Real-Time Composition of Sound Environments

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ABSTRACT

In this paper I will present some aesthetic and technical aspects of my work related to real-time composition of sound environments (soundscapes and vocalscapes) through two recent works: "Geografia Sonora", a sound and video installation on the theme of the Mediterranean sea, a navigation in an archipelago of "sound islands" of singing/speaking voices, sound signals, natural and mechanical sounds; "Vocalscapes on Walt Whitman", an electroacoustic composition exploring the idea of "poetry as vocalscape" and as "geography" of voices and performances based in the recordings of fifteen talkers.

The works have been composed and spatialized in real time by a "sound navigation map", a virtual score within Max/MSP, the Spatialisateur and Antescofo.

Through these two works I will show: 1) by which means a vast sound material can be organized and processed/composed automatically in order to beget a sound environment in real-time through a coherent open virtual score; 2) how such a sound environment may be seen simultaneously as a sound composition, as the trace of a shared experience, as the record of poetry and vocal performance or as the soundmark of a community and of a land.

1. GEOGRAFIA SONORA

"Geografia Sonora"[1] (2013) is a sound and video installation on the theme of the sea; an imaginary sound "constellation" of singing/speaking voices, sound signals, as well as natural and mechanical sounds from countries bordering the Mediterranean. The soundscape[2] [1] and the video image are generated, re-composed and transformed in real time ad infinitum. The sound material of the installation is a collection of personal field recordings, sample donations by my "informants" recorded or

found in their respective countries, and samples found in archives. The sound space is organized as an archipelago of "sound islands" grouped in families. The navigation between the "islands" (juxtaposition, superimposition and spatialization of sounds) is organized automatically by a "navigation map", a computer program within the environment Max/MSP and the Spatialisateur. This musical journey takes place within an appropriate "room". A video of a continuous changing texture of a sparkling sea is projected on the three walls of the room. The sea changes in color, luminosity and density and becomes a constellation of lights. The video is generated with Jitter in real-time. The visitor may move freely inside the room, walk around, sit down or lie down on the floor.
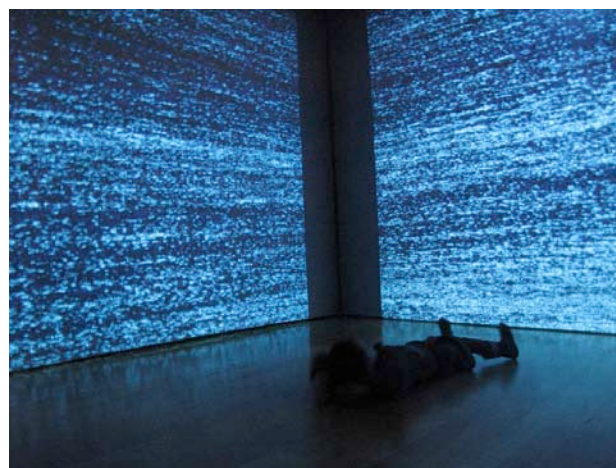

Figure 1. "Geografia Sonora": the space and the video of the sea.

1.1 The soundscape – An archipelago of sounds

In the soundscape the sound is distributed by 8 loudspeakers one pair per wall (8 channels). Each wall represents one of the four cardinal points in the map and corresponds to a part of the Mediterranean; each country (and its soundmark) has a fixed location and starting point in space. The north wall (N) is the "sound map" of the northern countries, the south wall (S) that of the southern countries, etc.

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1 "Geografia Sonora" has been commissioned by the curator Evelyne Artaud for "Marseille-Provence 2013, European Capital of Culture" and took part of the exposition "Cadavres Exquis" at the Granet Museum of Aix-en-Provence. It has been composed in the Muse en Circuit Studios.

2 R. Murray Schafer categorize the main themes of a soundscape in terms of keynote sounds, signals and soundmarks. A keynote is the tonality in a composition and also the sounds of a landscape created by its geography and climate; signals are acoustic warning devices or message transmitters; a soundmark is a community sound wich is unique. He proposes also a definition of a community as political, geographical, religious, social and acoustic entity.
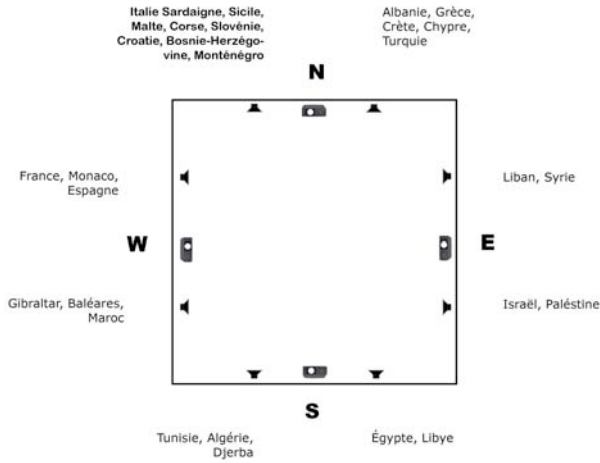
Figure 2. Spatial distribution of the Mediterranean countries and sound diffusion by 8 loudspeakers.

The sound material, concrete and mainly raw, is grouped in "sound islands" and "island clusters" (see Table 1). A "cluster" is a sound family (e.g. Human, Signals) and an "island" is the type of a sound within a sound family (e.g. singing, morse). I will confine myself to describe only a few sounds here. The "Human" and "Ambient" families are related to oral tradition (songs) or reflect the human activity on sea (fishing, navigating). The Morse code generated by the computer comes from a text fragment of Homer's "Odyssey" [2]. A very few samples (natural sounds, boats motors) are filtered in order to serve as continuous drones. The sound material is organised in 8 sound familes.

	Sound families	**Sound types**
	(island clusters)	*(sound islands)*
C o u n t r i e s	Human (voice)	singing, speaking, calls, onomatopoeia
	Instrumental	related to sea songs
	Ambient (with voice)	port, fish market, boat, carnage, celebration
O t h e r	Natural sounds	sea, wind, birds, insects, big fishes, unusual sounds
	Signals	boat horns, whistles, morse signals, sonars, unidentified sea sounds
	Mechanical	boat motors, chains
	Drones	filtered sounds
	Processed	filtered sounds

Table 1. The 8 sound familes of the Mediterranean soundmark.

