value", the longer will be the rhythmic duration of a musical note. For example:

219.621Hz = A2 (220Hz) attack time
214.381Hz = "incorrect value"
234.848Hz = "incorrect value"
235.523Hz = "incorrect value" note end

220.003Hz = A2 (220Hz) attack time
221.799Hz = "incorrect value"
242.159Hz = "incorrect value"
289.992Hz = "incorrect value" note end

292.947Hz = D3 (293.7Hz) attack time
304.007Hz = "incorrect value"
308.547Hz = "incorrect value"
326.367 Hz = "incorrect value" note end

If the value determined for each Unix Time unit represents a semiquaver, than the previous values represent the following rhythmic figuration: q q q, with the respective pitch of A2, A2 and D3.The previous example was extracted from Casa da Música's listening point, with the correspondent index time of 1376118294 (2013-08-10 07h04:54).

In the musical composition *...URB to B...*, the value assigned for each input / *Unix Time* is of 250 ms. Therefore, the shortest rhythmic value provided by this *reading mode* will be the semiquaver.

After establishing this algorithm, it was necessary to develop a new URB version in order to interpret the currently *reading mode* and allow it to communicate with a MIDI sequencer, thus making it possible to convert the URB tables for automatic music notation.

Complete score: www.jasg.net/URB/URB_to_B.pdf

3.2.2 Rascunho

Composer: Filipe Lopes

For: Live Electroacoustic Music

According to Lopes, the main issues that emerged upon the proposal was "why should one analyze a given soundscape as such, especially when targeted to music composition?". Intuitively it seems more expressive and interesting to use concrete sounds of the soundscape rather than its analysis. Nevertheless, Lopes was curious about what could be revealed by such data and to find if he would be able to use it in a formalized composition, since the combination of both does not necessarily mean interesting music.

The first experiments were focused on retrieving the online data, connect it to oscillators and hear the

results, in a very empirical approach. Later experiments evolved into controlling more broad parameters such as wet/dry reverb, faster or slower pulses (e.g. using the feed to control a metronome), extended or compressed harmonic fields (e.g. upon a chosen chord, use the feed to expand, compress or transpose that chord). The initial experiments were accomplished retrieving the values at slower rates, such as a value each second. Overall variations, however, ranged from 500 milliseconds to 5 seconds. In the former approaches, Lopes was evaluating the feeds number by number, assessing the sonic discourse between successive values, evaluating them with "the ear".

A different approach later taken was to extract the numbers very rapidly, in order to create a gestalt movement of the feed, which he used to assess its potential as melodic lines or rhythmic contours. Lopes did such experiments retrieving values at fast speeds such as a value each 100 milliseconds or even faster.

At this time, Lopes was yet not convinced about the sonic outcomes. It all sounded not natural. Melodies didn't have a melodic contour, rhythms didn't relate to each other and using URB to change any given parameter also raised the question of what sound to use, since URB, just like MIDI, does not "sound". Globally, URB provided values that had no musical feeling between them, at least in Lopes preferred domain: formalized electronic music.

Lopes aim to use URB's data values had to match a valid inevitability in order to make them different from a random generator. This was especially important since the descriptors were sound indicators with possible expressive sonic significance. Unlike sonification environments where often a composition is based on non-musical data (e.g. "*Omega – uma narrativa de sonorização e visualização"* (Lopes and Menezes, 2012)), URB is based on extracting musical features from soundscape, which has been the topic of many compositions and, thus, has potential musical interest.

The work *Rascunho* was played live as opposed to a fixed electronic composition. It emerged by the division of URB's feeds between "high-variation" and "low-variation". For the piece, Lopes also decided to use concrete sounds of Porto, playing them with the software *POLISphone* [6]. The form used was the classical: A B A.

Part A: Lopes used is older composition *Different Shapes, Same Rhythm* multiplied five times and used URB values to change its playing speed. Some of the values controlling playing speed were "high-variation" and others were "low-variation". This produced an organic drone but with a pitched feeling, as the composition itself is played in a piano. In addition, some values of URB were feeding a simple sine wave generator, masked with reverb. Towards the end of this section, it was introduced the concrete sounds of Porto and faded out all the other sounds.

