(De)Composing Immersion

Clerc Parada, M.

Chapter 3

On *Eufótica*

Figure 1 *Eufótica* (2010), performance at Theater De Gouvernestraat, Rotterdam, March 23, 2011.

3.1 Introduction

Eufótica for six musicians and tape was commissioned for the "XX Festival de Musica Contemporanea UC" (20th Contemporary Music Festival of the Catholic University of Chile, Santiago, November, 2010). I continued developing this work during a residency (November 2010-January 2011) in Loos Studio in The Hague. The main instrument used by each player is a chair with a metallic wire tied between its legs (Figure 1).

In this chapter, I will present general notions of sound perception under water, focusing mainly on sound localization by human listeners. In *Eufótica*, the characteristics of sound perception underwater are used as a reference for designing the visual and spatial setup. I did not try to emulate in an exact way underwater sonic conditions, but attempted to freely use these notions of underwater sound perception to develop musical material and spatial relations. Having underwater auditory perception as a reference for approaching the composition brings diverse problems which can be represented in virtual, physical and symbolic ways. In any case, departing from the nature of a different environment transforms the perspective from which common musical elements, such as harmony, rhythm, counterpoint or dynamics, are approached. The conventional characteristics of the performance space are brought into relation with spatial visual-aural ideas that do not correspond to the physical logic of a traditional concert environment. In *Eufótica* this approach resulted in various perceptual illusions that trigger a spatial awareness in the listener.

As in *La linea desde el Centro,* I intended in *Eufótica* to blur the perceptual boundaries between the musical time-space and the surrounding environment (non-musical time-space). I composed *Eufótica* bearing in mind the traditional context and conventional characteristics of the hall where it was going to be performed. In this chapter, I continue to propose that it is possible to use conventional characteristics of traditional music contexts to open different forms of relating to the surrounding environment, as well as inducing a mode of aesthetic appreciation in the listeners that will last beyond the time of the performance.

I will consider the special listening attitudes of exclusive attention towards concert contexts as an aspect of enculturation. Listeners who often go to concerts may perceive their entrance to the hall, their clapping when the music finishes, or the audience-stage duality as natural aspects of the concert ritual. Therefore, the conventions and habits of these contexts can be approached as musical material that can be molded to achieve new perceptual and psychological experiences. For example, music concerts can be understood as ubiquitous and conventional rituals. In a concert context there are ritualistic features that are common for an audience. This implies that there are habitual expected conditions and a traditional order of events. The habits that mold the concert experience offer a comfortable position for listening to music. When having in consideration the comfort of the concert ritual, it is possible to re-ritualize this process while transforming the conventions in order to make the audience perceive a multiplicity of experiential layers with a new perspective. From my composer's perspective, I propose that the conventional elements can be exposed and used to generate new artistic ideas. The conventions can become a source of musical material and in some cases intended to be present in the musical setup. Hence, by transforming conventions I do not intend to negate them nor aim at achieving an original

result but to generate an interaction between conventions and newer performance situations in order to expose a multiplicity of experiential layers.

One of the re-ritualization characteristics of *Eufótica* is reflected in the special disposition of musicians, audience and loudspeakers in space. The goal was to recompose the spatial setup of the concert space in order to avoid automatic attitudes towards music listening. The re-disposition of musicians within a conventional space is not a new practice. I consider that it is more common to think of the performance space as a closed structure (as in Xenakis' approach described in the previous chapter) even with the possible variations of spatialization. In *Eufótica* as well as in *La linea desde el centro,* I question this "closed" approach. Therefore, I explore the relations between events inside a circular setup with the physical space outside of it. Through this chapter I will demonstrate how this multi-spatial concern influenced the resulting musical processes and affected my approach towards the sound sources in their sonic and visual presentation.

Moreover, this chapter reflects on the idea that the creation of completely new contexts without taking into consideration listener habits and performance conventions might just result in experiential idealizations. Relocating music to unconventional contexts tends to make music blend into the multiple experiential layers of society's daily routines that listeners would, in any case, naturally experience as multiple. The overlapping of diverse musical and sound stimuli within daily life creates a homogeneous texture of layers of experience where aesthetic appreciations blur, rise and change. Many express forms of immersion are constantly occurring, overlapping and transitioning in everyday life.[41] Everyday experiences which affect aesthetic appreciations of reality do not necessarily have a critical or a significant lasting effect. Because of this ephemeral quality, the constant variety and simultaneous stimuli of modern everyday life, I propose that immersive environments that are created with the goal of producing significant critical and aesthetic effects depend on their contrast from these everyday situations (in reference to Ruth Herbert's examples).

As the meaning of *Eufótica* suggests (described in the following sub-chapter), the immersive environment should not make the listeners completely dissociate from their surrounding physical space. Through *Eufótica,* I will describe an approach towards immersion as an experience of simultaneous co-existing realities. I consider a conventional musical context as a comfortable space where immersion can easily occur as a form of dissociation from reality. In *Eufótica,* I explore what the differences are that might avoid this sense of total dissociation. Avoiding dissociation might be perceived as contradicting some of the definitions of immersion. In the case of *Eufótica,* the intended immersive environment must be understood as a filter that transforms the mode of awareness where different layers of experience overlap. What is music? What is virtual? What is real? What is sounding? From where? Immersion in *Eufótica* intends to offer the simultaneous experience of all these questions.

[41] Here the term "express" means rapid, efficient and transitory, as when used in relation to delivery.