A "sound navigation map" defines paths and interconnections between "sound islands" and/or "island clusters" and generates an "archipelago of sounds".
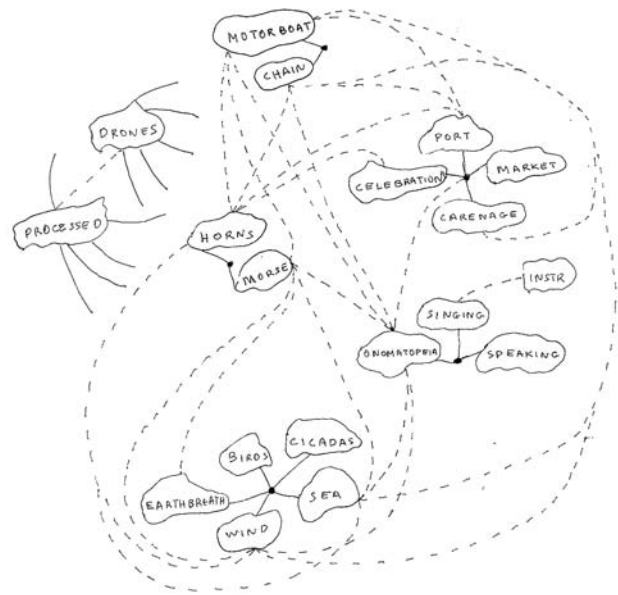

Figure 3. Sound navigation map, "sound islands" & interconnections (manuscript).

1.2 Virtual Score - A sound navigation map

The navigation between the "sound islands" changes ad infinitum in real-time. There is no fixed duration, beginning or end; sounds may be repeated but the listener will never listen to an identical combination of sounds. A "sound navigation map" is generated as a virtual score in the computer by means of Max/MSP and the Spatialisateur software. The navigation map is organised as a complex multi-level matrix constructed with three external tables that interact with each other: 1) a table for the horizontal interconnections between sounds (juxtaposition), 2) a table for vertical connections (superimposition) and 3) a table for the grouping of sounds and for the spatial movement.

island clusters	islands	Voice			Instrumental	Voice ambience		
		singing	onomatopeia	speaking	Instrumental	market	port	boat
Voice	singing	x	x	x	x	x	x	x
	onomatopeia	x	x	x	x	x	x	x
	speaking	x	x	x	x	x	x	x
Instrumental	Instrumental	.	.	.	x	.	.	.
Voice ambience	market	x	x	x	.	x	x	x
	port	x	x	x	.	x	x	x
	boat	x	x	x	.	x	x	x
	carnage	.	.	.	.	.	.	.
	celebration	.	.	.	.	.	.	.
	other	x	x	x	.	x	x	x
Nature	birds	x	x	x	x	x	x	x
	fish	.	x	.	.	.	x	x
	cicadas	.	.	.	.	x	x	x
	crickets	.	.	.	.	x	.	.
	sea	x	x	x	x	x	x	x
	wind	x	x	x	x	x	x	x
	breath	.	x	.	.	.	x	x
Signals	horns	.	x	.	.	x	x	x
	morse	.	x	x	.	.	x	x
	sonar	.	.	.	.	.	x	.
	unidentified	.	x	.	.	.	.	x
Mechanical	motor	x	x	x	.	x	x	x
	chain							
Drone	Drone	x	x	x	.	x	x	x
Processed	Processed	x	x	x	.	x	x	x

Figure 4. Sound navigation map: part of the table indicating allowed and non-allowed sound juxtapositions.

The first two tables define a random navigation between sounds types according to rules that determine the allowed or non-allowed combinations of sounds (e.g. birds to cicadas, birds and cicadas); this choice (yes/no) is either arbitrary or rational according to combinations one may listen in the physical word. The third table determines the spatial movement of sound types and their internal organization in "scenes". A "scene" regulates a particular behavior of each sound type (e.g. singing, fish) in time and in space:

- polyphony (one/many sounds & loudspeakers)
- spatial movement (static/dynamic within an angle in degrees)
- sample duration and onset (playback position in a sample)
- total duration of a scene (15- 70 sec)

Eight scenes are configured in "Geografia Sonora".

- Solo (a single sound type): monophonic, static, 1 L/S[3]
- Multi: polyphonic, static, 2-4 L/S simultaneously
- Respo; polyphonic, static, 2-3 L/S alternatively
- Ubi: polyphonic, static, 8 L/S simultaneously, quiet
- Circular: monophonic, dynamic, 8 L/S, 90°-360°
- Spiral: polyphonic, dynamic, 8 L/S, >360°
- Cross: polyphonic, dynamic, 2 L/S, jump across
- Zig: polyphonic, dynamic, 3 L/S zig-zag

Figure 5. Sound navigation map: "scenes" and sound spatialization.

All three tables are stored in Max/MSP into *coll* objects. The whole sound navigation is a random choice of path by the computer between "scenes" (see Figure 5) and "free" navigations between "sound types" (see Figure 4). A new "scene" appears after 4-8 "free" navigations. As all countries have a fixed spatial point (in a specific loudspeaker and angle) all sounds related to countries (and humans) are localized and start *migrate* in space in the loudspeaker of that country. All other sounds are spatialized according to "scenes". For example, in the Respo configuration the next sound will start at the opposite spatial point to the first one.

3 loudspeakers

A maximum of three polyphonic voices may be superimposed and read in players (*sfplay~* objects) in the Max/MSP patch. The number of sound sources, the spatial location and the movement of the sources, are controlled by the Spatialisateur. They are distributed in an 8-channel system with 15 virtual spatial points.

1.3 The video – A "breathing sea"

The video is projected by three projectors on the three walls of the room. The video image is the result of a continuous changing texture of a sparkling sea. When a new sound "scene" appears the sea changes in color, luminosity and density and becomes a constellation of lights.

The video image is a merge of two sources: the video of a shimmering moving sea and a similar photo whose color changes by the computer. From interaction between these sources results a sea-matter in continuous motion, that oscillates ranging from blue to silver blue-violet (and to silver) and whose shimmer is gradually transformed into constellation of lights. This "landscape" could suggest a constellation of stars, signals of lighthouses, boat luminous lines, or the night-lights of the islands.

The video treatment is calculated in real time by specific modules on Jitter software: *jit.op* for matrices operations in order to generate a new synthesized image; *jit.mxform2d* for image spatial transformation, *jit.scalebias* for color channels scaling and offset in a 4 plane input matrix (ARGB); *jit.slide* for temporal envelope following.