Part B: was comprised of very subtle concrete sounds such as night soundscapes or museum gardens and no URB usage. The use of concrete sounds of Porto seemed to fit the piece and the context proposed. The return to part A, was accomplished again with a fade-in, recycling most of the materials and URB's usage. The final section, or coda, comprehended the stopping of each sound-source one by one until, at a slow rate, the music reached silence.

Rascunho: www.jasg.net/URB/Rascunho.mp3

3.2.3 (25/04/2013) x 2

Composer: Palmer Eldritch (Luís Fernandes and Miguel Pedro Antunes Guimarães)

For: Live Electroacoustic Music

(25/04/2013) x 2 is a real time manipulation of the data provided by the URB system captured on the April 25th of 2013 using analog synthesizer:

- Modular synthesizer in eurorack format (modules: Make Noise, ADDAC, Mutable Instruments, Doepfer and Intellijel)

- Arturia Minibrute

- Doepfer Dark Energy

The music project Palmer Eldritch is a duo based in Braga (Portugal). They explore electronic music using microscopic textures, dreamy synths and danceable beats in a non-danceable context. Contrary to the other projects presented in this chapter the authors have no formal education in music composition and are not involved in the musical academic area.

However they are a project of recognized value by the musical community being members actively involved in artistic creation in various musical and aesthetic types for several years. This fact is quite relevant and interesting for this investigation in order to understand whether this approach serves musical styles less formal and trained and how is that different approaches may be.

This piece, as is well marked in the title, use the data captured from the 25th of April of 2013 [7]. For the work they choose two listening points, Sá da Bandeira/Mercado do Bolhão and Casa da Música, one for each musician.

The music piece is divided in three sections characterized by speed and note release:

A - Moderate speed and short note release

B - Fast speed and short note release

C - Slow speed with long note release (with extra sound processing)

The sound descriptors used in this live performance were pitch to control the Pitch of the synthesizers and the Amp descriptor to control the envelope release parameter. Using a Max patch to read the sound data information from the 25th of April 2013 the values from the Amp descriptor were scaled to match the release values and the pitch values were converted to MIDI values to control the Arturia and Doepfer synthesizers and converted to voltage to control the modular synthesizer.

The time line progression was totally respected. So the piece begins with the first line of data and continues progressively from that, line after line. The only structural parameter that was controlled by the musicians in real time, was the speed of descriptors progression. Meaning that the time lapse corresponding to the entire day was not scaled to the time piece. The speed was changing under the impetus of the musicians according to their musical taste.

(25/04/2013) x 2: www.jasg.net/URB/(25-04-2013)x2.mp3

3.2.4 Control and Unpredictability

Authors: Gustavo Costa and Eduardo Magalhães

Sound Installation

The sound installation used audio recordings and URB data from the Carvalhido listening point. It explored the subjective interpretation of the listeners, especially when confronted with sounds that were embedded in their own particular geographical and social references. Since the parameters extracted from URB were highly objective, this piece relied precisely on the confrontation of objective and subjective data.

Control and unpredictability consisted of:

-A loudspeaker inserted into the resonant body of a floor tom;

-A drum membrane with sand over it (see Figure 3);

-Two loudspeakers playing processed field recordings from the Carvalhido area. (spectral filters and time stretch previously processed with the Kyma software)

Two URB parameters were used as input values for a Max MSP patch. These inputs acted as triggers for melodic and harmonic content. Input 1: Centroid values; Input 2: Amplitude values.

