Acoustic Views of Dorgali

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Abstract

We present Acoustic Views of Dorgali, an ecological sound sculpture designed to immerse the audience within a reconstructed natural soundscape, allowing them to interact with it through physical movements. After a brief overview of the relevant context, rooted in sound art and acoustic ecology, the sound sculpture is presented. The last section proposes some observations derived from the premiere.

1 Sound Art and Sound Sculpture

The late Seventies registered the birth of a new form of artistic expression employing sound in peculiar ways, through creative processes more familiar to the context of plastic art rather than to the traditional music composition. Blending amongst the other disciplines, music, plastic arts, and architecture, it took the name of sound art. In this context, of primary importance is sound, fitting an augmented compositional process that bonds it with images, space, and time [Licht, 2009]. Sound sculptures, the outcome of this new artistic paradigm, free themselves from the sole material dimension characterising the traditional plastic art context, acquire a multidimensional one and allow sound to reach an expressive potential never experienced before.

1.1 Eco Sound Art

The interest of the artistic field, and the musical one in particular, for ecology, intended as the broader interaction with the natural environment, was not new, as composers like Vivaldi or Beethoven demonstrate. However, eco sound art gained momentum thanks to the development of the field of acoustic ecology. This discipline, which founders and most prominent figures are Raymond Murray Schafer, also the founder of the World Soundscape Project (WSP[1]), and Barry Truax, is interested in studying, preserving, documenting, and raising awareness on the soundscape [Wrightson, 2000]. In light of this renewed interest in the natural environment, eco sound art started as an artistic practice making use of the natural environment, either as a site or material. Eco sound art can be described as the artistic output of acoustic ecology, with the only difference being that it is not bonded to address ecological issues [Gilmurray, 2016]. Nowadays, despite the importance that this artistic movement gained, and although it fits the more general context of eco art, eco sound art still lacks wide recognition and clear definition [Gilmurray, 2017].

[1] https://www.sfu.ca/sonic-studio-webdav/WSP/index.html

2 Acoustic Views of Dorgali

Acoustic Views of Dorgali is an eco sound sculpture allowing the audience to explore and interact with the natural environment through sound. It diffuses 12 natural soundscape recordings, whose locations are shown in Figure 1, through a system composed of 17 hi-fi loudspeakers and three subwoofers. The placement of these sources within the 3D environment took advantage of some architectural characteristics of the building hosting the premiere, such as the two floors, to enhance the illusion of being immersed within the Sardinian soundscape, making it possible for the audience to wander it. The mockup in Figure 2 shows the placement of the sound diffusion system used within the theatre of the 'L. Canepa' conservatory in Sassari, where the premiere was held.

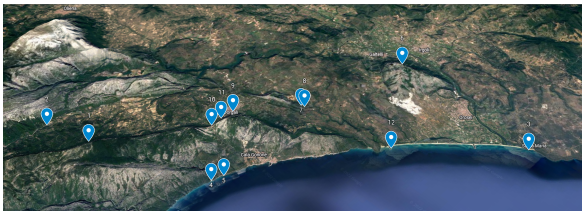

Figure 1: *Locations of the 12 recording sites*

The recording sites chosen are of particular interest due to their characteristics, most importantly the

morphology and the fauna present. Additionally, they are characterised by a low human presence, which results in perceptually minimal disruption of the natural soundscape. There is to notice, however, that 'minimal' is way different from 'absent', and the recordings, further analysed, made it possible to trace the sonic pollution present, which, generated by distant human activities, still affects the recording sites.

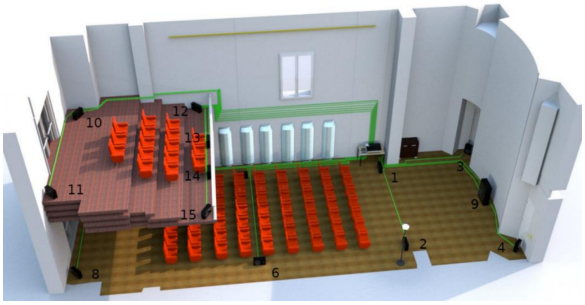

Figure 2: *Mockup of the placement of the sound sources*

2.1 Realisation

Acoustic Views of Dorgali consists of two sound environments distinctly characterised soundwise and space-wise, in which the audience can interact with the sculpture by moving freely. The two-floor theatre was chosen to create a metaphor in which the soundscapes recorded in a mountainous environment were placed on the higher floor, while the ones belonging to the maritime environment were on the ground, linking the actual height to the represented one.

The two sound environments interact with each other through spatialisation and sound trajectories. Additionally, they are ideally and artistically connected one to the other through a loudspeaker placed on the second floor and projecting the sound of a waterfall. By walking under it, the audience can experience the physicality of water, which is rendered through the sound interacting with their bodies.

Through these artefacts and spatial arrangements, the audience was able to experience a reduced recreation of some of the less anthropomorphised, and thus unknown, locations within the Dorgalese outskirts, which translates into a metaphorical, virtual exploration of the actual physical places home of the recordings. As mentioned, the interactive experience when visiting Acoustic Views of Dorgali relies on the movement of the persons. The interaction takes place as the visitor moves to explore the environment, and the recreated soundscape unfolds accordingly, giving them the possibility to hear the sound of a specific physical space. There is also to consider that, in nature, the environment interacts with sound, determining its constituent matter. However, in the case of recreated soundscapes, this paradigm is overturned: sound shapes the environment by delimiting or extending the physical boundaries of the space thanks to its aural power [Leitner, 1971], and this should be considered when designing sound sculptures.

3 Discussion

The practical realisation of Acoustic Views of Dorgali highlighted some points for further discussion, which could also lead to improvements for future showcases.

Firstly, the sculpture proved valuable in promoting ecological awareness in the audience, as it allows one to experience, through interacting with the recreated soundscape, places either difficulty accessible or unknown. Discovered through informally questioning the ones attending the premiere, this also demonstrates that deep knowledge and understanding of the natural environment are not trivial and only achievable through constant and careful human-environment interaction. However, for future showcases, formal and structured questionnaires should be designed to collect data and evaluations on themes such as engagement, immersiveness, and fidelity.

Additionally, it highlighted two main points concerning acoustic ecology. On the one hand, the pervasiveness of anthropomorphisation, which affects even the most isolated places, while, on the other, by offering a peculiar shared experience to the audience, it allowed them to understand the impact of human activity on the environment, the sonic one in this case.

Lastly, this sound sculpture is the first of a planned series of works exploring different natural places. As it happened for Acoustic Views of Dorgali, suitable buildings will be chosen from time to time to highlight the characteristics of the chosen environments.

The premiere of Acoustic Views of Dorgali was held in October 2021. Documentation realised through a collage of audience-made videos is available here[2].