2. VOCALSCAPES ON WALT WHITMAN

"Vocalscapes on Walt Whitman" (2014) are electroacoustic interludes extracted from "The Body Electric"[4] cycle based on Walt Whitman's "Leaves of Grass"[5] [3]. It is composed for a speaking-singing female voice, clarinets, trombone, viola, percussion and 6-channel tape. The cycle is a work in progress, which started with four pieces[6], but more ones will be added in the future. The four pieces are bounded by electroacoustic vocalscapes (interludes). Some instrumental or concrete sounds of the work are directly inspired by the soundscapes in Whitman's poems (boat horns, wind, whistles, whispers).

"Vocalscapes on Walt Whitman" can be seen as an electroacoustic composition as well as a sound installation. The piece explores both the idea of poetry as sound-space and as "geography" of languages, voices, performances and humans. The sound material derives from the recordings of fifteen talkers, each one having recorded a Whitman's poem excerpt in her/his mother tongue in a chosen place. Each spoken poem (and voice) is accompanied by the ambient sound of the place where it's been recorded. The recorded material has been composed and spatialized automatically by Max/MSP and the Spatial-

4 The work has been comissioned by the French Ministry of Culture for the Arts Nova ensemble. The title comes from Whitman's poem of the same title.

5 "Leaves of Grass" is a poetry collection of 400 poems by the American poet Walt Whitman (1819–1892). Whitman composed it during his entire life, writing and revising it in five editions until his death.

6 "City of Ships"; "A Clear Midnight"; "Yet, Yet, Ye Downcast Hours"; The Rounded Catalogue Divine Complete".

isateur both driven by Antescofo[7] software and programming language. This computer environment for real-time composition has been initially conceived for the installation of "Geografia Sonora" and developed further for the "Body Electric".

2.1 The Vocalscape (Fonotopia)

Most of the fifteen talkers, women and men, have recorded an excerpt of Walt Whitman's "Song of Myself". Some of them have recorded excerpts of five different poems[8]. The languages actually recorded are: English, French, German, Greek, Hebrew, Italian and Spanish – more languages will be added in the future. All talkers provided a recording of the ambient sound of the space of reading; many of them have chosen a particular *mise en scène* (staging) of that space with very interesting consequences both for the background sound of the recording and for the work. Dieter Kaufmann recorded on the Pilgram-bridge in the middle of a crowdy Vienna an excerpt[9] where Whitman expresses his strong conscience of citizenship and involvement in the city (New York); Allen Weiss recorded a quiet snowy soundscape full of birds in Huntington NY; Joel Chadabe chose the West End Avenue sound in front of his studio building and Philippe Leroux the night ambience of Ecole Normale Superieure street of Ulm.

The recorded poems have been edited and arranged (in folders) by language, gender, type of audio sample (poems, strophes, verses, words, ambience samples) and poem (title and talker); e.g italian/woman/verse/A_Song_of_the_Rolling_Earth_paola.
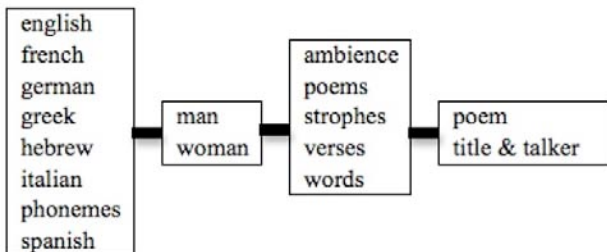

Table 2. Organization of the recorded poems samples by: language – gender – sound type – poem title

2.2 Virtual score – programming in Antescofo

The compositional process and method in "Vocalscapes on Walt Whitman" is an extension of that of "Geografia Sonora". But "Vocalscapes" by its nature needed a higher compositional control and precision in working on the material. The music material has been generated in real-time on studio, recorded as fixed 6-channel musical sequences and mixed as standard electroacoustic pieces. Each sequence is composed and spatialized as a micro-

form similar to Geografia's "scenes" described above: Solo, Multi, Respo, Ubi, Circ, Spiral, Zig (see Figure 5). The sequences here are generated by the Antescofo software and programming language and generated through Max/MSP and the Spatialisateur.

A new version of the Geografia's Max/MSP patch has been developed with a 3-player module, with an increased internal polyphony for each player and a maximum of 15-voice superimposition.
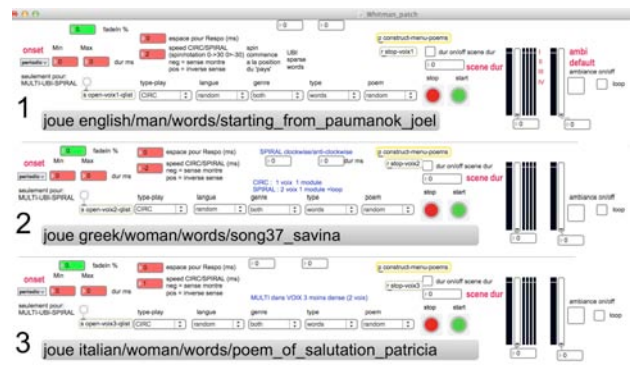

Figure 6. The 3 voices (players) in Max/MSP patch.

When launching the Max/MSP patch all the audio samples are preloaded automatically. The *recursivefolder* object of Alex Harker[10] allows to construct the folders tree for the sound types (poems, strophes, etc.), to access easily to the audio samples and to add more samples without changing the patch. By the *antescofo~* object in the main patch window one can access to the Ascograph graphical score editor.
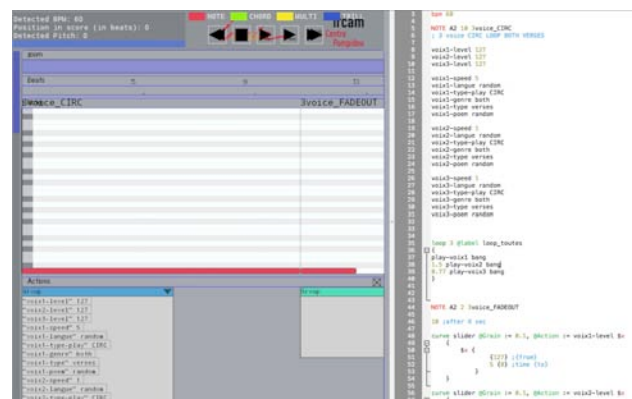

Figure 7. The Antescofo's Ascograph graphical score editor.