Centroid provided frequency values that were

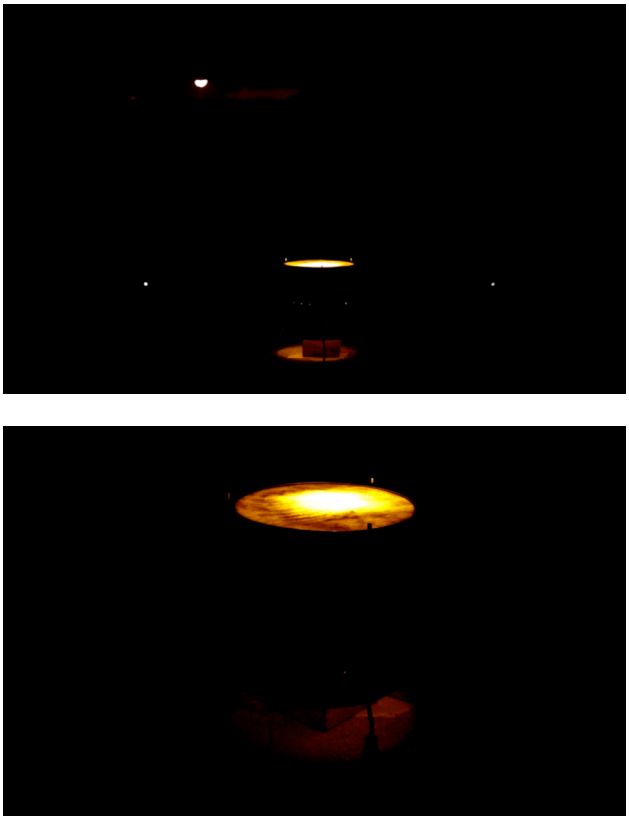

Figure 3 | Control and Unpredictability sound installation.

translated into pitch class sets (from 0 to 11), which were then transposed randomly to different octave registers to be played by a virtual instrument (a celesta). The values were then filtered to prevent the occurrence of some undesirable intervals. Only notes from a whole tone scale would be played and unisons, octaves and perfect fifths were blocked. Amplitude values provided a trigger for the processed field recordings after a defined threshold. Since the original values were triggering too many sound events, a re-scaling of those values was made in order to become musically adequate.

The sound of the virtual celesta was played by a loudspeaker inserted inside a floor tom. Over the membrane of the drum was some sand that was being excited when certain frequencies induced the vibration modes of the membrane. Since there was also a light inserted inside the floor tom, the sand created different visual patterns according to different vibration modes of the membrane.

There were many layers of transformation of the natural soundscape of the Carvalhido listening point. The natural sounds analyzed by URB, audio recorded, digitally processed, recombined with a melodic layer provided by URB data and ultimately recombined again with its natural sounds, since the sound installation was on an open air space. Regarding URB, some of the values were translated musically in a way that they became impossible to have a direct identification with the original sources. However, there was an extremely important level of conceptual coherence that was obtained while mixing the objective data of URB and translating it into a subjective, and sometimes distorted, musical reality.

3.2.5 Urban Sonic Impressions

Author: Rui Dias with the collaboration of Gilberto Bernardes.

Sound Installation

"Urban Sonic Impressions" is a sound installation inspired by the URB system, that creates moving sound textures using sounds from the *Porto Sonoro* [8] sound archive. Using the analysis data from the online stream coming from the four URB locations in Porto, the data is used to continuously select and alter the parameters of four granular synthesizers and processors (see Figure 4). Implemented in the Max/MSP/Jitter environment, the data is retrieved and mapped to four audio processor parameters to determine the resulting sound for each one. The audio processors consist basically on granulators and spectral FFT processors. Using the *EarGram* concatenative synthesis software by Gilberto Bernardes [9], a selection of sound recordings from the *Porto Sonoro* online archive were analyzed and segmented according to the *brilliance* and *amplitude* descriptors. The segments were then reordered into a "scale" of sound grains forming a continuous sound file that starts with the segments with the lowest brilliance values and ends in the segments with the highest values. In order to obtain a greater sonic diversity, for each of the four different locations, a different set of sounds was chosen.

Because all of the four listening points are set on city streets, the real sounds that are analyzed are not necessarily very distinct. However, the locations have some relevant landmarks that were used as metaphors for the selection of the sound material. As such, while the selection of sounds for the Sá da Bandeira and Oliveira Monteiro streets were regular city sounds that include all sorts of vehicles, noises, voices, etc., the sound selection for the listening point in Casa da Música includes musical instruments, and the Sonoscopia location includes sounds from several percussive and metallic objects, seldomly used in the venue's music concerts and sound installations.