3.2 Diving: immersion as a metaphor of underwater experiences

3.2.1 The title

Entering into an immersive experience can be understood as entering into a special conscious mode, or into a special physical space which can be identified as different from a mode of full awakeness or a normal physical reality. This notion can lead to the idea that immersion occurs within a framed environment that is surrounded by an external one. The identification of a characteristic immersive period of time suggests that there is a going-in and a going-out, a pre and a post time-space to the duration of immersion. For example, when describing an underwater immersion, the commonly used terms *submerge* and *emerge* represent the transitions that separate two different environments. From this point of view, it is easy to observe the immersive time-space isolated or separated from that which surrounds it. This separation can be perceived as a duality: immersion implies an interiority that has a corresponding exteriority. The immersive reality can be perceived as an "other" and as "different" in relation to the environment that surrounds the experience. This duality can also be associated with the relation between simulated environments and their real referents. By using the term simulation, one knows that the experience offered by the simulator refers to a copy of reality. Therefore, the simulated realities automatically enhance their perceived separation from reality. A simulation is not reality or something in between realities. It is a copy. When I enter into a flight simulator, I immediately know that it is not the real thing despite the verisimilitude of the experience. These dualisms do not correspond to the immersive experience that I study and reflect in *Eufótica*. In this case, immersion occurs through perceptual transitions and also through the experience of multiple experiential layers. The meaning of the term *Eufótica* serves me to exemplify these notions.

I came across the name *Eufótica* (Spanish for *euphotic*) while reading oceanographic literature after the composition was finished.

> The *photic zone* is the surface layer of the ocean that receives sunlight. The uppermost 80 m (260 feet) or more of the ocean, which is sufficiently illuminated to permit photosynthesis by phytoplankton and plants, is called the *euphotic zone* (Greek for "well lit": *εὖ* "good" + *φῶς* "light") (Encyclopædia Britannica).

Through this term, I was able to, metaphorically, represent the kind of musical experience that *Eufótica* would produce. The sunlight establishes an uninterrupted connection between the immersive environment and the external world. It establishes a link between the underwater world and the outside.

The term *Eufótica* can be related to an immersive environment that lives in co-existence with the environment that surrounds it. Light penetrates the environment to give life to it. Both the euphotic and external world share a dependence on light to produce life. As an analogy to a musical immersive experience, the euphotic maximum depth represents an experiential border, establishing the differences between what is below and within the photic zone. An experience "below" represents a total detachment from the surrounding reality. On the other hand, an experience "within" represents an immersion in which the immersant is able to observe and simultaneously experience, from the perspective of a transformed conscious mode or physical state, multiple realities. The immersive time-space

merges with what is perceived as "external". The perceptual differences between the sensorial transformations caused by the fluid (or different) environment and reality are blurred.[42]

These notions relate to the idea of absorption as described by Ruth Herbert:

> Absorbing experiences commonly occur when individuals feel focused, balanced or pleasantly dreamy. Episodes demonstrate a preoccupation with/immersion in sensation, and alterations of consciousness are noticed retrospectively (Herbert 2011: 100).

In this quote, absorption is described as an immersive process within a mode of awareness, and not as a mode of dissociation. Immersion, in this case, functions as a form of engagement. In relation to everyday music listening, Herbert describes the "multimodal" nature of experiences of absorption:

> Although everyday absorbed trancing may be strongly emotionally arousing and intense, more common is a low arousal type of experience that is commonly multimodal in nature: where the listener engages spontaneously in a performative blending together of sights, sounds and activities. This confirms that the use of music in contexts where attention is divided in between various activities or stimuli is not *necessarily* superficial: descriptions of music in such scenarios as functioning as 'sonic wallpaper' that is 'barely perceived' (North et al., 2004), may simply be missing the point that music has the capacity to become one of several impacts that, when combined, yield experiences that are potentially richly involving (Herbert 2011: 105-106).

When translated into a composer's practice, the previous arguments offer an immersive perspective towards composition: when taking into consideration all the aspects of the performance context, then the creative focus moves not only towards the aesthetic object but instead mainly towards the relations between the aesthetic proposal and its context. This suggests that an immersive approach would be a method of composing according to these relations. From this perspective, the aesthetic object loses its main role, and it both works as a part of and furthers the immersive experience.

As already mentioned in Chapter 2 (page 66), Herbert describes absorption and dissociation as being self-regulatory processes that serve as resting and recovery mechanisms. However, through music, these mechanisms are more evident in dissociation. "Dissociative trancing via music emerges as a common but acknowledged strategy with which to deal with the vicissitudes of everyday life (…)" (Herbert 2011: 106). Dissociation can also occur in engagement. When special attention is given to music listening, it can induce a dissociative mode. This also occurs in virtual realities that approach immersion as a self-contained space. In both cases, in engaged or passive listening, dissociation implies a

[42] The painting "Der Jungbrunnen" (cover) by the Serbian painter Goran Djurović is related to this argument. The human figures in the painting are partly submersed. They are able to observe the substance from an external position while they are simultaneously immersed in it. I also perceive this as the ability to observe oneself through a transformed state.

detachment or a distancing from the environment. For this reason, absorption, despite being also considered a rest mechanism, and commonly associated with dissociation, is a term that better relates to my approach to immersion as a multilayered experience.

However, from a composer's perspective, it is important to relocate these notions, associated to everydayness, into a special context. Absorption and dissociation in the context of everydayness can be related to the idea of "falling" as formulated by Martin Heidegger. Richard Polt describes "falling" as follows:

> Falling is the movement or direction of everyday Being-in-the-world. Everyday Dasein exists as a they-self, and is wrapped up in what it is doing, which it understands in a superficial and conventional manner (Polt 1999: 75).

According to Polt, for Heidegger, "(...) falling is a permanent tendency in the human condition" (Polt 1999: 76). In this way, falling describes a tendency towards habits. The everyday experiences described by Ruth Herbert occur within a realm of normality and they can be associated to a sense of falling.[43] These kinds of everyday immersions do not necessarily cause a consequential effect. The special attention demanded in artistic contexts contrasts with these habitual events, mainly because of the audience's conscious decision to attend an artistic event. This decision implies that the audience willingly gives a more exclusive attention towards the artistic form presented. This exclusive attention may result in a less multilayered experience than in an everyday situation mediated by music. Moreover, special attention itself does not guarantee that the artistic event will produce a more aware or open immersive experience. The initial special connotation that one gives to an artistic space, despite the common conventional usage of these spaces, serves as a point of departure for approaching composition in relation to the diverse layers that build up the performance experience. This approach points towards a questioning of the habitual automatisms of the creative process and of the conventions of performance contexts.