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[2] https://www.youtube.com/watch?v=sojOLCExAEo

Spillover, A Risky Game

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Abstract

Noisy sounds with often surprising morphological features can be obtained by means of trivial binary manipulations applied to bitmap image files. Score sketches that may be performed on the fly can be get by analysing these same sounds through common information retrieval processes. In the project *Spillover* a computer system lets data to be transposed between the visual, auditory, and symbolic scopes to generate musical information thanks to the collaboration of interacting musicians. The project has two outputs, the first of which consists of a real-time composition for two pianos, sound synthesis, live electronics, video projection and laser printers premiered in February 2022 - the subject of this paper. The second output consists of the *Spillover* installation, where images are handed over to the system by the user, and sound files and scores are returned to be played, respectively, on a loop station and on toy instruments.

1 The composition

In the *Spillover* composition, the electronic performer displays on the screen the graphic interface of the system and proceeds to scrutinize bitmap images of his choice, which he audificates on the fly by means of bit sequence manipulations. The sounds thus get are played on a self-programmed loop station building up MIDI files by means of, mainly, pitch and onset detection algorithms. At the same time, the sounds are diffused through the loudspeaker system. When the electronic performer stops writing a MIDI track and starts a new exploratory session, the file is recoded in traditional notation and a score is immediately printed by printers placed next to each pianist. The instrumental players take the sheets, and after a short look at their part, silently projecting their own interpretative schemes, on which a strategy has been agreed previously, they play it trying to fit into the overall sound. The printers are also amplified; the sound of the pianos is processed through further bit manipulation algorithms and fed to the loudspeakers. The steps of the procedure here described are repeated circularly at least three times, resulting in a performance lasting about 10-15 minutes.

2 Trivial audification

With the term we intend to differentiate the practices here described from sonification, the topic of sound and music computing studies. Audification, presented there as an elementary technique of sonification, responds to needs of an eminently functional nature, that is to say the auditory display of properties and information contained in sequences of data, offered to the user through the immediacy of perceptual-cognitive mechanisms [Hermann et al., 2011].

In the performance the image formats are left untouched. Their often poor quality gives rise to a remarkable sonic variety. The only constant is that the chosen repertoire consists of JPEG files with various compression amount. After an initial evaluation of uncompressed images, in particular TIF, it was found that compression allowed to access differently the chromatic information of the rasterized image and the bit sequence of the file itself. From the practical point of view, the lossy format obviously produces unpredictable results, while in an uncompressed file the image pattern and data sequence are consistent.

2.1 Technique

For the image audification, GNU octave[1] scripts are used, called on the fly from the system's main interface. The audification techniques are essentially the following.

The image file is read as a three-dimensional matrix (8 bits for each RGB channel). Optionally, the size of the matrix is reduced by 8 or 16 times[2], to avoid the generation of excessively long audio files with sonic content distributed in the lower spectrum mainly or even in the inaudible region.

- The bit sequence is read as an array of 32 bit signed integers (script "rgb bit compose").

[1] https://octave.org

[2] Operators *imread*, *imresize*.

- The three chromatic channels are interleaved reading the matrix by column; each 8 bit unsigned integer is decreased by 128, divided by 128, and converted into a double precision floating point (script "rgb interleave cols").
- As above, but the matrix is read by row (script "rgb interleave rows").

The arrays thus obtained are filtered as a digital signal though a second order Butterworth high pass - a functional filter aimed at electroacoustic reproducibility - and saved as a mono audio file with 48 kHz sampling rate and 32 bit resolution (a single array element becomes a single audio sample).

3 Symbolic transposition

Musical scores can be generated from the previously described audio files using well-known information retrieval algorithms implemented in audio to MIDI conversion programs. Software having been evaluated included Melodyne[3], intelliScore[4], AudioScore[5], AnthemScore[6] and online services[7].

To better adapt to the interactivity of the project, it was preferred to program an *ad hoc* SuperCollider algorithm[8].

3.1 Technique

When the previously generated audio files are played during the performance, the sound stream is analysed by an algorithm using the Onsets [Stowell & Plumbley, 2007], Loudness[9], and Pitch[10] operators. Basically, the detection of an attack causes pitch and intensity data to be stored as *Note on* events. *Note off* events are returned according to composition-oriented conditional logics and arbitrary mappings.

When a MIDI file is closed, a score representation can be obtained. MuseScore[11] is called here in the background using the *velocity* plugin[12] to obtain, as an exploratory step, the basic dynamics for an effective musical interpretation[13].

[3] https://www.celemony.com
[4] http://www.intelliscore.net
[5] http://www.sibelius.com/products/audioscore/ultimate.html
[6] https://www.lunaverus.com
[7] https://www.ofoct.com/audio-converter/convert-wav-or-mp3-ogg-aac-wma-to-midi.html
[8] https://supercollider.github.io
[9] From the software reference: "A perceptual loudness function which outputs loudness in sones; this is a variant of an MP3 perceptual model, summing excitation in ERB bands. It models simple spectral and temporal masking, with equal loudness contour correction in ERB bands to obtain phons (relative dB), then a phon to sone transform. The final output is typically in the range of 0 to 64 sones, though higher values can occur with specific synthesised stimuli. [...] This UGen is an informal juxtaposition of perceptual coding, and a Zwicker and Glasberg/Moore/Stone loudness model."
[10] From the software reference: "Autocorrelation pitch follower".
[11] https://musescore.org
[12] Coded by Joachim Schmitz, 2018.
[13] Commands "musescore -M ms/midi_import_options.xml -o msscore FILENAME.mscz FILENAME.mid" and then "musescore -j ms/job.json", with import options such as 1/16 quantization, 4 voices, tuplets, staccato, dots and others, to facilitate the symbolic interpretation by the piano players.

4 Interface and live electronics

The performance is managed on a graphic interface programmed in SuperCollider.

Among the various windows, one in particular is used to control the processing of the piano with some algorithm implementing following techniques:

- signal degradation by reducing the number of bits;
- left and right bit shift (with dynamic compensation);
- logical (AND) and inclusive (OR) conjunction of the bits of the signals of the two pianos;
- bit shift left and right depending on the (degraded) signal of the other piano.

5 Recordings

A video recording of the performance is available at https://www.youtube.com/watch?v=YFjum3ktZm4. Also refer to the recording of a rehearsal where the ensemble seems to the author a little more balanced at https://klauer.it/giorgio/public/pieces/2022_-spillover/take/mix2.wav (or /mix2.mp3).

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How ICT and non-ICT Solutions Can Facilitate the Interactions in Migration-related Work?

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Abstract

In this paper, we present a preliminary study carried out within the Horizon 2020 PERCEPTIONS project (2019-2023), in which we investigated through quantitative and qualitative methods how ICT and non-ICT solutions can facilitate the interactions among users (practitioners, stakeholders, migrants) in migration-related work.