After the segmentation and re-ordering process with EarGram, the resulting sound files are then loaded into

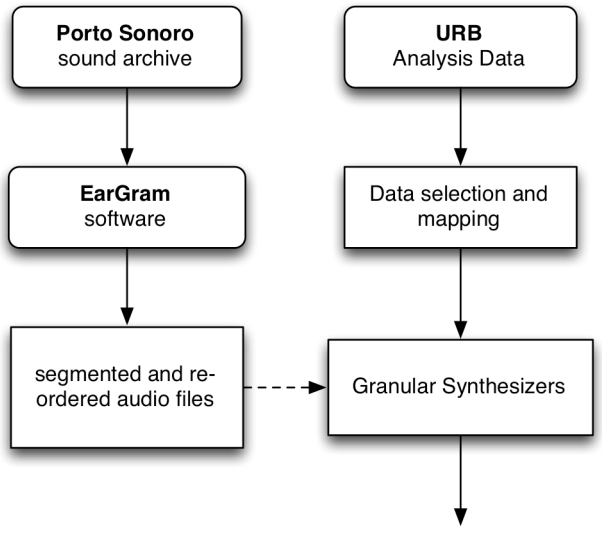

Figure 4 | Workflow diagram.

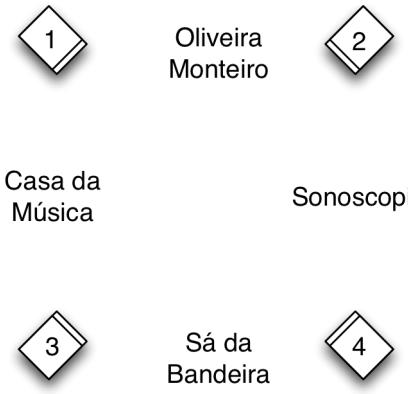

Figure 5 | Source spatial position configuration.

the granulators, and the current URB *brilliance* analysis feature is mapped to the buffer read position.

Other audio processors are used to provide more richness and variation, namely FFT filters and resonators. The *amplitude* and *spread* features from URB control respectively the amplitude of the filter and resonator modules, while the *pitch* defines the base frequency for the resonators module.

The resulting sounds are then arbitrarily positioned in a four speaker square configuration around the space (Figure 5). Each of the four sound locations is placed in a speaker pair corresponding to one side of the square.

Note: *Rascunho, Control and Unpredictability, Urban Sonic Impressions* were presented in the event "We, the citizens" at Future Places Festival 2014 [10].

3.2.6 Re-Interpretação Urbana

Authors: Filipe Lopes and José Alberto Gomes

40 hours Sound Installation

Re-interpretação Urbana (*Urban Re-interpretation*) is a sound installation which inhabited the chapel during the Serralves em Festa 2014. This work was commissioned by the Serralves em Festa 2014 Festival, the biggest contemporary artistic expression festival in Portugal and one of the largest in Europe, and the Sonoscopia Associação Cultural [11].

This sound installation has a special meaning for this investigation because marks one year of the first URB listening point installation allowing for the first time an approach with a time window of one year. Additionally it seemed to be a perfect opportunity to compare processes already use in order to analyze the sustainability and relevance of artistic processes.

The context of this festival is very particular. Although it is a festival with a contemporary and experimental aesthetic it is an 40 hours non-stop event with a major impact on the general public, being visited by thousands of people in a very small amount of time. The space chosen for the intervention was a big white room in the second floor of the Serralves chapel illuminated by a huge round window.

According to the physical and symbolic space the authors decided to develop a contemplative sound experience, promoted through an immersive soundscape that mirrors the sonic complexity of the city, particularly their behaviors and patterns, also exploring the room acoustics.

Being an event with big impact in the city, thus creating a specific soundscape on those days, it seemed promising to use the material of the exactly same days of the festival of the year before. The public experienced an artistic sonification of the city from exactly the same time of the previous year. The process used was exactly the same used in the music piece *L'abre des Songes* [12]. Although in *L'abre des Songes* all the information was compressed to 6 minutes, in this case the time lapse was fully respected, which represents a significant difference . As used in the original piece, i.e. *L'abre des Songes*, the pitch sound feature information was used to control a simple oscillator. The resulting soundtrack was chosen to be the background sound of the installation. Additionally we used a very basic random midi note generator with only three variables: low limit, high limit and note density. The notes range was controlled by a combination of the centroid and the spread features (providing us the spectral center and

Figure 6 | Re-interpretation sound installation.

its limits), and the loudness feature controlled note density.