The photic zone acts as a metaphor of a special environment that is not perceived as separated from other layers of reality. From this perspective, *Eufótica* intends to keep the special connotation of a concert context, while blurring the conventions that generally would make one perceive the musical experience as separated from that which surrounds it.

3.2.2 Underwater sound perception

By describing the differences between sound localization in air and sound localization underwater, I intend to present the context that gave form to the ideas in *Eufótica.* Reflecting on how these ideas influenced the way the composition operates, was the departure point for developing the arguments discussed in this chapter.

Sound localization in air occurs due to the interaction between the sound wave produced by a source and the auditory apparatus and the head. Differences of phase and intensity of a sound wave provides information for the localization of a sound source:

[43] "Realm of normality" refers to our everyday context in which we have various kinds of experiences that we consider as normal or habitual.

> Directional perception of sound in air is based on the utilization of phase (time-of-arrival) and/or intensity information provided by the arriving signal to the auditory mechanism. For the low frequencies, time differences appear to be the most important and the arrival of sound at one ear (versus its arrival at the opposite ear) can vary up to 0.6-0.7 msec. At higher frequencies the head creates a shadow effect which in turn produces a marked difference in intensity between the two ears (Hollien 1973: 1288).[44]

The intensity differences are referred to as ILDs (interaural level differences). The phase differences are referred as IPD (interaural phase difference) (Middlebrooks and Green 1991: 140). As mentioned above, each of these mechanisms correspond to the perception of high and low frequencies. This differentiation describes a dual theory:

> The notion that spatial information is derived from at high frequencies from ILDs and at low frequencies from IPDs is often referred to as the duplex theory of sound localization (Middlebrooks and Green 1991: 140).

As I will explain later, the duplex theory relates to how humans listen underwater. The acoustic properties of water are different than that of air. The ability to locate sound sources is reduced underwater. The faster speed of sound and the similarity between the impedance of the skull and the surrounding water substantially reduces the shadow effect experienced in air.

> First, sound velocity is greater in water than it is in air by a factor of from 4 to 5 (depending on salinity, temperature, etc.). Because of this many fold increase in the speed of sound, the difference in time of an arriving signal between the two ears would be correspondingly diminished, thus potentially eliminating or severely reducing directional perception.
>
> Another factor which also operates to reduce underwater sound localization is related to the intensity differential (shadow effect) that permits the auditory processing in air of the directionality of higher frequency signals. Briefly, this effect is present in air because of the mechanical impedance of the head, i.e., normally the impedance mismatch between air and solids (such as the head) is sufficiently great so that the head constitutes an effective acoustic barrier. This relationship does not hold in water as the impedance of the head is similar to that of the fluid. Therefore, sounds virtually go through the skull, reducing by a substantial magnitude (or eliminating altogether) the shadowing effect and its concomitant intensity differential. Such a situation further reduces man's potential ability to localize sounds underwater (Hollien 1973: 1288).

In this quote, the phenomenon known as bone-conduction is described ("sounds virtually go through the skull"). The sound travels through the skull reaching the cochlea (Hollien 1973: 1289), and is later on processed in the brain as usual. As sounds underwater are perceived through bone-conduction, depth changes do not attenuate humans' ability to listen

[44] Dr Harry Hollien is professor of linguistics, speech and criminal justice at University of Florida. He is responsible for various articles on human sound localization underwater.

underwater (Ridgway et al. 2001: 3829). As a result, one might deduce that since the sounds have to pass through the body to reach the auditory system, that which is perceived is a more involved listening experience. "Sound in water can propagate relatively freely through the human body, as the acoustic properties of human tissue and water are similar" (Anthony, Wright and Evans 2009: iii). In air, bone-conduction does not appear to have much effect in sound localization, while underwater, bone-conduction is one of the main mechanisms of sound localization. This appears to be one of the main differences between air and underwater listening.

Investigations on diver sound localization prove that tympanic conduction also participates in underwater listening and localization.

> Although underwater hearing is not fully understood, the likely explanation is that both bone conduction and tympanic sound conduction produce hearing underwater, the so-called dual path theory. At low frequencies tympanic conduction appears to predominate and this may explain why sound localization is more acute at these frequencies. At high frequencies, bone conduction is considered to be the dominant factor (Anthony, Wright and Evans 2009: 7).

This quote implies that the correspondence between underwater bone conduction and the perception of high frequencies can be associated to the ILDs of air listening. Bone-conduction (corresponding to ILD) and tympanic conduction (corresponding to IPD) create a dual mechanism of sound localization underwater that resembles the duplex theory as it happens in surface conditions.[45] The quote also indicates that there exists an essential difference between land and underwater localization. On land, it is easier to localize higher frequencies, and underwater, lower frequencies. Sounds in air from 250 Hz downwards lose their directional quality as they propagate almost equally in every direction around the sound source. Sounds around 1000 Hz and higher have a better directivity.

Despite one's reduced ability to localize sounds underwater, studies on the ability of divers to localize sounds indicate that localization underwater is possible under determined conditions.

> Recent experiments have shown that auditory localization cues are sufficient to allow relatively precise sound localization under water. Moreover, it has been demonstrated that under controlled conditions divers are able to localize and navigate to sound beacons (Hollien and Hicks 1983). This research and practical experience have shown that not every diver is able to localize and navigate to sound beacons under all conditions. In general, successful sound localization and navigation depend on clearly audible pulsed signals of short duration that have frequency components below 1500 Hz and above 35,000 Hz and are pulsed with a fast rise/decay time (National Oceanic and Atmospheric Administration NOAA 1991: 60).

[45] "Surface conditions" refer to sensory conditions in air, as it is presented in the *NOAA Diving Manual: Diving for Science and Technology*. Throughout the text, I will address air sensory conditions as "surface conditions".