1 Introduction

In the last few decades, attention at the European level on the topic of migration has increased greatly, and with it the search of solutions to support the management of processes aiming at the social and economic inclusion of migrants and refugees. In this context ICT solutions may play an important role. There are many solutions (ICT and non-ICT) for migrants and practitioners, but with some limitations that impact on the interaction among the users. While many recent studies have investigated the use of technology by migrants (e.g. [Gioppo et al., 2022], there are fewer studies investigating the use of technology as a daily work tool for practitioners or stakeholders working for or directly with migrants (e.g. [Leligou et al., 2021]).
This paper is a preliminary contribution to the research in this area. To this end, we present the main findings emerged during the study carried out within the Horizon 2020 PERCEPTIONS project by involving practitioners working with or for migrants.

2 The PERCEPTIONS project

PERCEPTIONS project (2019-2023) investigates what perceptions of Europe exist among migrants, refugees, and asylum seekers, i.e. how they are informed, whether the information corresponds to reality and how such information influence migration decisions [Bayerl et al., 2020].
Within the project, we investigated how best practices in migration-related work can facilitate the interactions among practitioners and multi-stakeholders who work with and for migrants (e.g., policymakers or members of NGOs, civil society organizations, charities, etc.), and between practitioners and migrants. In particular, we evaluated gathered third-party solutions that successfully address challenges related to migration (e.g., discrimination, misinformation, human trafficking, etc.) through a survey and online focus groups with the practitioners. We figured out positive and negative User eXperience (UX) aspects [Hartson & Pyla, 2012] of the gathered best practices in order to take inspiration for the final output of the project, the PERCEPTIONS platform, and to improve its design and implementation.

3 Study with practitioners

Among the activities conducted during the project, we contributed to the elaboration of an online project survey to collect quantitative data regarding the human computer interaction (HCI) and specifically the UX with ICT solutions of stakeholders and practitioners who work in migration-related work. We investigated through the questionnaire mainly if the organizations where the respondents work use ICT solutions and for which purpose. We also asked how effective, user-friendly, and easy to understand they found the existing solutions. Moreover, we organized five online workshops with a total of fifteen multinational (from nine different countries) and multi-stakeholder participants. During the online workshops we investigated, through the use of a Miroboard, the interaction of the users with the ICT solutions (e.g., *for education and training, for sharing guidelines and practices, for enabling connections, etc.*)

and non-ICT solutions (e.g., *awareness campaigns, music performances, art-based exhibitions*).

4 Findings

According to the 381 answers to the survey questions specifically concerning ICT solutions, the use of ICT tools is mainly devoted to support practitioner/stakeholders' education and training (24.1%) and accessing data on migration (17.6%). Such solutions are considered quite effective, user-friendly and understandable, whereas solutions for migrant education and training (17.6%) are considered effective but less user-friendly and still less understandable.

The participants of the online workshops underlined that the ICT solutions should be user-friendly. They should also be user-centered. Indeed, it is fundamental to always take into consideration the intended users of the solution (be they migrants, practitioners, or stakeholders) and tailor it to their characteristics and needs. For the PERCEPTIONS web platform, which addresses different stakeholders – particularly policymakers, researchers, and first-line practitioners – this means finding a common language that allows to address these groups. When the intended users are mainly migrants and refugees, it is fundamental that the ICT solutions are mobile friendly, since they often have smartphones than laptops, and easily accessible, multilingual, interactive, and adapted to specific needs. For example, use of visual representations, images, and infographics can help the user to navigate through the site bypassing the problem of not understanding the host country's language.

According to the participants of the study, the ICT-related solutions (e.g., online interactive platforms, mobile applications, digital portfolios) can play a crucial role in empowering the migrants to access services, interact and engage with others in a digital way, since they help manage data and information. At the same time, a "face-to-face" interaction among the participants is considered the best tool to understand and fight prejudice since in-person interaction grants an efficient and successful delivery of information and communications through a better engagement on behalf of the participants.

Also, arts and culture (through photo galleries, festivals, theater, exhibitions, concerts, etc.) can support the creation of awareness and engagement of communities, trust, and shared values.

Finally, about the specific needs of the practitioners and stakeholders in migration-related work, it emerged that they usually get in contact with other national or international organizations for their work. For this reason, it might be helpful for them a platform that facilitates networking organizations through (a) "Sharing practices and experiences", (b) "Co-developing activities" with other practitioners, and (c) creating/improving a "professional networking".

5 Conclusions

According to this preliminary study, we can confirm that ICT and non-ICT solutions can be a great support for interactions among users (both migrants and practitioners/stakeholders) in migration-related work. If these solutions are user friendly and user centered, and if they are able to create both digital and "face-to-face" interactions, they can play a crucial role in empowering the migrants and support the creation of awareness and engagement of communities, trust, and shared values. More details will be presented in the poster.

Acknowledgments

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Making Music Together. A Study in Correction and Synchrony

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Abstract

The research focuses on rehearsals by an amateur group in which many errors occur. In response to these, the musical flow in some cases continues thanks to specific practices that allow synchrony to be restored, and in others is interrupted by the conductor who begins a sequence of correction.

It is important to emphasize that synchrony during the performance continuously occur through practices that are carried out by the players and the conductor, using a set of patterns which has been isolated and described using the ethno- methodological approach. The influences of wider social structures have been taken into consideration along with the role of the score on synchrony and error correction.

1 Introduction

How do musicians manage to be in time while playing together? The process is often taken for granted and the mechanisms are rarely analysed. In fact, several social practices are required to successfully play together.

In large groups, performance is often managed by the conductor. He not only provides the desired *prescriptive* musical version, but incessantly communicates where the musical flow should go, and where it is at that exact moment. He also corrects errors made by the players, either during the performance, or by interrupting it.

The musicians themselves must play in a coordinated manner not only by taking the conductor or the score as a point of reference but also by constantly adapting their musical flow with the others.

The error itself is thus the fundamental element that brings out anything taken for granted.

2 Analytical Framework

The starting point of my research is an essay by Alfred Schutz entitled Making Music Together (1964). In it he analyses music from a phenomenological point of view as a social construction. His focus is on the social roles of the composer and listener, as well as on the relationship between inner/external times (Bergson) within the *polythetic* time (Husserl) of the musical flow [Schutz, 1964].

Another key point of reference is *Ethnomethodology* by Harold Garfinkel. It is the phenomenological study of *social facts* through which people produce and manage everyday relationship situations, such as the processes used to make them *accountable* in the social world through specific practices [Garfinkel, 1967].

Additional fundamentals are studies by Sacks, Schegloff and Jefferson on the organization of turn-taking and on the preference for self-correction in conversation, which have been applied in the domain of performance [Sacks, 1974, Sacks, 1977].

Also important are works by Peter A. D. Weeks on the synchrony and error-correction within the performance, from which the concepts of verbal (VES) and illustrative expressions (IES) have been taken [Weeks, 2002b, Weeks, 2002a]. The transcription methodology used for the dialogues is the same of Weeks, i.e., *Conversation Analysis* [Psathas, 1967], to which I have added the transcripts of illustrative gestures with images sequences, and of music using scores.