The system consists of two loudspeakers, close to the height of a person, front to front, creating a hot spot aligned with the center of the round window, thus creating a perfect harmony between the sound and the space (Figure 6).

This reworked soundscape was occasionally interrupted, 4 times a day for 15 minutes, with a sound composition by Filipe Lopes. The intervention focused on exploring the acoustics of the room (especially the resonance frequencies) to expand "sound everywhere," as opposed to a sound concentrated at the center.

The experience between *L'arbre de Songes* and *Re-Interpretação Urbana* is considerably different mainly because of the format, one is a music piece and the other one an installation. The evolution of the day characteristics is more perceptible in the music piece since it is in a kind of fast forward, while in the installation, the direct relation with the soundscape, although less obvious, is more immersive. It can be concluded, however, that different days and locations using the same approach, capture, analysis and compositional treatment, can envisage artistic meaningful experiences and reasonably unique.

Re-interpretação Urbana Video:
www.vimeo.com/jasg/re-interpretacao

3.2.7 URB XY

Author: Diogo Tudela

URB's data visualizer software

The new media artist Diogo Tudela answered the call with a different format than a classical or usual art piece. Being right in the center of a new generation of programmers artists (or artists programmers) movement, were the artistic concept boundaries are often are blurred and challenged, the author presented a visualizer to URB's data named URB XY.

URB XY was developed in the open source programming language Processing. It is a data visualization software designed to display the sound metadata stored by the URB project and to grant a fluid and intelligible navigation through URB's stored

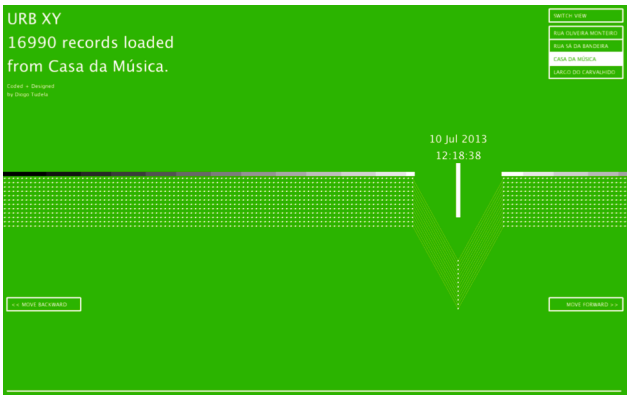

Figure 7 | URB XY starting interface.

data. Providing interactivity to URB's static and orthogonal tables, URB XY allows its users not only to explore the recorded material in its individuality, but also to grasp its overall contours as a whole.

The software starts with a very simple interface where is always a grid, representing an horizontal time line, and were is possible to choose the data location or see the evolution of the records loaded of that specific place (see Figure 7).

The interface allows to move back and forward in time, while browsing through URB's complete on-line public database and hovering through the grid displays the sound descriptor and the corresponding data stored in the database (see Figure 8).

The software presents a grayscale section on top of the grid that makes notice of the time of the day in which the recording took place by making a chromatic reference to daylight.

In addition to the default frontal view, URB XY allows the rotation of the grid into a side view, while transferring the database information to a small table at the bottom of the screen. This view was designed

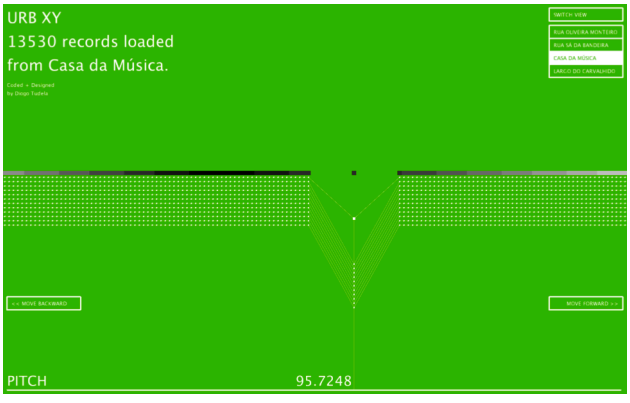

Figure 8 | Descriptor and data in URB XY grid.