As described above, specific frequency ranges and duration (short attacks) aid in achieving sound localization. Through using "clearly audible", the authors emphasize the importance of sound intensity in sound localization underwater. The ear's sensitivity to pressure changes is highly reduced underwater. In order to hear sonic stimuli underwater, they have to be louder. The quote below clearly describes this phenomenon:

> The human ear is an extremely sensitive pressure detector in air, but it is less efficient in water. A sound must therefore be more intense in water (+ 20 dB to 60 dB, SPL [sound pressure level]) to be heard. Hearing under water is very similar to trying to hear with a conductive hearing loss under surface conditions: a smaller shift in pressure is required to hear sounds at the extreme high and low frequencies, because the ear is not as sensitive at these frequencies (National Oceanic and Atmospheric Administration NOAA 1991: 60).

The need for a stronger intensity shows how the density of our body is an obstacle for the sound wave to reach our ear. This also emphasizes the notion that humans listen to sound also through their skin and body. As a consequence, underwater listening can be understood as an embodied and resonant experience.

3.2.3 Why underwater?

Sounds in the environment (surface conditions) place us in reference to diverse and distant sound sources. Particular localizations clash with all-involving immersive notions discussed in the previous chapters. When we listen to a sound at a distance coming from our right side it is not perceived as coming from everywhere despite the multiple sound reflections with all of their involving sound waves that produce this particular localization. The source does not need to be at our right side for the sound to be perceived as coming from our right. A reflection can be perceived as the original. In any case, the identified distance and position in space achieved through localization create a particular event that can be related to a sense of separation similar to the visual process.

Sound localization, when observed as a practical everyday feature, exposes immersive notions of listening as being more theoretical than experiential. Observing the psychological and practical contexts in which listeners localize everyday sounds, makes us readers perceive some of the philosophical and phenomenological immersive ideas connected to listening as mere idealizations. Environmental sounds reveal a multiplicity of distances and surrounding forms. These sounds define the reference position of the listener. Sounds are identified as coming from somewhere, even if the distance recognized is perceived as "here". "I can perceive a distance but that is a heard distance. The distance is what I hear here, not over-there" (Voegelin 2010: 4). Voegelin describes a phenomenology of listening but does not relate it to the functional attitude with which listeners may deal with the perceived distance.

The previous paragraphs only refer to an specific and practical approach towards sound localization. The localized sounds or sources will always also reflect an *aural architecture.* In the book *Spaces Speak, Are You Listening?* Barry Blesser and Linda-Ruth Salter explore auditory spatial awareness. For the authors "...*aural architecture* refers to the properties of

a space that can be experienced by listening" (Blesser and Salter 2009: 5). According to the authors, the perception of aural architecture produces diverse emotional and behavioral responses.

> Listeners react both to sound sources and spatial acoustics because each is an aural stimulus with social, cultural, and personal meaning. […] Depending on the physical design and the cultural context, aural architecture can stimulate anxiety, tranquility, socialization, isolation, frustration, fear, boredom, aesthetic pleasure, and so on (Blesser and Salter 2009: 11).

The quote above describes the mediating effect of space on psychological and physical experiences. It also implies that personal histories in relation to spaces conditions one's experiences. For example, a reverberant space could give a peaceful feeling for some while others get wary. People connect their sonic environment to their past experiences. It is not possible to create a generalized cultural context, such as in this example, since every case is conditioned by countless differences. The relevant issue is that space always mediates aural experiences. The authors approach their research on aural architecture in a similar manner to Herbert's (2011) study of the mediating effects of music in everyday life situations. The main difference between these two studies is that Blesser and Salter's book is developed making a meta-analysis of existing literature, while Ruth Herbert empirically develops her study using experiential feedback from interviews with diverse people who describe their daily experiences with music. In Blesser and Salter's case, the focus is more towards the effects of the cultural context and space itself, while in Herbert the focus is more on the psychological effects on the listeners. For a composer, it is easier to develop an argument in relation to the physical and cultural context than to the particularities of the psychology of the listener as in Herbert's study. The physical context is an integral part of the feedback loop of the compositional/performative process. However, it is important to consider both approaches as complementary. As mentioned in the quote above, "the listeners' context" is created not only by space, but also through social, cultural and personal aspects. As a consequence, I consider it important to focus on "the listeners' context", with all of the implications of the musical performance space, which in many cases condition the aesthetic experience by its traditional characteristics and conventions. These conventions create a context which listeners approach through many automatic and habitual behaviors.

Although there is always a spatial context in which the sound events are perceived, there are countless situations in which people only react to stimuli in a functional manner. For example, when I hear my mobile phone ringing on my living room table, I just go and pick it up. Space has aided me in recognizing the specific cue. Space has a functional role, as it does in many cases. This acquired behavioral pragmatism resembles many other everyday life automatic behaviors (as in the "pragmatics of the mirror" mentioned in Chapter 1). When a listener localizes a sound, he also perceives the surrounding space. That is considered normal. The source and the receiver are always projected into an acoustic context. However, this phenomenon does not imply a sense of spatial conscious awareness. This pragmatic behavior also relates to how people might perceive a performance space. Generally, people go to a concert to "see" the music, and the acoustic space is simply there,

already available. Music does not necessarily produce a conscious spatial awareness despite the music being mediated through it.

What happens when listening does not reflect an aural architecture? As just mentioned, under surface conditions (in this case I am not considering the use of headphones or other external listening apparatuses) sounds generally seem to come from "somewhere", and reveal a surrounding architecture. Sounds might appear as a reflection, or they can be directly identified as connected to a specific source. As described in the previous subchapter, this does not occur so simply underwater. Generally, sounds underwater are hard to localize, and they appear as a resonance through the head.

> For example, Bauer and Torick (1965) suggest that when an individual is submerged: "Sounds appear to arrive from nowhere. The location of a friend or foe becomes a matter of dangerous conjecture and reverberant sounds mix with direct sound into an unintelligible jumble." At that time, this observation seemed confirmed by de Haan (1956), Dudok van Heel (1962) and others (Hollien 1973: 1288).

Harry Hollien describes a generalized notion of sound localization ("sounds appear to come from nowhere"). This generalization can be related to the description of an aural experience underwater of any inexperienced diver. More recent investigations on divers' sound localization describe that regular training improves their sound localization abilities (Shupak et al. 2005: 130). This provides evidence that without training one would generally experience sound localization underwater in a more blurry way, connected to Hollien's experiential generalization.