All electroacoustic sequences have been programmed with a high precision in the right part of the editor. It has been possible to compose a large number of appended sequences by controlling numerous parameters:

- a sequence's global duration
- the sequence's number of "voices" (3 polyphonic voices)
- the sound level and the fades
- the choice of an audio sample by language, gender, type of sound, or poem title, also randomly

7 "*Antescofo~ is a modular polyphonic Score Following system as well as a Synchronous Programming language for musical composition. The module allows for automatic recognition of music score position and tempo from a realtime audio Stream coming from performer(s), making it possible to synchronize an instrumental performance with computer realized elements. The synchronous language within Antescofo allows flexible writing of time and interaction in computer music*". Arshia Cont, http://repmus.ircam.fr/antescofo, 2009.

8 "A Song of the Rolling Earth"; "The Dalliance of the Eagles"; "Faces"; "Poem of Salutation".

9 "*...A call in the midst of the crowd, My own voice, orotund sweeping and final.../ This is the city and I am one of the citizens...*" from the "Song of Myself".

10 https://github.com/AlexHarker/AHarker_Externals

- the superimposition of a poem with its ambience recording
- the onset (position of the playback in a sample)
- a delay time for the playback
- the speed variation of the playback
- the type of spatialization of a scene, the speed and the sense of rotation (clockwise-anticlockwise)
- the loop of a sequence with a different onset for each voice
- the generation of a sequence of sequences

The following *antescofo~* virtual score is a simple example of a 1-voice sequence from a randomly chosen poem's verse and language, told by a woman, rotated in a full circle in 5 seconds, looped once and faded out immediately after 10 seconds.

```
bpm 60

NOTE A2 10 3voice_CIRC
; 3 voice CIRC

voix1-level 127

voix1-speed 5
voix1-langue random
voix1-type-play CIRC
voix1-genre woman
voix1-type verses
voix1-poem random

loop 1 @label loop_toutes
{
play-voix1 bang
}

NOTE A2 2 1voice_FADEOUT

10 ; after X sec

curve slider @Grain := 0.1, @Action := voix1-level $x
    {
            $x {
                    {127} ;{from}
                    5 {0} ;time {to}
                }
    }
```

The electroacoustic sequences are spatialized by the Spatialisateur in a 6-loudspeaker system with 15 virtual sources offering a fine precision of the sound movement in the hall.
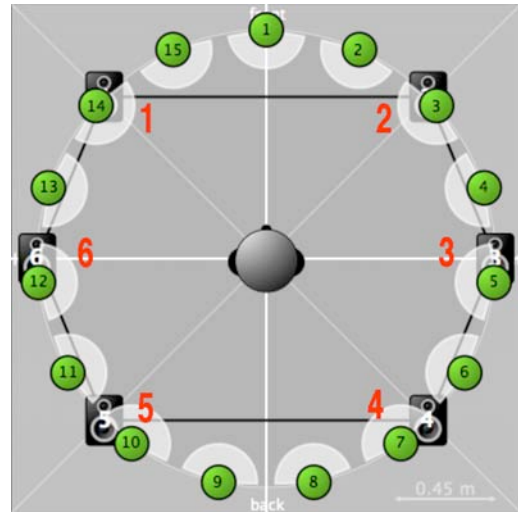

Figure 8. Representation of the 6-channel loudspeaker system with 15 virtual points in the *spat.oper* object of the Spatialisateur

Similar to "Geografia Sonora", each country and language has a specific location in the sound space. A sound diffusion with a fine control of parameters related to perceptual factors and sound radiation are possible within the Spatialisateur such as the reverb, the source presence and brilliance, the room presence, the distance or proximity of sound events.

3. NOTES ON SPACE, SOUND, VOICE AND POETRY

"Geografia Sonora" and "Vocalscapes on Walt Whitman" are the first two works of *the "Ritual Chambers"* series of sound environments (soundscapes and vocalscapes).

Physical Space

The notion of the "chamber" as private space and as shared space by a small community comes from personal live and/or sonic experiences in popular rites[11]. The sonic influence and the compositional approach of the ritual in my work can be found in my earlier pieces "Klama"[12] [4] and "The Bacchæ"[13] [5]. The "chamber" in rituals is often a small shared place that opens to the spiritual space: *"Place is security, space is freedom,"* writes the geographer Yi-Fu Tuan, *"we are attached to the one and long for the other."* [6]

In "Geografia Sonora" installation, the room can be freely approached by the visitor: she/he may move freely inside, walk around, sit or lie down on the floor, enter or exit, listen, contemplate, or discuss. The space could be a place of listening and meeting like in Roland Barthes' "phantoms of the Opera": *"Je rêve d'un Opéra aussi libre*

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11 The fire rite of Anastenaria in Nothern Greece, the Greek death rituals, ethnographic audio collections from Smithsonian Institution and CNRS-Musé de l'Homme archives.

12 "Klama" (IRCAM 2006) is a work for mixed choir, live electronics and "audio documents" and have its roots in the death rituals, performed in the region of Mani. *(http://www.georgiaspiropoulos.com/programnotes/klama.html)*

13 "The Bacchæ" (IRCAM 2010) is a solo opera for one performer, tape, live electronics and lights based on Euripides' ancient Greek tragedy. *(http://www.georgiaspiropoulos.com/works/bacchae_excerpts_en.html).*

et aussi populaire qu'une salle de cinéma ou de catch: on y entrerait, on en sortirait selon son humeur…"[14] [7].

Abstract Space

The notion of space as structural element for the composition and as integral part of the sound is explored in both works. The sound comprises the space, the sound has spatial features and disposition right from the beginning (through compositional decisions) In both works the audio content may change completely but abstract space not. The space is open and can be modulated in terms of temporality, density and internal movement but the structure remains the same. The space is structured by a virtual score that determines the *"scenes"* - sequences organized in terms of material, polyphony, density, duration, spatial position and movement. In "Geografia Sonora" the virtual score generates randomly an open structure, a moving space; in "Vocalscapes on Walt Whitman" the virtual score generates pre-programmed scenes that can be orchestrated in multiple ways.