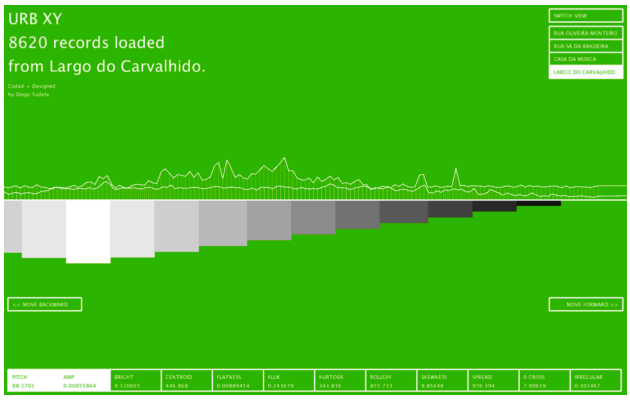

Figure 9 | URB XY side view.

to display the behavior of features over time. This specific view is quite useful perceive the evolution of the sound during that period of time, not only through a single a descriptor but the sound as a all because is possible to visualize more than one descriptors at the same time enabling the possibility to analyze the behavioral relationship between various elements (see Figure 9).

At any given time, it's possible to refresh the stored data or download information from another location, allowing the comparison of the behavior of specific descriptors between two different places.

URB XY site and download: www.urbxy.org

URB XY presentation video:
www.vimeo.com/87868012

4 | CONCLUSION

URB proved to be efficient in the access to audio descriptors data retrieved from sound ambient, particularly to its time alterations. It also provided composers enough raw materials in order to devise their works in addition to an higher awareness about sound environment. The artistic outcomes analyzed point to diverse realization about the aesthetic significance of using URB's raw data. While Peixoto, Costa, Dias, Gomes and Palmer Eldritch duo guarantied musical elements such as melodies, rhythm or formal coherences, Lopes claimed that his instinct as a composer induced him to adopt URB's metadata as a 'variation source', independent of the descriptors significance. In the case of Lopes, even if the work is artistically interesting, there is not an evident correlation with the original source, thus, breaking with the Soundscape Composition and Eco-Structuralism principles.

This kind of application can also be verified in the piece *(25/04/2013) x 2* were the duo applied the amp values in a different musical parameter, the note release.

In a sonic point of view before this small survey of works we can notice similar uses and processes to the data. Most of the artists apply the descriptors in corresponding musical elements, such as pitch, rhythm, structure, there is also an appeal, on a smaller scale, to use metadata as a 'variation source' independent of the descriptors significance. However there is a similar approach independent of aesthetic and academic origin of the artist.

URB's data visualizer software, although is not completely an artistic result by itself, shows the potential applications of the soundscapes data in other artistic areas beyond the music and sonic arts.

Further research will be focused in determining how these and other artistic outcomes resulting from using the URB system, can converge to an understanding of the different soundscape composition based in raw data, as a coherent musical framework.

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ENDNOTES

[1] The Soundscape concept and movement was presented to the world in the 70's Murray Schafer considerations and researches. (M. Schafer 1977, 1998). Soundscape**:** Technically, any portion of the sonic environments regarded as a field for a study. (M. Schafer 1977).

[2] www.urb.pt.vu

[3] Sound maps are digital geographical maps that associate landmarks and soundscapes.

[4] Described in detail in *Urb : Urban Sound Analysis and Storage Project.* (Gomes and Tudela 2013)

[5] Formed by the percussionists Rui Sul Gomes and Nuno Aroso

[6] https://vimeo.com/85330001

[7] This date is very important for Portugal because is the anniversary of the Carnation Revolution. A military coup in Lisbon, Portugal, on 25 April 1974 which overthrew the regime of the Estado Novo. This event effectively changed the Portuguese regime from an authoritarian dictatorship (the Estado Novo, or "New State") into a democracy.