Under surface conditions, people generally feel comfortably oriented by the sonic environment. When submerged underwater this comfort disappears. Where is the "nowhere" mentioned by the divers? The theories on bone-conduction refer to a mediation of the body. This suggests that the initial source of audibility is one's vibrating body. The mechanoreceptors that allow listening on surface conditions also vibrate inside the human body, but the perceived spatial sensation allows the listeners to develop a sense of distance from the sources and space. Underwater, the fluid environment and the human body resonate through sound without this sense of distance. This can be seen as a synthesis of the body with its fluid environment. With no clear spatial references, the listeners' embodiment stretches out into the surrounding media (water). Through underwater listening, the human body resonates with a sort of vibratory spatial infinity.

In this underwater context, the ontological and phenomenological ideas derived from listening and immersion have a more empirical basis than on surface conditions. The involving density and the reduced perception of spatial referents eliminate the perceived distance between objects and blur the perception of a spatial self-reference.

There are incongruities between surface and underwater sound perception. The general localization correspondence between sight and hearing that someone develops on the surface is transformed underwater. The underwater incongruity creates a perceptual space in between what divers perceive as virtual and real. The multiplicity of worlds is experienced from the perceptual incongruities.

In virtual realities (in gaming or any sort of digital emulation of physical spaces), visual events and sounds are designed correspondingly to surface sensory characteristics. This aims at perceiving the new reality as real. Audio-visual correspondence is generally used to aid full immersion (as a fully self-contained reality). Familiar sensory conditions aid in creating a virtual space that is easy to navigate. Finnish acoustics researchers Matti Gröhn, Tapio Lokki and Tapio Takala (2003) studied the differences in navigating a virtual environment when following sonic, visual or audio-visual cues to find given gates.

> A navigation test was carried out in a spatially immersive virtual environment. The test was a game-like experience where [the] task of subjects was to find as many gates as possible while they navigated through a track guided by auditory and/or visual cues of the gates. The results are presented as a function of the number of found gates, searching times, and normalized path lengths. Audio-visual navigation was clearly the most efficient. Visual navigation was the second, and the auditory navigation the least efficient. Further analysis of travel paths indicates that auditory [cues were] utilized in the beginning to locate the next gate, and visual [cues were] the most important in the final approach to the gate. [abstract] (Gröhn, Lokki and Takala 2003: 200).

The audio-visual cues create a more organic reality where two kinds of sensory stimuli respond to each other to outline the virtual space. Audio-visual cues offer more possibilities for localization. The sequential order of the cues as described above (first auditory then visual) can be associated to real localization events. Sound is perceived in every direction while vision is only perceived frontally. It is common to hear stimuli behind or beside ourselves before looking at that which is heard. The sound source can be hidden from vision in many ways. Sound attracts the attention and vision finally captures the object in a specific point. A visual encounter can also precede the sound event associated to the object. However, in this case sound is not necessary to localize the object seen, and it can be deduced from the experiment above that the visual cues give less opportunity to localize diverse objects. Sound aids in bringing attention to the unseen.

These characteristics derived from a simulated reality describe an aural pragmatism which relates to how people perceive sounds in everyday reality. Underwater sound perception clashes with this certainty. Aural pragmatism implies a more objective and practical relation to the sounds heard. Introjected aural behaviors are perceived within a sense of everydayness. The underwater localization incongruities emphasize the sensorial experience and move the listener away from these behavioral automatisms. As a consequence, the perception of sound underwater refers to a transformed reality and not to a simulation of it.

Another aspect of being underwater that is unrelated to the sonic experience is the impossibility of staying underwater. The necessity to breathe represents moments of self awareness and moments of spatial awareness of the reality outside musical time and space. Breathing implies a relationship with the external environment, which betrays the notion of a fully-immersive environment as it happens in an emulated reality. Breathing, represented in a musical context, demands a presence of openings or windows from which listeners

should be able to observe and perceive that which seems to be "outside of music". However, the musical context always mediates the way in which they look out. In this sense, the openings do not separate the listener from the musical context. Breathing has to be understood as a perceptual shift within an experience. The experience of an act of "breathing" in any musical context can just simply occur. However, the idea of breathing has persuaded me to experiment with the relations of the musical time-space with that which surrounds it. Despite being aware that breathing as a conscious process might occur naturally, I intentionally explore the musical elements that might affect these sorts of experiences to transform the way that listeners perceive conventional musical contexts. The following subchapters will describe musical processes that will demonstrate this exploration.

3.3 Compositional processes: transmutation of underwater notions

3.3.1 Thinking of spatiality without a physical source

In *Eufótica*, I developed the sonic spatial design having as reference the characteristics of sound perception underwater as previously described. I also intended to think of sound as water currents. These currents should be imagined as flows of movement through the area of the audience. The starting point for designing the sound movement should not be the sound source but the spatial sound paths themselves. As a result, my idea was to approach the musical design from the diverse positions of the listeners. I wanted to create sonic movements swirling through small areas of the audience. The main question was how I can make sound seem to make a circling movement on a specific area within the audience space or even around one person? For instance, how to create the sound of a fly circling around the head of one listener, using the resources available for me in this performance? I initially thought of more mechanical solutions which were somehow unpractical, like players moving around in between the audience or using a complex system of rails in the ceiling with hanging speakers moving from place to place. I finally did not use these solutions either.

A possible solution (but also not very practical considering that *Eufótica* is only for six musicians) could have been to create a setting similar to the one of Iannis Xenakis' *Terretektorh* (1965/1966). This piece is written for an orchestra of 88 musicians forming six concentric circles in between the audience (Figure 2).