3 Results

During the empirical analysis (a/v recordings of three rehearsals of the amateur wind orchestra *Corpo Musicale S. Giorgio di Vigolo Vattaro*, Italy, in which I was a member of the group), I looked for the forms/expressions and patterns where social practices to maintain synchrony and correct errors, were carried out. A few of the examples will now be discussed.

The guidance of the conductor (*Self* – cf. Sacks, et al., 1974) to maintain synchrony during the performance typically occurs through embedded correction, or *Other* (players) *adjustment*, with a dialectical relationship between external/inner time (i.e., every gesture brings a new context into the *polythetic* time). The forms of the corrections are IES (quasi-singing, gestures) and/or VES (counting). In the first rehearsal the sound expressions are more frequent than VES (e.g., verbal cues), because the performers need to stay focused on the score, and the corrections (only IES) of the conductor are focused on rhythm. Although the study by Sacks et al. states that the *Self/Other* in the conversation is not fixed [Sacks, 1974], the conductor has instead a predetermined role (*Self*). It is usually him who interrupts the musical flow and initiates the sequence of correction. The pattern of interruption is an IE (gesture of interruption or stopping movements to indicate the beat) sometimes with a VE with evaluations. After that, the correction sequence begins with the pattern VESIES or IESVES. Sometimes, the IES include a pair of contrasting IE to emphasize the error, one IE is the correct version and the other the wrong one. Unlike the ongoing performance guidance, there is never a single form of expression, but always patterns. We thus have the demonstration that IES/VES are *reflexive* and *indexical* [Garfinkel, 1967]. In other words, to understand the meaning of any expression, one must incorporate it within the context in which it was produced. In this way the embodied practices employed, produce recognizably ordered, 'natural' courses of action for the members of the group.

It is therefore clear that there is a quite different use between the patterns for correction during performance (IES perceived through mutual listening) and the sequences of corrections during interruptions (always IES/VES pairs).

Another role of the conductor is to locate the 'now' in the music flow (i.e., linking the external time with the *polythetic* inner time). During the performance he can use the counting (VE) to emphasize the metre before a cue or to guide a player out of time. Sometimes it can be paired with IES (e.g., the gestures of conductor). The pattern of localisation can begin after the interruption, as well. It is usually composed of a VE (e.g., the bar number) and/or an IE (e.g., singing the passage, reproducing the rhythm clapping the hands, etc.). The VES and IES in this situation are often independent and one may be understandable without the other.

4 Discussion and Conclusion

In the episodes examined, it became clear that attempts to correct and maintain synchrony within the performance are fundamental to its success. The forms/expressions and patterns identified by Weeks were thus confirmed and integrated with the conductor's gestures. It was shown that there is a relationship between the context and the use of forms/scores/IES. Despite the prescriptive nature of musical notation, it was approached differently according to each situation. For instance, during the last rehearsal, the players attributed greater importance to listening to each other and to the IES of the conductor than to the score. It is my opinion that the results achieved from this research can contribute to making the interactions within the performance more intelligible. Once the *black box* has been opened and the mechanisms within it identified, they can be used to improve the processes required to maintain synchrony. The next step will be to test the models in situations involving complex algorithms or AI in real time (see post-internet art, or Internet of Musical Things). It is possible, for example, to think of Alexander Schubert's intermedial opera Asterism of 2021. Through a creative use of AR, AI and environment, the relationships between them and the performers are taken to the limit. What forms are put in place by the performers *in situ* to maintain synchrony? How would the influence of the external social structure be reflected? Furthermore, it is my opinion that the identification and description of such patterns may open the way for their development in algorithmic terms. They could then be integrated into new software, and be used in performance without affecting the synchrony, but also to help manage it in a more successful way.

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Event After Event: Collectivity Formation Process in Music Worlds

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Abstract

The general aim of this study in progress is to investigate the relational dimension of musicking collectivities formation and development processes, placing emphasis on the events, to be intended as key elements to understand how the participants act collectively. The case study for this research is Algorave. Strictly tied to the live coding practice, this collective phenomenon emerged and developed worldwide in the last ten years, articulating in a network of (trans)local communities and normed musicking events. My suggestion is that the collectivity formed around the Algorave phenomenon has generated from a pre-existing musicking network – the 'live coding world' – thanks to the sustained involvement and the repeated sharing of the same experience during the events by the actors involved. To empirically explore this statement, I adopt a network-based approach for the study of collective action and related methodology, namely formal Social Network Analysis.

1 Events, Music Worlds, and Networks of Collective Action

Among the different elements argued to characterize 'music worlds' [Crossley, 2015; 2020], the 'structuring factor' of *focal time-space* [Crossley, 2020] is to be understood as crucial for the purposes of this study.
Events represent opportunities for the people involved to "converge in particular places at particular times", thus facilitating both interaction and, in Durkheimian terms, the collective effervescence necessary to a world to be formed [Crossley, 2020: 7; see also Crossley, 2015: 87-9].

More broadly, events represent an important element to understand collective action as a process. From this perspective, the consistent course of action pursued by the constructing individuals can be intended as also articulating in series of interconnected events, in which the interaction among participants becomes sustained, thus providing the occasion not only to 'combine' orientations [Melucci, 1996], but also to reinforce or forge, whether these are already present or not, social relationships, possibly resulting in the formation of a wider collectivity [Diani, 2009].

2 Research Purposes

This study aims to investigate the process of collective creation of an 'action system' [Melucci, 1996], *event after event*, by the individuals involved in the same practice, eventually assessing if, despite possible barriers – e.g., physical distance or belonging to a wide variety of diverse social contexts, they can be considered to have formed a collective entity.
In sum, my point is that the involvement and sharing of experience has been possible through mechanisms underlying, among others, the active participation to a system of social events, that eventually constitutes the phenomenon investigated. I propose to understand these events as social situations – meaningful contexts in which interaction between the actors involved takes place – which have to be intended as interconnected, not because of sharing certain characteristics, but because manifestation of a singular collective action.