[8] http://www.portosonoro.pt/

[9] https://sites.google.com/site/eargram/

[10] Rascunho, Control and Unpredictability and Urban Sonic Impressions video:

www.jasg.net/URBconcerts%26pieces.html

[11] www.sonoscopia.pt

[12] Described in detail in *An Eco-Structuralism approach in soundscape (data) composition.* (Gomes, Barbosa and Penha, 2014)

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BIOGRAPHICAL INFORMATION

José Alberto Gomes born in Porto in 1983. In 2007 he completed a degree in Composition at the School of Music and Performing Arts, creating strong bonds with new technological possibilities and the role of music in music theater, film, installations and electronic improvisation. He taught in the courses of Electronic Music and Music Production - ESART, Audiovisual Communication and Multimedia - Lusófona University of Porto and Composition - ESMAE-IPP. He is the curator of the project Digitópia of Casa da Música Foundation. Currently is doing his PhD in Computer Music at Catholic

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Nuno Peixoto de Pinho, born in São João da Madeira (Portugal) in 1980. In 2003 he started is composition bachelors degree at the Escola Superior de Música e das Artes do Espectáculo (ESMAE) in Porto. Recently Nuno is doing is PhD in Composition at Universidade Católica do Porto (U.C.P) where he explores the musical data processing in a more specifically field "The Musical Reuse as a Creative Process Compositional" under the supervision of Erik Oña and Sofia Lourenço.

Filipe Lopes is an awarded composer, performer and an academic. His practice focuses on music composition, frequently encompassing electronic music, digital media, audiovisual installations, interactive digital systems and software development. He has composed music for performers and ensembles but also music for films, dance and theatre. In addition, he has also developed significant of work related to music education and new technologies. At the moment Filipe is doing a PhD in Digital Media at FEUP and UT | Austin. His research is focused on sound, space and identity. http://www.filipelopes.net

Gustavo Costa was born in Porto, 1976. Studied percussion, music tecnology, sonology, composition, music theory and is currently attending a PhD in Digital Media at Feup, Porto on the subject of expressiveness and interactivity in computer music. His work as a musician and composer is based around underground counterculture, improvised and electroacoustic music. He has toured and recorded extensively around Europe, United States, Japan, Brasil and Lebanon. http://www.gustavocosta.pt

Rui Dias was born in Braga – Portugal in 1974, where he studied classical and jazz piano. BA in Composition at the Music and Performing Arts School (ESMAE, 2005) in Porto, and MA in Multimedia at the Engineering Faculty of Porto University (FEUP, 2009), where he is currently a student in the UTA/Portugal Digital Media Ph.D. program. Teacher since 2005 and program director since 2007 of the Electronic Music and Musical Production program at the Applied Arts School of the Polytechnic Institute of Castelo Branco – Portugal. http://www.ruidias.pt

Diogo Tudela (Porto, 1987), completed a degree in "Sound and Image" in 2009 and a Masters in Digital Arts in 2011, both in the School of Arts of the Portuguese Catholic University. During his Masters, performed a short-lived stage in CITAR: Centre for Research on Science and Technology in Art, Porto, Portugal; and attended the Erasmus Intensive Programme "The Art of Sound / The Sound of Art", the Music Conservatory of Cosenza, Cosenza, Italy. Was speaker the "BEST Days on Technology'11" at the Faculty of Engineering, University of Porto; and "II National Meeting of Typography" at the University of Aveiro. Has exhibited work in events and spaces as "Future Places", "Serralves em Festa", "Glimpses of Autumn", "Semibreve Festival", "Project IMAN",etc. Recently designed and taught some workshops in Serralves, part of the team responsible for the exhibition "Close-Up". http://www.diogotudela.com

Álvaro Barbosa (Angola 1970) is an Associate Professor and Dean of the Creative Industries Faculty at University of Saint Joseph (USJ) in Macau SAR, China. Until September 2012, was the acting director of the Sound and Image Department at the School of Arts from the Portuguese Catholic University (UCP-Porto), co-founding in 2004 the Research Center for Science and Technology of the Arts (CITAR), in 2009 the Creative Business Incubator ARTSpin and in 2011 the Digital Creativity Center (CCD). Holding a PhD degree in Computer Science and Digital Communication from Pompeu Fabra University in Spain and a Graduate Degree in Electronics and Telecommunications Engineering from Aveiro University in Portugal, his academic activity is mainly focused on the field of Audio and Music Technology, in which he worked for five years as an Resident Researcher at the Barcelona Music Technology Group (MTG). His creative projects, in collaboration with other artists and researchers, have been extensively performed internationally, with special emphasis in Sound and Music Design, Collaborative Interactive Installations, Live Electronic Music, Computer Animation, Design Thinking and Systematic Creativity. http://www.abarbosa.org