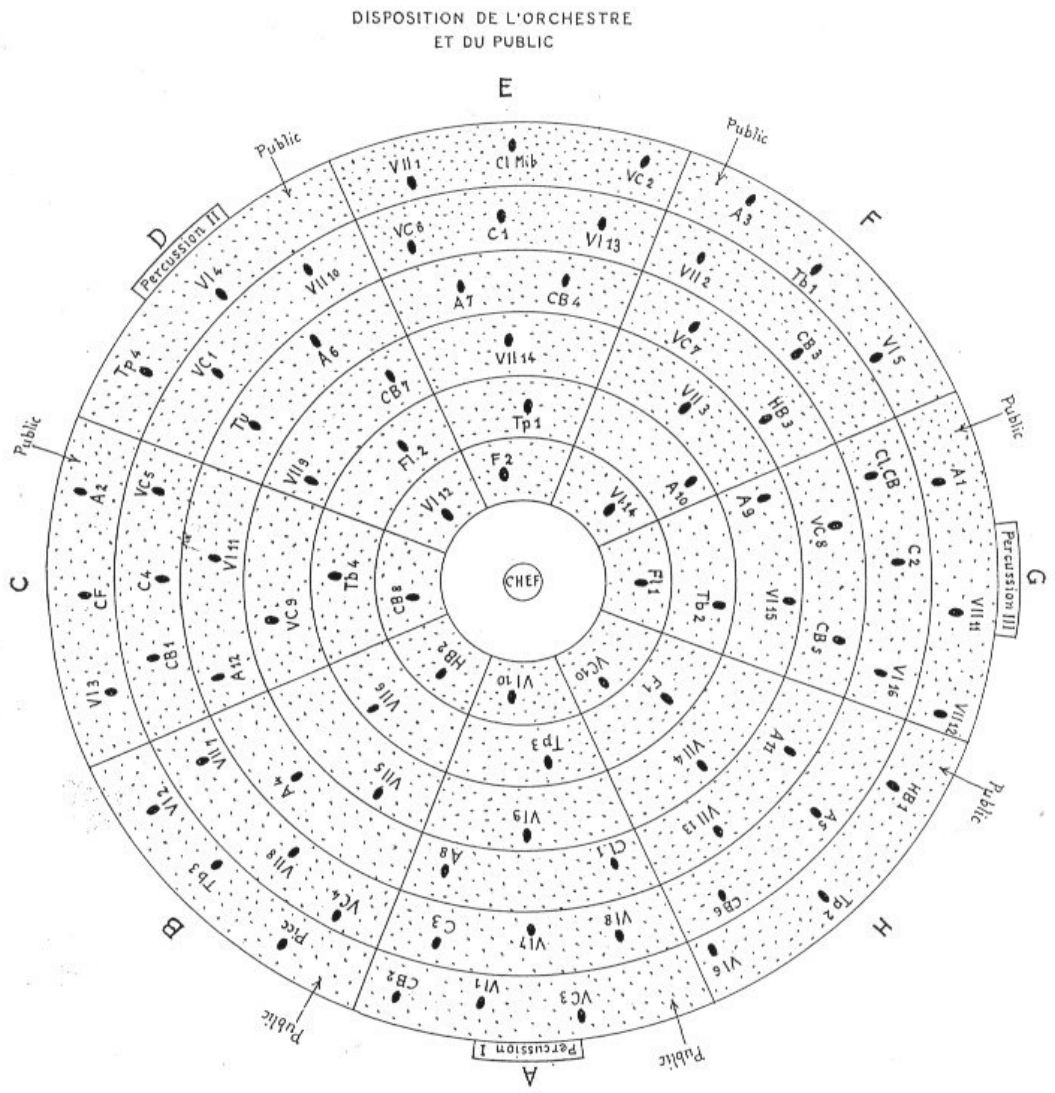

Figure 2 Disposition of Iannis Xenakis' *Terretektorh.*

In this context, Xenakis experiments with multiple rotations, sound fields and textures that blend with the listeners' positions. The musicologist Boris Hofmann describes the relations between the performers and audience of *Terretektorh* as follows:

> The former relationship stage-audience has been eliminated in favour of a new placement of the musicians and spectators who in fact merge with each other. So the recipient does not receive a form of presentation from one single point anymore but is simply present together with a large group of musicians who occupy the whole space. Ideally each listener is placed isolated from the other and at a special place inside the orchestra, so he indeed perceives a very special sound image, which differs from that of any other listener. This is in fact a very democratic opinion of musical presentation (Hofmann 2005: 2).

It is easy to imagine in this setting how these aural experiences (as explained in the quote above) are spatially perceived in each position. A sound line can be getting closer, further away or passing in between different listeners simultaneously; an area of the audience can be filled with loud sound while another area is in silence, the listeners from this area perceiving the sound from a distance. These sonic images are directly related to the spatial experience of the listener and they also can reveal the intention and approach of the composer.

> In the program notes he [Xenakis] speaks of certain experiences or impressions of nature […]: "the listener [...] will find himself either perched on top of a mountain in the middle of a storm [...] or in a frail barque tossing on the open sea". […] For Xenakis, it is obviously important to make the whole space of performance sound and to give the listener a direct experience of this (Hoffman 2005: 3).

These impressions could be interpreted as Xenakis' intentions of creating an immersive experience. At the same time, this piece is conceived as an open work for the audience. In the quote above, Xenakis shows his awareness of the variety of experiences that listeners will have according to their position in the hall. As a consequence, the spatial nature of *Terretektorh* can be understood as a blending of openness and immersion. For Xenakis, this experiential approach (immersive and open) is clearly a concern, and it is reflected not only in the spatial disposition of the work but also in the material and musical processes of the piece.

In *Eufótica*, I wanted to experiment with similar issues. However, unlike in *Terretektorh* I imagined sound movements through the audience without having the sound sources as reference. How can sound move around and through the audience without performers or speakers in between the audience? How does an open and immersive concern affect the musical processes similar to that of *Terretektorh*?

Sound cannot be easily controlled to make sudden turns and swirls through the air, and it is difficult to control where and how it bounces. For this reason, my solution without using sound sources in between the members of the audience (which I will describe in the section below), is an abstract interpretation of the problem developed through compositional processes. The next sub-chapters also intend to answer the questions mentioned above.

3.3.2 Designing spatiality from a virtual perspective

The map below shows the setup of the piece as it appears in *Eufótica*'s score (see Figure 3). The position of players and speakers is defined on the map. The grey background map is from the hall where the piece was going to be premiered. I composed the piece specifically referencing that location. The text in the lower part of the figure describes the setup specifications.