3 Algorave: the Case Study

Since its appearance in the United Kingdom back in 2012, the term 'Algorave' has been used in several acceptations. Starting from a basic etymological dissection, the term derives from the crasis of the English words' 'algorithm' and 'rave'.
This portmanteau essentially suggests a connection with the so-called 'Rave Culture' [Anderson, 2009], while placing the emphasis on the distinctive involvement of algorithms in the musical performance.
Relying on both the self-definition provided by the main actors involved and the existing literature on the topic, four distinct dimensions – *practical*, *situational*, *normative*, and *collective* – of Algorave as a concept emerge from the investigation of the particular meanings associated with the term over the years.
Algorave is strictly tied to the 'live coding' practice, to the extent that it has also been considered as "an important subset" of it [Haworth, 2018: 573]. In general, live coding can thus be considered "what ties together" [McLean, 2019: 175] a multi-faceted phenomenon like Algorave.
In the ten years since its emergence, the Algorave phenomenon "has taken hold as a distributed network of thriving scenes, with events organized by experienced promoters finding large audiences in club and festival venues, or adopted by local musicians putting on parties in small rooms with big sound systems" [Ibid.].
Adopting a socio-phenomenological perspective, Algorave presents itself as constituted by a series of events "[focused] on humans making and dancing to music" (algorave.com/about), and may thus be intended as a 'collective phenomenon', insofar it represents a "[set] of social events [comprising] a number of individuals or groups exhibiting, at the same time and in the same place, behaviours with relatively similar morphological characteristics" [Melucci, 1996: 20]. In this sense, Algorave as a collective phenomenon is argued to involve a body of social actors, whose joint work has been able to sustain the organization of particular events, reproduced over the years among a wide variety of socio-cultural environments. Moreover, my suggestion is to understand Algorave community as a 'cell' [Gerlach, 1971] originating from a pre-existing network built around the live coding practice, which I refer to as the '*live coding world*''.

4 Methodological Note

This study is framed within the research program based on a relational approach to the study of collective action, applying the tools of formal social network analysis (SNA) method [Diani and McAdam, 2003; Diani and Mische, 2015; Crossley and Diani, 2019]. The intent is to consider not only the ties connecting the individual actors involved, but rather to focus the analysis also on their connections to the Algorave events to which they actively participate (*multi-modality*), considering two different perspectives: the individuals' one and the one of the events (*multi-levelness*). I confine my attention on a particular tie linking individual musicking actors to the events, namely the performance of the firsts at the latter, signifying their active participation to the construction of the Algorave action.
In order to assemble the network datasets, I mainly rely on digital archival data as primary data, retrieved from the reference website for the community (algorave.com), focusing first on the reconstruction of the Algorave events set. For the present study, only the events organized during the first five years of the phenomenon (from March 17th, 2012, to March 17th, 2017) have been considered, focusing on its initial expansion. Data have been elaborated in order to make them usable for network-based analytical purposes.
A matrix including the connections among single actors and the event(s) at which they performed has been created, resulting in a 2-mode relational dataset – the Algorave Event-Performer Network (AEP). In order to particularly focus the attention on the process of collectivity formation through active participation to events, a *single-mode projection* analytical strategy is adopted [Everett and Borgatti, 2013], presenting the results from the performers' perspective (Figure 1, next page).

5 First Results

5.1 One single component, a unique collectivity (A)

The suggestion of Algorave as constituted by a set of interconnected events – an 'event system' – has been substantiated by empirical evidence, showing the cohesiveness of this system, and favouring its interpretation as a whole. This was reflected in the fact, as clearly emerging from the network visualization presented (Figure 1), that a community composed by the performers actively participating to these events has emerged as a unity – or, in network terms, as a single component.

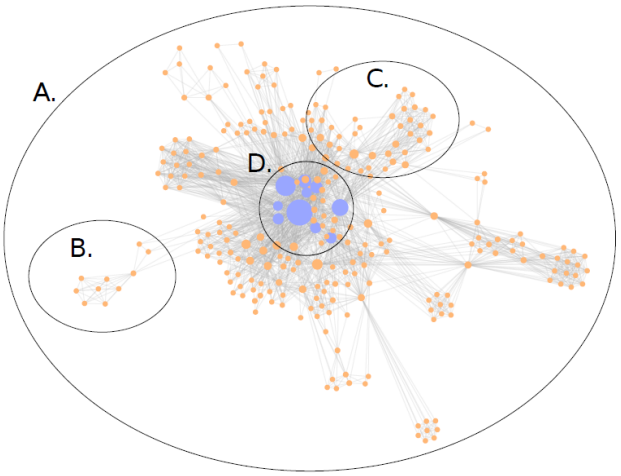

Figure 1: *The Algorave Performers Network [N=276, tie: performance to at least one common event, Core (Light Blue) Periphery (Orange) distinction, size of the node proportional to total number of events performed at, single-mode projection of the Algorave Event-Performer bipartite Network]*

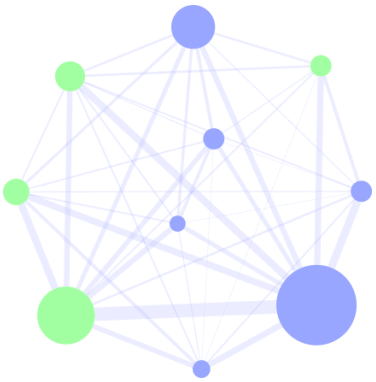

Figure 2: *Core of the Algorave Performers Network [N=10, Females (Light Green) Males (Light Blue), size of the node proportional to total number of events performed at, size of the tie proportional to number of events in common]*

5.2 Local Communities (B)

Local communities emerged in the more peripheral areas, as densely connected sub-structures of Algorave-based interactivity. It has to be considered, though, that these communities may be existing *a priori* with regard to the collective action inquired, thus representing communities belonging to the wider 'live coding world' rather than specific Algorave local communities. Significantly, several actors central within these communities do not belong to the group positioned at the core of the network, hence characterizing Algorave collective as not dependent on the presence of few central individuals, but rather to be also supported by a wide share of locally more active individuals assuming key roles in the action. In this sense, the initial intuition of framing Algorave collective as characterized by a 'polycephalous' structure [Gerlach, 1971] seems to be supported by evidence emerging from the analysis.

5.3 Translocal Communities (C)

Addressing the issue of Algorave events 'orderability' [Abbott, 2001] has been proven crucial to reconstruct the Algorave system formation process. Focusing on the emerging chains of consequent events framed as 'tours', made come forth distinct patterns of musicking interactivity across different localized social places over time. In literature, the act of touring has been argued to forge and reinforce relationships by mean of which individuals belonging to different local communities connect, favouring the constitution of 'translocal' communities [Verbuč, 2022]. From the analysis performed, Algorave tours seems in line with this statement. Nevertheless, one particular aspect characterizing Algorave tours emerged: namely, its collective dimension, from which the suggested definition of *collective touring*. Indeed, differently from other known forms of touring – such as the most common related to music industry – the events saw the joint participation of temporary collectives, instead of single performers or bands. Thanks to this shared experience the participants not only forge – or reinforce – relationships with those belonging to the contexts in which the tours stopped, but also establish durable ties among each other, that eventually contribute to the formation of a wider collectivity.

5.4 The Algorave 'Carrier Group' (D)

A 'carrier group' [Weber, 1968] of performers positioned at the core of the network emerged (Figure 2), who not only participated to the largest number of events, but did this together, resulting crucial in the spreading of their view on the live coding practice and the consequent development of the collective formation process. This group appears as fairly balanced in the distribution of male and female individuals composing it – respectively 6 and 4 over the total of 10, thus not being characterized by male-exclusivity.
Some of the events connecting these performers seems to be meaningful and may be even considered as *turning points* in the construction of the collective, being the occasions in which part of these actors shared their first Algorave experience, or the ones of collectively sharing an experience in

another country.