Liquid Spaces

"Geografia Sonora" also explores the idea of liquidity, the flow of the water (the sea) but also the continuous flow of sonic events from the Mediterranean soundscape. "Vocalscapes on Walt Whitman" explores the flow of the language, of Whitman's poetic language and of the articulated speaking as recorded by the fifteen talkers[15]. Bachelard says: *"Liquidity is… the very desire of language. Language wants to flow. It flows naturally."* [8] [9]

"Vocalscapes" are geographies and Geografia's sea changes to a vocalscape too — by songs, onomatopoeias, calls and speakings. In the Homeric sea people speak; and they speak in different languages: *"I navigate the wine-colored sea among people who speak different languages."[16]* [10]

"Vocalscapes" is geography of Whitman's poetry but also a talkers' portraits. It is a testimony of languages, pronunciations, dialects and idioms similar to Whitman's introduction of foreign, borrowed words, slang, onomatopoeias and pronunciations inside the chosen tongue: *"Pronunciation is the stamina of language, - it is language."* [11] The talkers are the voices of the poem and the text-poem joins the "oral" dimension.

"O what is it in me that makes me tremble so at voices?"[17]

But the talkers becomes also performers, "vocalists", speakers, readers, and, in a way, directors - many of them have chosen a particular *mise en scène* (staging) of the space/place of reading with significant consequences for the background sound of the recording. The recording keeps the vocal mark of the talker and the soundmark of the space/place. The talkers are not alone; like Messiaen's "oiseaux"[18] they are in a changing landscape together with their neighbors singing with them. [12] "Vocalscapes" is a virtual space of characters, of vocal performance and an environment of "oral" poetry. *"The poems in* Leaves of Grass *'are not* about *the environment, whether natural or social,'… They* are *environments."[19]* [13]

Sonic Space

Like "Geografia Sonora", "Vocalscapes on Walt Whitman", is a collection and a cartography (of Whitman's poetry). Whitman collects and classifies images, scenes, voices, humans, objects, words in detailed catalogues: *". . . Collecting I traverse the garden of the world . . ."[20]*

If there is a Whitman's verse that reflects best the idea of "Vocalscapes" it is the following: *"Human bodies are words, myriads of words... / Every part able, active, receptive, without shame or the need of shame."[21]* Whitman's recorded poems are used entire or in fragments: strophes, verses and words. Beckett says: *"I'm in words, made of words, other's words [...] I'm all these words, all these strangers, this dust of words, with no ground for their settling, [...]."* [14]

Like "Vocalscapes", "Geografia's" archipelago is a sound collection and cartography of the Mediterranean, bringing tonalities, signals and communities soundmarks.

Visual Space

The idea of "Geografia Sonora" installation as an endlessly changing sea has been formed from repeated observation (and contemplation) of the wide open landscape of the Aegean and Ionian seas from different perspectives: the sea as cartography & calm landscape from aerial view (for the sound); the sea as texture when seen from the top of the mountain of an island (for the video).

The video[22] of a "breathing sea" is in part inspired by James Turrel's "Aperture" works[23], Rothko's "abstract icons"[24] [15] or by the "thinking ocean" in Tarkovsky's "Solaris"[25] [16] planet: "an endlessly changing and apparently sentient alien ocean" [17]. But instead of a disquieting heterotopia, Geografia's sea invites; it's a space of listening, of thinking and maybe of meditating and exchanging.

"... Sea breathing broad and convulsive breaths..."
Walt Whitman, "Song of Myself"

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14 *"I dream of an opera as free and popular as a movie or catch hall: one would get in and come out depending on their mood".*

15 *"I have heard what the talkers were talking, the talk of the / beginning and the end, / But I do not talk of the beginning or the end."* W. Whitman, *Leaves of Grass*, "Song of Myself".

16 *"πλέων ἐπὶ οἴνοπα πόντον ἐπ' ἀλλοθρόους ἀνθρώπους".* Homer, "Odyssey" Homer, Odyssey A. 183. Literally "people who make different noises".

17 *Leaves of Grass*, "Vocalism".

18 *"Chaque pièce est écrite en l'honneur d'une province française. Elle porte en titre le nom de l'oiseau-type de la région choisie. Il n'est pas seul : ses voisins d'habitat l'entourent et chantent aussi (...)- son paysage, les heures du jour et de la nuit qui changent ce paysage, sont également présents, avec leurs couleurs, leur températures, la magie de leurs parfums."* O. Messiaen, Catalogue d'Oiseaux, CD booklet.

19 A. Fletcher, *A New Theory for American Poetry: Democracy, the Environment, and the Future Of the Imagination.* Cambridge, MA: Harvard Univercity Press, 2004, p.103

20 *Leaves of Grass*, "These I Singing in Spring"

21 *Leaves of Grass*, "A Song of the Rolling Earth"

22 http://www.georgiaspiropoulos.com/programnotes/geografia-video/geografia-sonora-video.html

23 *"A Turrell Space Division (also called an 'Aperture' work) consists of a large, horizontal aperture cut into a wall… The aperture [...] appears to be a flat painting or an LED screen but is a light-emitting opening to a seemingly infinite, light filled room beyond".* http://jamesturrell.com/artworks/by-type/#type-wedgework

24 *"fields of color and light born by Rothko's experience of the emptiness in the American landscape"* in "L'art au XXe siècle. : Peinture, Sculpture, Nouveaux médias, Photographie" Taschen, 2000

25 Based on Stanislaw Lem's novel, "Solaris" 1961.. S. Lem, J. Kilmartin, S. Cox, "Solaris", Mariner Books, 2002

"If one could be shot out of the Earth to fly into space, and if sound could be transmitted so far, or if the ear had the qualities of a super-machine, one would listen to the overall sound, the 'soundmark' of the earth. That noise would be made of all the earth sounds: human, animal, mechanical, natural. And if the ear could zoom to an area, it would be able to hear the 'soundmark' of this region. And if you could zoom in even further, you could hear families of sounds or individual sounds. This is what 'Geografia Sonora' is: a flight, a trip, an imaginary zooming above the Mediterranean, its countries and their sounds."[26]

4. CONCLUSIONS

In this paper I have presented some of my recent research, compositional approach and computing strategies for real-time composition of sound environments. In "Geografia Sonora" sound-video installation, the soundscape, an archipelago of sounds, is generated by a virtual score in Max/MSP and the Spatialisateur. In "Vocalscapes on Walt Whitman" electroacoustic sequences are composed automaticaly by the same tools and controlled in detail with Antescofo's virtual score.

The further the environment series grows, the more improved computer environment Max/MSP – Spatialisateur - Antescofo is needed in order 1) to create a generalized control of the whole form and music structure via the virtual score; 2) to provide an automatic editing of audio samples and automatic organization of a database constantly growing; 3) to integrate live sound treatment; 4) to explore different spatial audio rendering techniques such the Ambisonics and the Wave field synthesis.