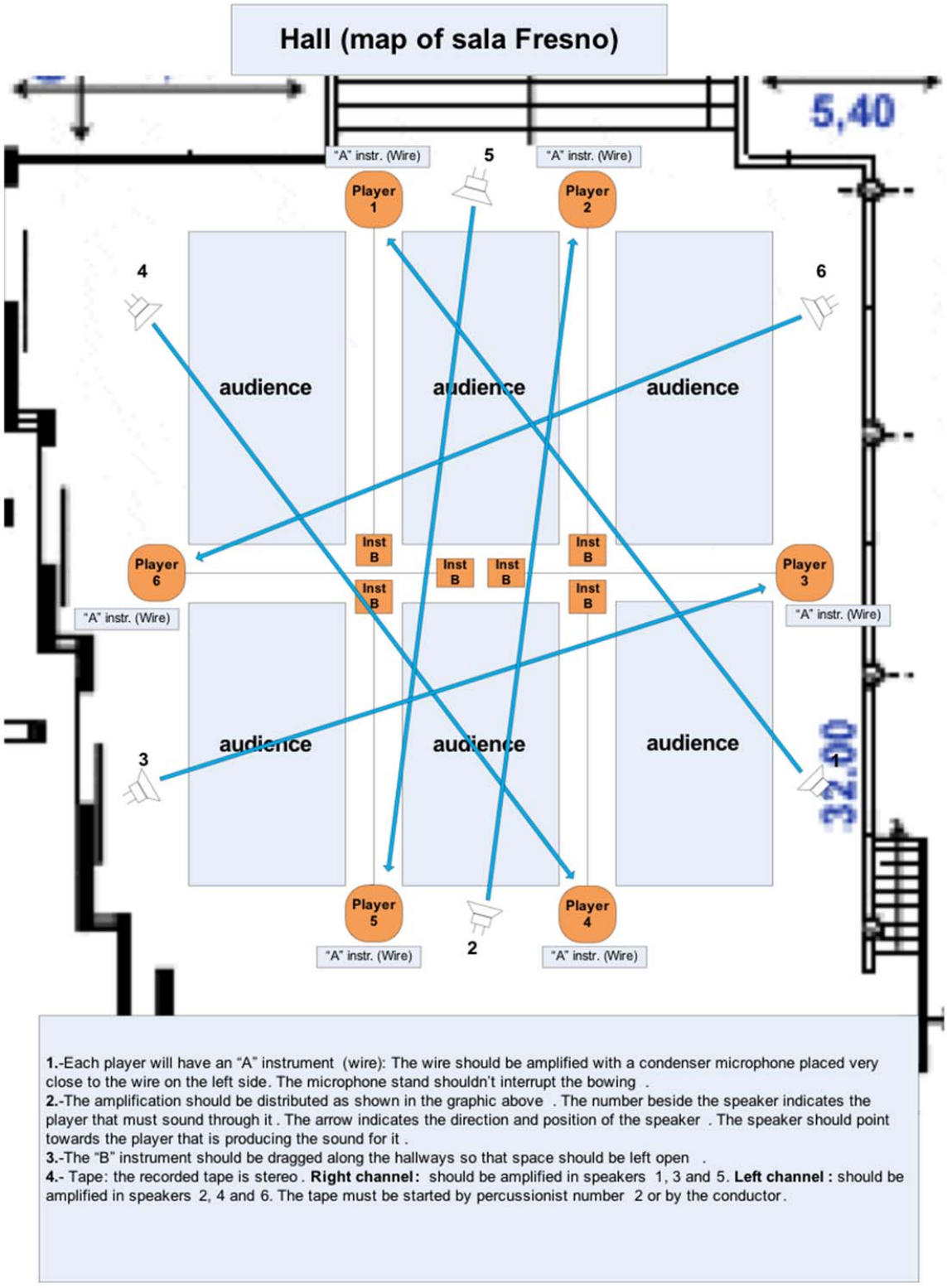

Figure 3 *Eufótica's* disposition and specifications.

The arrows indicate the orientation of the loudspeakers. The loudspeakers are located across the hall pointing towards their respective performers. Each loudspeaker points towards the performer who produces the sound for it. This crossed setup is used to produce a separation between the visual and sonic gestures, creating two gestural layers. To understand this, it is important to have in mind that the acoustic dynamic level of the instrument is almost imperceptible, and the speakers close to each performer produce the amplified sound of other performers much further away in the hall. The homogenous gestural quality of the piece creates the illusion that sounds could have been performed by a specific player but the visual gestures do not match with the sounds perceived. This is an effect that is related to perception of sound underwater, where the position of the sound source is more difficult to identify.

In addition to the intention of creating a spatial sound design, the loudspeaker setup creates a visual effect that aims at blurring the correspondence between visual movement and sound. The physical movements do not correspond to the place where the amplified sound gestures come from. In the figure above, the performer's number corresponds to the number of the speaker that amplifies him/her. As earlier mentioned, each loudspeaker is placed across the hall pointing towards the player that produces the sound. Listeners receive the amplified sound of a different player from the one seen in front of them. The incongruity between the visual and the aural confronts the listener with a blurring of the listener-source correspondence. On the other hand, seeing the correspondence between sound and object allows people to perceive their actual spatial disposition. When someone can associate a sound to a visual gesture, he/she is able to recognize the source and its sound as an external separated object. By breaking this correspondence, sound is released from its visual phenomenological objectivity. In *Eufótica*, the visual movements of the players create a space where the listeners can associate the sounding environment to a kind of physicality, but not to a specific correspondence. In this way, the listeners are confronted with a situation where their habitual manner of perceiving is distorted.