6 Further Research

The preliminary results here reported could open new lines of research, which I suggest should be based on the following points:

- regarding the case study, as my research has covered only the first five years of the phenomenon so far, a natural extension is to also consider the second ones (2017-2022), insofar as a preliminary descriptive analysis based on the number of events organized per year highlighted the distinct presence of a wave, which peak is reached in 2019, before a significant decrease in the following two years.
- the relationship occurring between the Algorave phenomenon and related collectivity with the wider 'live coding world' is a key element to be investigated, as in my research I only focus on the Algorave collectivity, only theoretically referring to the presence of a pre-existing network upon which it originated.
- more data regarding the performers have to be collected, both in terms of their characterization with more socio-demographic information, meanings, and motivations, as well as regarding the relations among them outside Algorave and the live coding world.

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Interacting with Audio in Unity

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Abstract

Unity is a well-known game engine used within academia and industry, as well as by makers and artists. While it comes equipped with a powerful graphics engine and plenty of possibilities concerning interaction, interfacing with external systems through different protocols, and generative graphics, it lacks tools for procedural audio, as it relies heavily on pre-made clips. The URALi project, here presented, proposes a possible solution to fill this gap.

Keywords: Unity; sonification; generative art; interactive audio

1 Introduction to Unity

Unity is a game engine used by a wide and diverse audience in different scenarios. On the one hand, Within academia, it is often used for prototypes and demos, especially for applied VR and XR research, given the potential the software has this way. On the other, it is employed for high-fidelity rendering (e.g. in architecture and automotive) thanks to its capabilities concerning 3D models and lights. Furthermore, as a game engine, it is used mainly by independent or small to medium-sized game development studios. Lastly, Unity is also employed within the artistic context thanks to its multimedia features, which include a high-level graphic engine and the possibility to communicate with the outer world through different protocols, amongst which the Open Sound Controller (OSC) [Wright, 2005].

Unity is programmed through C# scripts, with programs usually organised within scenes with a camera and one audio listener, the eyes and ears of the player.

1.1 Overview of Audio in Unity

There are different ways to deal with audio in Unity. The most popular is to rely on pre-made clips attached to a source and played back when needed. This way offers basic clip controls and a mixer similar to the one found in modern Digital Audio Workstations (DAW). The audio flow can also be manipulated through different filters provided (e.g. delay, echo, equalisers) and also affected by 3D spatialisation.

Another way to deal with audio is to connect third-parties plugins and external software, which provide specific environments and abstractions for sound and music. This category comprises the possibility to connect software such as SuperCollider, Pure Data, ChucK, and Max/MSP, which, however, lack native support and need additional libraries or software to be at least partially supported. This argument is currently quite debated in specialised forums.

Using audio middleware such as FMOD and Wwise grants flexibility and freedom. However, these tools are employed commonly within the context of game development, not only because they are designed specifically for this professional sector but also due to their specificity and knowledge required.

The last way to deal with audio in Unity is to implement a custom OnAudioFilterRead function, which allows the access and manipulation of the audio stream before the output. The stage in which this happens depends on the position of the script in which the function is implemented. Implicitly this means that the programmer can procedurally populate the audio stream rather than manipulate it.

2 URALi

URALi is the acronym for Unity Real-Time Audio Library. As the name suggests, it is a project developed to provide programmers with functions for real-time audio synthesis and manipulation through chains of high-level audio objects designed to be the building blocks of complex audio algorithms. The logic recalls the workflow of well-known software such as Max/MSP and Pure data, although, here, their visual interfaces are substituted by lines of code.

The development of URALi started as an attempt to bridge the gap related to the absence of tools for generative audio in Unity. The purpose was to cover the scenarios in which pre-made audio clips result insufficient due to the necessity to drive sounds by data

or algorithms, which may offer unpredictable evolutions and thus interactions with such samples. As notable use cases, this includes projects dealing with data sonification and generative multimedia artworks [Dorigatti, 2022]. At the same time, however, URALi was designed to seamlessly integrate within Unity scripting system, giving access to C# functions to the users by simply loading the .dll file in the project, thus allowing them to work within the same environment while avoiding the necessity to rely on external software and learn another specific language.

2.1 Functioning of the Library

OnAudioFilterRead is a function automatically called at a fixed rate to provide the number of samples necessary for a smooth audio stream. This means that relying too much on it for calculation, especially in the case of complex audio chains, could lead to slowdowns, data starvation, and, perceptually, glitches.

The system designed to avoid this occurrence and free OnAudioFilterRead from the heavy load, schematised in Figure 1, consists of a separate thread and two circular buffers, one for data and the other for flags. Additionally, it requires the user to create a specific synthesis function, a 'sandbox' in which to work with the previously instantiated audio objects. This function is then passed to the thread, which runs it and calculates each sample. Through busy waiting, the thread checks the flag corresponding to the cell of the buffer it is going to write: should it report a free cell, the sample is stored in that position; otherwise, writing pauses until data are read and erased and the corresponding flags reset.

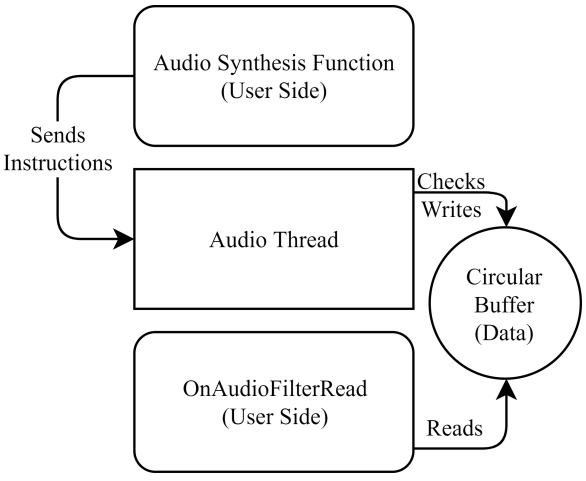

Figure 1: *Schema of the system*

While the calculation of the audio data occurs in a thread which is not timed and therefore has no speed constraints, it is at the reading time that OnAudioFilterRead starts handling the samples. Within this function, the user only needs to access and retrieve a number of samples corresponding to the size of the buffer times the number of channels.

3 Discussion and Conclusions

The system implemented proved to be robust and reliable, providing a smooth and glitch-free output stream even in the case of complex audio chains and operations. Yet, more in-depth testing is certainly needed and might lead to improvements. Related to glitches and artefacts, the problem of aliasing [Schimmel, 2012], particularly affecting some waveforms, has been addressed by implementing the technique described in [Välimäki et al., 2012].