Acknowledgments

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Audio, videos & interviews

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KLAMA: the Voice from Oral Tradition in Death Rituals to a Work for Choir & Live Electronics

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Abstract — Klama, **for mixed choir, live electronics & prerecorded sounds, has its origins in the ritual lament of Southern Peloponnese (Greece); a "polyphony" composed of improvised monodies** *(moirolóya),* **epodes, crying, screams and monologues, accompanied by ritual gestures. By its acoustic violence the lament can be considered an alteration of vocality which affects simultaneously tonality, timbre and language.** *Klama* **has been developed in three levels, a nexus where vocal writing interacts with electroacoustics and live electronics, the latter seen as a metaphor of the inherent vocal alterations on the lament. In this paper we will show : 1) how the compositional material derived from the voice in oral and byzantine church tradition is explored for the choir and electronic writing; 2) how the three levels of Klama, acoustic, electroacoustic & live electronics interact through the act of composition and by means of the technological tools (Open Music, Max/Msp, Audio Sculpt).**

Keywords : lament, vocal techniques, noise, Max/Msp, OpenMusic.

INTRODUCTION

Klama has been commissioned by Ircam and the Accentus Choir and performed at Agora Festivall 2006 at the Centre Pompidou, Paris. It is a work for mixed choir, live electronics and pre-recorded sounds, having its roots in the death rituals, performed in the region of Mani, in Southern Peloponese. The meaning of the word "*klama*" is simultaneously "cry" and "ritual lament". It characterizes a "polyphony" encompassing improvised monodies (*moirolóya*), epodes, crying, screams and monologues, accompanied by ritual gestures. Due to its acoustic violence, and related to the experience of loss, lament can be considered more like an alteration of vocality rather than a song; an alteration which, because of the emotional shock, affects tonality, timbre and language as well. Performed by women, mainly in the dead person's house in front of the corpse, this "polyphony" is a kind of accompaniment and appropriation of the dead, reorganizing the social structures. This ritual is followed by the Byzantine monody of an Orthodox Funeral Mass celebrated in church. The two forms are then joined in a complementary and at the same time antithetic way, in a kind of chaotic acoustic dissemination and dispersal.

In the structure of *Klama* my intention was to (keep and) explore this dramatic opposition which separates and brings together two cultures dissimilar to each other, an oral and a textual one. The material of *Klama* originated from the recording of Katerina Xirou's voice, together with others, found and performed in situ.

The musical text evolves in three parallel levels that are superimposed and interact with each other as in Arnulf Rainer's *Übermalungen* of *Totenmasken* (overpaintings on the photographed people's death masks). The vocal text uses melodic traits and certain techniques of the mourning voice. The electroacoustic text assembles rough or transformed material, integrating the noise and the deterioration of the analog storage medium (vinyl record and audio tape); mainly focused on timbre, the electronic treatment focalizes on distortion, mask "filtering", vocal noise simulation, accentuation of breath, amplitude modulation and granular synthesis. It has an effect on the voices of the choir in real time and acts as a metaphor of the vocal perturbations inherent in the lament.

Klama has been composed for an 8-part mixed chamber choir of 33 voices (SSAATTBB) with 3 soloists, soprano, contralto and baritone, who at certain moments join the other parts.
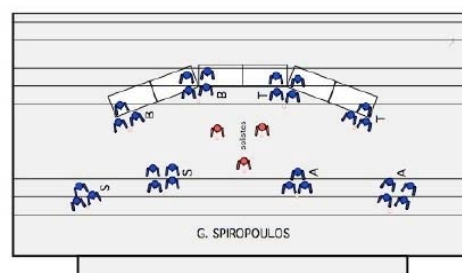

Fig. 1. Choir on stage

Klama develops as a triptych form of three semi-autonomous panels, *klama – melos – diaspora*, bordered and bound by electroacoustic parts.

Intro	Klama	Interlude I	Melos	Interlude II	Diaspora	Finale
	lament		*monody*		*dissemi-nation*	

Fig. 2. *Klama* - form

I. COMPOSITIONAL MATERIAL & VOCAL WRITING

A. Compositional material

The compositional material of *Klama* comes from three sources of found and created audio "documents":

1) mourning and speaking voices and ambient noises form an old audio tape recording of a ritual lament in situ;

2) excerpts of a Katerina Xirou's lament cycle recorded at Ircam and pressed in a vinyl record; 3) excerpts from a hymn of the byzantine Funeral Mass of Ioannis of Damascus (7th-8th centuries). Both electroacoustic & live electronics parts are a deliberate combination of HiFi and LoFi sound. The deteriorated audio tape and vinyl record quality, natural or artificial, offers a large sound palette (noises, crackles, hisses and scratches) determinating for the "noise" aesthetics of the work. The vocal, the electroacoustic and the live electronics parts are interwoven and interdependent; these three levels tend to maximal fusion as if past and present formed a continuous circuit, a new acoustic reality where different "époques" co-exist.

B. Text

The text use on *Klama* is restrained, mainly based on the acoustic quality of the phonemes; melted in the sound, rarely perceived, the text is used more as a vehicle of phonetic colors and as a "guide" for the form narratives than for its semantic quality. The Mani's linguistic and poetical idiom, whose imitation is condemned to failure, exists only as "traces" on the fragmented prerecorded voices.

Klama starts with a sequence of five vowels (e i ou a i) derived from the first words of a traditional lament. We can mention shortly some other types of used material: isolated phonemes chosen for their acoustic quality in relationship with vocal register, articulation and intensity; fragmented or entire screaming words; the first word "οιμοι" (= imi, a greek exclamation of pain) of the byzantine hymn; the poetic text of a traditional lament in a spoken version.

C. Vocal writing

In Mani's ritual lament tradition we find two types of interpretations of a lament : the *mourning way*, in situ, during death rituals and the *singing way* in an "every day" context. My main interest focuses on the womens' *mourning way* and the *beyond-the-singing* vocal "techniques" and timbres; consequently I chose not to use any modal contents of the singing, the tonaly stable "every day" version. As for the fragment of the byzantine hymn, attributed to the male voices only, an approximation of the voice position in the church tradition is demanded.

All vocal parts of *Klama* should be sung without any vibrato. The main vocal techniques used are scream, voiced pant, sob, hoarse voice, "breathing in" and "breathing out" noise, speaking voice sotto voce.