Overall, URALi is already a fully-functioning software, yet its building is still in progress. While many audio objects have already been implemented, there is a list of features yet to be added, including new objects and some usability improvements, such as the possibility to draw the envelopes graphically in place of defining them numerically. The implementation of these features is also planned in light of a future public release of the library, which date, however, is uncertain due to time constraints slowing its development. Currently, a short demonstration of some of the features available can be found here[1]. The demo, employing a short delay effect and shelf filters, also shows how URALi integrates with Unity built-in audio features. In the scenes showed, different audio parameters are linked to the mouse axes, which also control the direction of the particle system. However, visuals here cover a purely artistic role, unlike the work covered in [Dorigatti, 2022], realised alike in Unity.

Given the current status of the project and its aim, discussing it with programmers, musicians, and multimedia artists, to whom it is designed, would benefit the development in terms of gaining feedback and suggestions on new and future features.

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An Intra-actionist Approach to Musical Composition

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Abstract

The present contribution concerns a compositional (or pre-compositional) process for the elaboration of the pitch material of a composition within which two sound fragments/worlds are placed in a particular relationship. The starting theoretical perspective is that of relationality.

1 Theoretical framework

There are many different relational ontologies: Nagarjuna's Buddhist thought, Bateson's theory, Rovelli's relational interpretation of quantum mechanics, Ladyman's ontic structural realism, Barad's agential realism, etc. I will not be going into the merits of the different interpretations and characteristics of relationality – some more radical, others less so (see, for instance, Marmodoro, Yates, 2017; Candiotto, Pezzano, 2019). The physicist Carlo Rovelli, in his recent book entitled *Helgoland*, writes: "We must abandon something that seemed most natural to us: the simple idea of a world made of things. We recognize it as an old prejudice, an old vehicle that we no longer have any use for" (Rovelli, 2021, p. 164). Going a little further back in time, in his 1979 *"Last Lecture"*, Gregory Bateson wrote: "I have offered you the idea that the viewing of the world in terms of *things* is a distortion supported by language, and that the correct view of the world is in terms of the dynamic relations which are the governors of growth" (Bateson, 1991, p. 311) and, just above that statement, he specified: "You should be counting not the things which are related, but the relationships; not the relata, but the relationships" (ivi, p. 310). Again Rovelli, discussing his relational interpretation of quantum mechanics – which, among other things, draws on the philosophical thought of Nāgārjuna, an Indian Buddhist monk born in the second century AD –, writes: "The best description of reality that we have found is in terms of events that weave a web of interactions. 'Entities' are nothing other than ephemeral nodes in this web. Their properties are not determined until the moment of these interactions; they exist only in relation to something else. Everything is what it is only with respect to something else" (Rovelli, 2021, p. 166). The physicist and feminist philosopher Karen Barad, an exponent of the new materialism, even proposes to speak of 'intra-action' instead of 'interaction' because the latter notion assumes the prior existence of independent entities, the *relata*. Barad states that "relations are not secondarily derived from independently existing 'relata', but rather the mutual ontological dependence of 'relata'—the relation—is the ontological primitive. […] relata only exist *within* phenomena as a result of specific intra-actions" (Barad, 2003, p. 815).

2 Proposed method

These reflections led me to wonder what could be a musical/compositional procedure that could be considered as 'relational' as possible and the least 'object-based' as possible, thus going into Barad's intra-action relation and having a focus on relations rather than *relata*.

The starting point was, in a certain sense, metaphorical: I wondered what kind of a process (if any) would result in an 'absence', an emptiness of things, objects, *relata*. And I thought of the coring process in geology, or rather its inverse. In the coring process, a core sample – a cylindrical section of a natural substance – is obtained by drilling the natural substance. I referred to the inverse, because I was not interested in the core sample, but rather in the hole that the process leaves behind: the 'core hole'. At this point, trying to reason in terms of relationship (i.e. between at least two elements), I identified an analogy between the *core hole* and the

exclusive or or *exclusive disjunction* (XOR), a logical operation that is true if and only if its arguments differ. Simply speaking, what is in common is eliminated.
Thus, the general idea is to try to realise a sort of 'sonic coring' (*carotaggio sonoro*, in Italian), to throw away the 'core sample' (*carota*, in Italian) and keep what remains. To put this general idea into practice I make use of the logical operator XOR, which in set theory corresponds to the symmetrical difference: given two sets, A and B, the symmetrical difference between A and B is the set C to which all the elements of A and B belong, with the exception of the elements that A and B have in common, that is, with the exception of their intersection (the intersection, therefore, is the 'core sample'). See Figure 1: the brown part is set C.

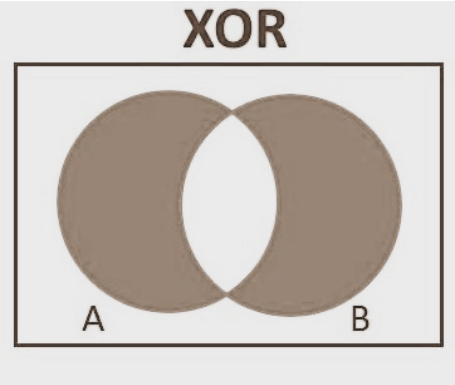

Figure 1: *XOR in set theory*

3 Results

I have used this procedure in two recent compositions: *greens' xor* for clarinet, vibraphone, piano, violin, and cello, and *radical beauty* for flute, tenor sax, percussions, guitar, baritone, violin, and double bass. *Greens' xor* was performed by Ensemble21 and directed by Marc Collet at the Trento Conservatory (24.03.2022). *Radical beauty* was performed in the context of the Gustav Mahler Music Weeks 2022 in Dobbiaco/Toblach by El Cimarrón Ensemble (with baritone Robert Koller) and directed by Clemens Heil (17.07.2022).
In *greens' xor*, A is the sound spectrum of a bell; more precisely, the set of its *nominal* note (one octave above the *prime* and two octaves above the *hum*) and lower and upper partial tones with their respective intensities. There are eleven Bs: these are the chords derived from the theoretical (even partials only) spectra of a clarinet transposed on the pitches of a melodic fragment taken from the *Lacrymosa* of Verdi's *Requiem*.

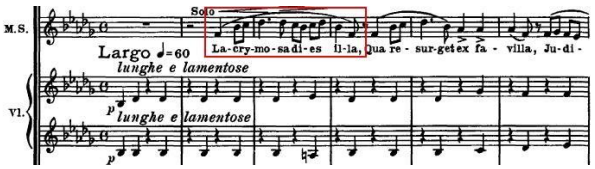

Figure 2: *Lacrymosa melodic fragment (11 notes)*

The symmetrical difference between the *bell chord* and the *Lacrymosa chords* was calculated (using Max/MSP software) and gave origin to the pitch material (eleven pitch sets).

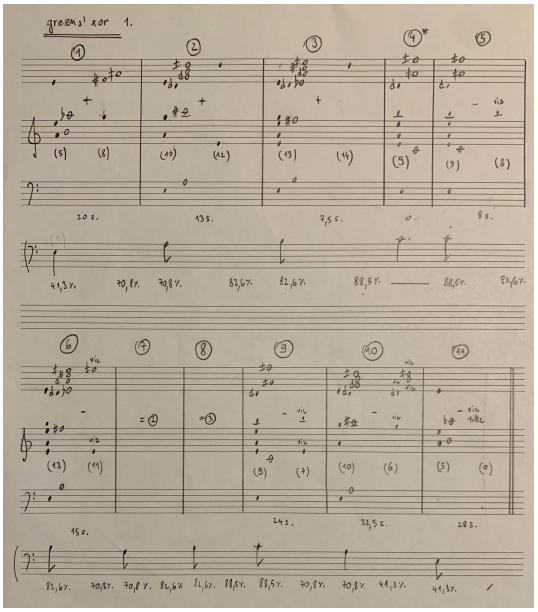

Figure 3: *Sketch (the 11 pitch sets)*

Radical beauty is a composition inspired by the fourth movement (*Von der Schönheit*) of Mahler's *Das Lied von der Erde*. At the basis of Mahler's *Von der Schönheit* there is a strong dualism: that between the feminine and the masculine (Mitchell, 1985; Hefling, 2000). I decided to start from a very general dualism in the development of the material. My two starting points are the song of a whale and the sound of an ice shelf melting. The whale song fragment is related to the male element through a reference to a paper by Gregory Bateson (1972), who argues that cetaceans have developed a discrete (rather than analogue) form of communication for discourse about relationships. On the other hand, the sound of the glacier melting is ideally connected to the feminine element: both in its strength and power and in its ecosystemic fragility.

I undertook some analyses of these two fragments and derived two spectra or groups of notes (in this case, there are two As). In short, this was the workflow. I cleaned up and normalized the two sound files, the whale song of about 10 seconds in length, and the melting glacier recording of about 30 seconds. With the Ircam AudioSculpt software I did spectral analysis and Chord Sequence Analysis. Basically, I finally merged the spectra of the whale song into a single chord and did the same with the melting glacier recording (frequencies have been approximated to quarter tones).

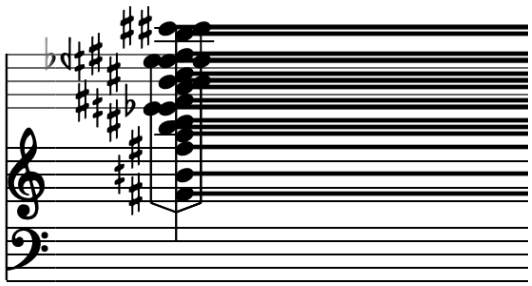

Figure 4: A[1]: *Whale song (frozen)*

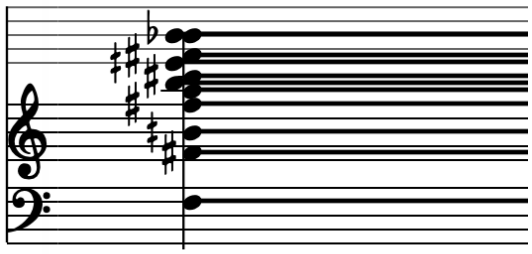

Figure 5: A[2]: *Melting glacier (frozen)*

The common element of comparison (the B) is the *Von der Schönheit*'s line (10 notes) of the first clarinet from 130 to 132. Adorno (1960) speaks of that clarinet motif as a sublime musical passage, condensing joy, beauty, and melancholy.

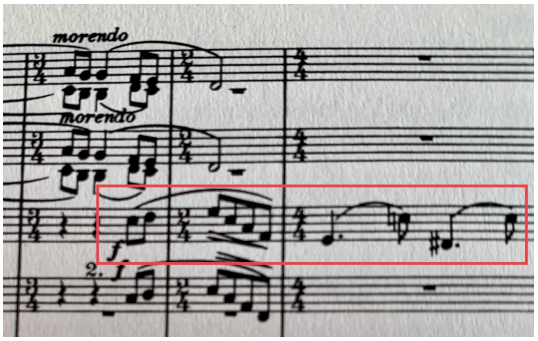

Figure 6: B: *Mahler's fragment (10 notes)*

Thus, there are ten Bs: ten chords derived from the theoretical (even partials only) spectra of the clarinet.
At this point I compared (i) the *whale song chord* to the *Mahler fragment chords*; (ii) the *melting glacier chord* to the *Mahler fragment chords*. I operated the symmetric difference (XOR) obtaining two sets of chord charts (10+10 pitch sets) with note priority indications (given by the relative amplitude of partials).

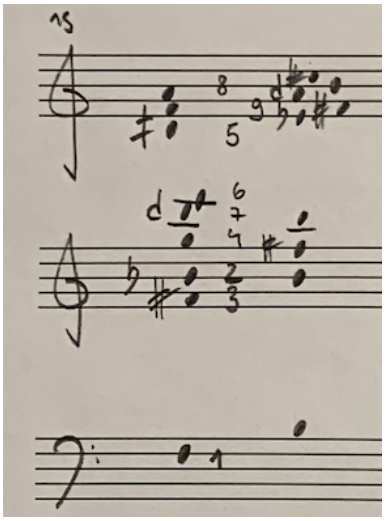

Figure 7: *Sketch (one of the 20 pitch sets)*

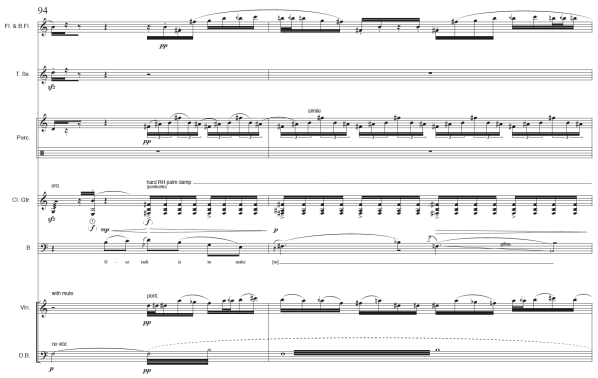

Figure 8: *Radical Beauty excerpt (section in which the pitch set in Figure 7 is used)*

4 Conclusions

In discussing this compositional process (also using audio examples), I will try to show its adherence to a relational perspective, its potential for interweaving relations between (even quite distant) sonic worlds, and its ('harmonic') consequences.

From the perceptual point of view of listening, the two sound worlds put into relation with the proposed XOR procedure are not discernible, they interconnect and lose their individuality: this fact actually goes in the direction of an intra-action, where the relation is more relevant than the individual *relata*. This theoretical 'conquest' has an interesting consequence, again from the point of view of listening, because this procedure – especially in the case where the XOR operation is applied to a single A (a fixed or frozen sound spectrum) and several Bs constructed on a melodic fragment – can generate a pitch set with its own 'harmonic' consistency and uniformity.

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