The "melodic" vocal writing is based on: single-tone or drone phrases, sometimes including microtonal fluctuations or short glissandi, and continuous ascending glissandi as those observed at the end of phrases/verses of the laments - often, these phrases are to be sung with a continuous raising intensity until exhale air finishes; two citations, short looped melodies in Byzantine Mode 2, of the world "imi" of the byzantine hymn; short melodic skiping phrases, executed with the chest voice in a high intensity, shapes of real *screams* (words or syllables) often time-expended. Some other extra-singing sound shapes and rythmic cells of the mourning voice are used: approximatively pitched, like aspirated *sobs* (descending glissando), noisy and unpitched like short voiced *pants,* long *hoarse voice* sounds and short *"breathing in* and *out*

noises. Fast spoken sotto voice passages are used for a traditional lament murmured by the tenors in the singers language. The passage of the score (meas. 55) on "Fig. 3," includes some of the above vocal techniques.
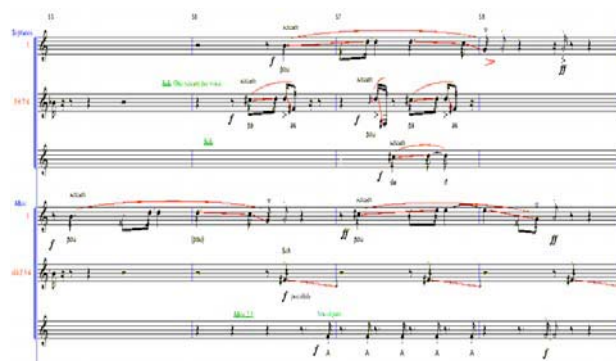

Fig. 3. Vocal techniques for sopranos and contraltos;

scream – aspirated sob – voiced pant – "breathing in" noise.

D. Electroacoustics

The introduction, both interludes and the end of *Klama* are entirely electroacoustic; the introduction is spatialised in the hall during the audience entrance until the choir finds its final position on stage. The sound material uses speaking and mourning voices and ambient noises from an old audio tape recording of a ritual lament in situ and a high pitch-shifted sampled lament of K. Xirou, representing the "announcing bird". The electroacoustic part accompaning throughout the vocal part uses similar transformed audio material integrating deteriorated audio tape and vinyl record sounds. *Klama* ends with vinyl record laments phrases spatialized all around the audience.

II. COMPUTING TOOLS

A set of computing tools has been specially developed for *Klama* at Ircam by Benoit Meudic. They have been used in different steps of the construction of the piece: for the composition of one section of the score (using the OpenMusic software), for the creation of the electronic sounds on studio and for the real time sound treatments of the choir (using the Max/Msp software).

A. Open Music

Open Music is a full visual programming language. It is mainly used by composers for non-real-time generation of symbolic materials (such as midi-files) used for writing scores.

We have chosen this language to emulate a granular synthesis module *(munger~)* taken from the software Max/Msp. We have called our module *simul-munger*. It is written in Common Lisp Language and uses the Open Music graphic interface. The interest of using Open Music stands in the possibility of fine tuning the parameters of the module, and in the conviviality of the symbolic music editors that are provided by the environment. Each time we evaluate the module, it outputs a new 8-voice midi-file that we can visualize in a graphic score editor. The module can potentially provide a great number of different

scores that correspond to many possibilities for making the glissando texture attributed to the sopranos and altos at the third section of *Klama* (meas. 143-164).
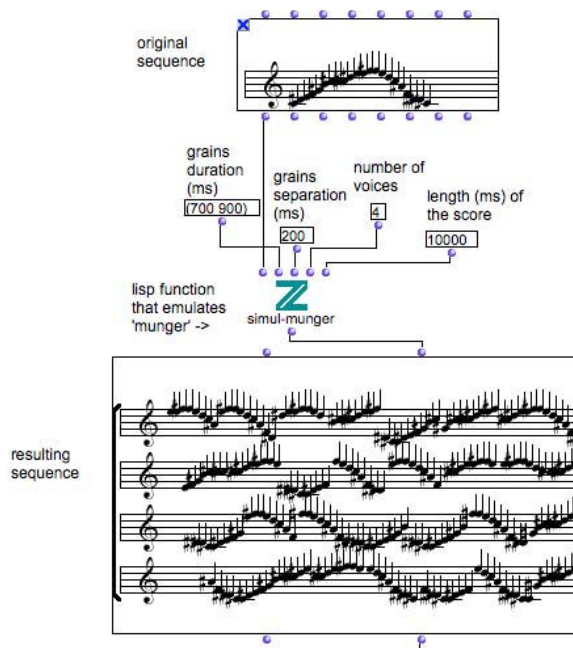

Fig. 4. An OpenMusic patch generating a glissando texture.

B. Max/Msp and Audio Sculpt.

Following the same concept as Open-Music, Max/Msp is a full visual programming language, but it is more dedicated to real-time sound processing. Its modularity provides a great flexibility of use and offers the possibility to personalize the interface in depth.

We have used it for making several real-time sound treatments modules. The choir was divided in 11 groups (SSAATTBB + 3 soloists) and each of them could be treated independently during the concert. The signal communication between the modules uses a matrix so that the modules can be connected to each other in all the possible ways. Considering that, the total number of possible module combinations is very high. For instance, if we provide a sound file as input to the system, we can transform it and record the transformations as a new sound file. This can be done an infinite number of times and makes the generation of a great variety of sound files possible starting from only one sound. The modules that we have developed correspond to some special voice treatments that had been desired by the composer. Many of them consist in of adding some noise to the voices following the idea that the emotion of the singer alters his/her voice, as it occurs in a real *lament*. In the following paragraph we will describe some of the modules and provide some examples.

1) masque. The *masque* module is a set of filters that have been developed starting from the idea of applying different real "masks" (that is to say objects modifying the vocal identity) to the choir-singers. Four masks have been built from the recording of real masks. The process consists of computing a filter that transforms a given source (singer without the mask) in a given target (singer

with the mask). This is very delicate because the source and the target should be synchronous. We have used a Max/Msp library called FTM to compute the signal vector matrices. The resulting masks, even if not so near from the initial targets, provide filters that alter the sound by giving to it a particular colour. It is also possible to interpolate between two masks. We may find some examples of the *masque* use on measures 18, 80 (contralto solo) and 73 (tenors).

2) modamp. The *modamp* module applies an lfo (low frequency oscillator) to the voice. It can be used to alter a continuous sound. One could compare the result to an extreme tremolo (amplitude vibrato). It has been used in a prerecorded hoarse voice (voix rauque).

3) disto. The *disto* module provides another kind of distortion by modifying separately the amplitude and the phase of a signal in the frequency domain. It is possible to shift, randomize, resample and filter any component of the amplitude and/or the phase and to re-inject the result in the processing via a matrix. The result sounds hoarse and can be used on harmonic and clean sounds. "Fig. 5," 'patch+disto' shows the matrix and the different graphs from which the module is controlled. The "disto2" module has been used for the basses byzantine melos on the part II of *Klama* and simulates the timbre of the voice of K. Xirou singing a B-flat low tone (Bb2).
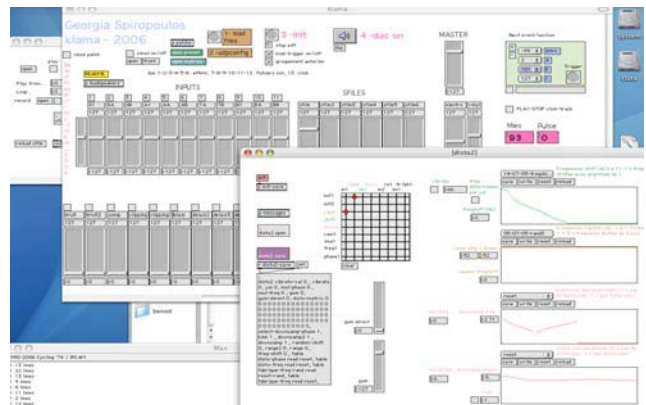

Fig. 5. *patch+disto.* The *disto* module and the main Max/msp patch

4) munger~. The *munger~* module is a granular synthesis object made by Luke Dubois that we use in order to emulate another kind of distortion. Various-sized grains of sound are taken from the signal and re-synthetized after adding small random time and pitch variations. The "announcing bird" audio file on the electroacoustic introduction of *Klama* has been generated with the *munger~* (and *psychoirtrist~*) modules applied on a "screaming" phrase of K. Xirou.

5) bruit. The *bruit* module has been developed to emulate a specific vocal mode very difficult (maybe impossible) to be produced by a singer who is not used to that mode. Starting from an original audio recording of K. Xirou, we have generated a sonagram with Audio Sculpt, a software that performs in-depth spectrum analysis and editing, and we have analysed it in order to emulate the different noisy components of the voice. We have defined two transformations: the first one is the adding of inharmonic partials by modulating the signal by an lfo

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tuned to a harmonic frequency of the voice, and the second one is the adding of noise filtered by the cepstrum of the voice in a specific frequency range and scaled by the amplitude envelope so that high amplitude levels provide more noise. "Fig. 6," *"voixrauque"* (hoarse voice) shows the two areas of the sonagram from which we have defined our module. "Fig. 7," *"bruit"* (noise) shows the interface controlling the module.
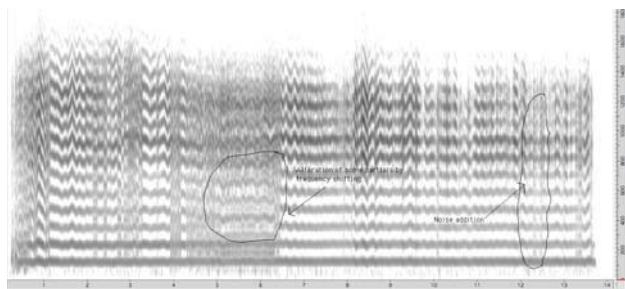

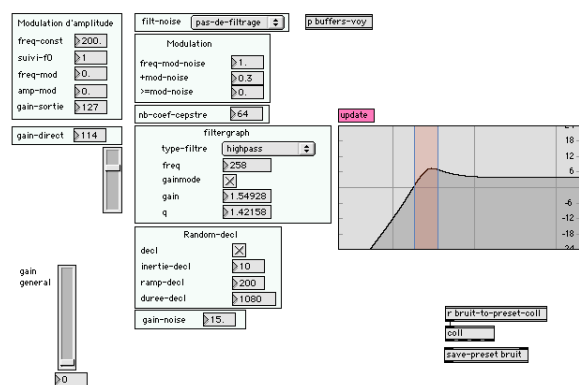Fig. 6. The *"voixrauque"* Audio Sculpt sonogram.

Fig. 7. "*bruit*". The *bruit* Max/Msp module parameters.

6) psychoirtrist~

The *psychoirtrist~* module is a psola (pitch-synchronous-overlap-analysis) choral harmonizer developed by Norbert Schnell at Ircam. Applying random temporal and pitch modulation parameters it is used to emulate a choir from the voice of one singer. It has been used on the electroacoustic part of the first section of *Klama* to create progressively a 4-voice virtual choir glissando texture between a given interval (major second and major third) from a single repeated tone phrase of five vowels.

Several other classical treatments such as clipping, frequency filtering, granular synthesis, compressors and delays have been used in the piece in complement to the modules we have described.

C. Spatialisation

Several spatialisation techniques have been used for isolating some singers from the choir. We have used a 6-point diffusion system disposed around the audience.
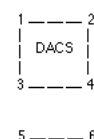

Fig. 8. Basic loudspeakers configuration

ROOTS & ROUTES

Klama reflects the questioning of compositional approaches and music technologies use whitch is based on two main axes :

1) the relationship and movement *from orality to textuality* and vice versa; how living oral/aural traditions are conveyed through "voice" (and body) and audio/visual "documents"; how orality, reinforced by personal experience, can be integrated in new forms through textual representation (musical score), material innovation and vocal/instrumental/computer techniques evolution; in which way a foreigner to a given tradition interpreter embodies, mixes, transforms and (re)creates orality to a new milieu. How the musical idea and consequantly the text can create topoi and liberate regions (entities from fragments) where different "époques" co-exist in constant dialog with each other.

2) the movement from *noise to sound* and vice versa: how found noise models and intentionaly inserted noise transforms and becomes part of the musical sound in order to produce a whole new living sound organism; how noise may be used to testify the presence of the medium, the passage of time or the distance of the "source"; how sound/noise can be used as music material in all of its aspects and qualities, from natural to artificial and from "hi-fi" to "lo-fi"; finaly how noise, as a positive force dynamically related to sound wouldn't turn to the totalitarism of the maximum level and of the constant fullness of the sound space.

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