It is important to consider that the non-correspondence between the seen and the heard runs the risk of being perceived as unnatural. The conventional correspondence between the seen and the heard is more habitual, and as a consequence it offers an experience which occurs from a comfortable state. In relation to this problem, Ezequiel Menalled (Argentinean composer and conductor of the Dutch ensemble Modelo62) describes the setup of *Eufótica* as interfering with his intuition:

> The first time that I heard *Eufótica* [Menalled conducted *Eufótica* in a different venue on a different occasion, MC], in Studio Loos, I was not sure whether the non-correspondence between the position of the loudspeakers and the performers was a good decision. However, I do not have a clear way of justifying this doubt. I felt a lack of naturalness in the audio-visual non-correspondence. It was an intuitive sensation. I was not able to contextualize the audio-visual effect in the sonic frame of the piece. Now I think that if the instruments are not conventional, why should the way to amplify them be conventional? However, this is a rational way of justifying

> the use of your spatial setup. In any case, the transformation of the habitual context captured my attention.[46]

In this statement I discover the conflict that rises between introjected perceptual behaviors and the perceptual incongruities of the spatial proposal. The uncomfortable feeling that Menalled experienced is related to his inability of being fully immersed in sound due to these incongruities. This also suggests that he was unable to dissociate his mental awareness from the experience. The incongruities seemed to make him too aware of his unconscious heuristic processes in a way that bothered him. However, as he stated in the last sentence, he still acknowledges his change of habit and transformation of the conventional context. This reveals that the immersion that he experienced was not into a habitual musical state, but into an immersion that relates to the context of the whole situation.

The visual correspondence between sound and physical movement also defines a spatial boundary. Sounds are identified as coming from specific sources in spite of the multiple directions from which their reflections may come. [47] Generally, an audio-visual correspondence is perceived as a certainty and offers a position of comfort from which someone is able to focus on sound. On the other hand, if the visual and the aural do not correspond, the listener experiences a spatial concern and a phenomenological illusion. The listener thus constantly poses the question "Where is this sound coming from?" The virtual and the physical borders blur into a confusing experience. This question relates to the perceptual differences of underwater listening from normal on the surface listening. This relates to Hollien's quote mentioned earlier:

> For example, Bauer and Torick *(1965)* suggest that when an individual is submerged: "Sounds appear to arrive from nowhere. The location of a friend or foe becomes a matter of dangerous conjecture and reverberant sounds mix with direct sound into an unintelligible jumble (Hollien 1973: 1288).

Where is "nowhere" if one is listening to sounds? The experience of sound always occurs in someone's body. However, the inability to locate sounds when there are visual elements as possible sound sources creates a spatial concern in the listener and a sense of vulnerability. If there are no physical visual gestures associated to the sounds, as in a loudspeaker installation where the audience is aware of the characteristics of this context, the listener naturally accepts the sounding experience as a virtual proposal that does not need to relate to the physical world around it. In this way, the listeners experience sound without needing to perceive themselves as part of the surrounding physical space. As listeners are prepared to be immersed in a self-contained sonic environment, they do not feel the need to focus on their surrounding physical space. In this case, immersion occurs as a more virtual and individual experience.

[46] Personal interview with Ezequiel Menalled on May 16, 2014.
[47] This argument can be related to the Ventriloquist effect (described in Chapter 1).

3.3.2.1 Imaginary circular currents

Immersion through music does not need to be approached as a simulation of reality. In *Eufótica* I did not intend to simulate underwater sonic conditions. The circular currents reveal a compositional process that uses as its material real physical phenomena to design an imaginary space that is transformed in its projection towards the physical reality. The hall and the nature of sound underwater are the initial physical referents to develop this process. These physical referents are used to compose an imaginary space that resembles the physical reality. The final sonic outcome works as a new level of transformation of the imaginary space into the physical reality. The immersive characteristics of the original material are not used in order to create a simulation of sensory conditions but to create an artistic outcome which interrelates physical reality, virtuality, and aesthetic aspects.

To design my idea of currents, I imagine that the arrows on the map (Figure 3) actually represent a laser-like projection of sound without spreading out to a wider area. This is not how it physically occurs. However, through the composition I approached frequencies with reference to the duplex model of perception in air for higher and lower frequencies mentioned earlier. Higher frequencies have a higher degree of directionality that makes it easier to localize the sound source. The directionality of sound decreases gradually as frequencies become lower. For the lowest range of perceivable frequencies, sounds are perceived as coming from all directions, or as vibrations within someone's body.

As a consequence, I mostly use high frequencies to represent lines, and lower frequencies to open another layer of space. For instance, if a high frequency points towards a certain position in space, I imagine that the sound is being produced in that specific position. In other words, if the sound is pointed towards one listener I imagine that the sound is produced exactly where this listener is, not in position of the real source. If the frequency in this position gets lower, I imagine that the sound's initial position spreads out to occupy a larger area. In this imaginary setup, high frequencies work as a narrow spotlight that illuminates only the space of one person whereas as the frequencies go lower the spotlight starts to spread out, gradually revealing the space around the initial position. In the physical reality, frequency directionality works in a similar way. However in this case I propose that these phenomena occur at a distance from the real sound source, which is actually impossible. This reveals that I used the notion of frequency directionality mainly to develop my compositional ideas. I was aware that my spatial imaginations were not going to occur exactly as described.

In spite of having a higher directionality, the higher frequencies produce patterns that aurally do not correspond with the rotations designed on the map. I associate this non-correspondence with underwater sound perception. In underwater localization of sound, the perception of high frequencies is associated with bone conductivity; as a result it is more difficult to localize sounds underwater. Because of this, I imagine that the members of the audience, despite their correct physical localization of the perceived sounds, do not recognize the imaginary positions that I mapped out as correct. The correct positions belong to an imaginary space that exists within the musical process as I will describe below.

To design a swirling movement within specific areas of the audience (imaginary space), I first drew a circle over the map (see Figure 4 below). Then I connected the intersections of the loudspeakers' trajectories with the circumference of the circle and finally with straight lines forming a cyclic polygon. Then I put the angles of the polygon into alphabetical order. The length of each line of the polygon corresponds to a specific length of time. This length of time is also imaginary, as the imagined speed of sound is considerably slower than the actual speed of sound (on the map, centimeters are equivalent to seconds). As a final step in designing the circles, I used a rotation that circumambulates all the lines of the polygon starting from point A and returning to A (seen in Figure 4). Each circle is used only once in the composition.

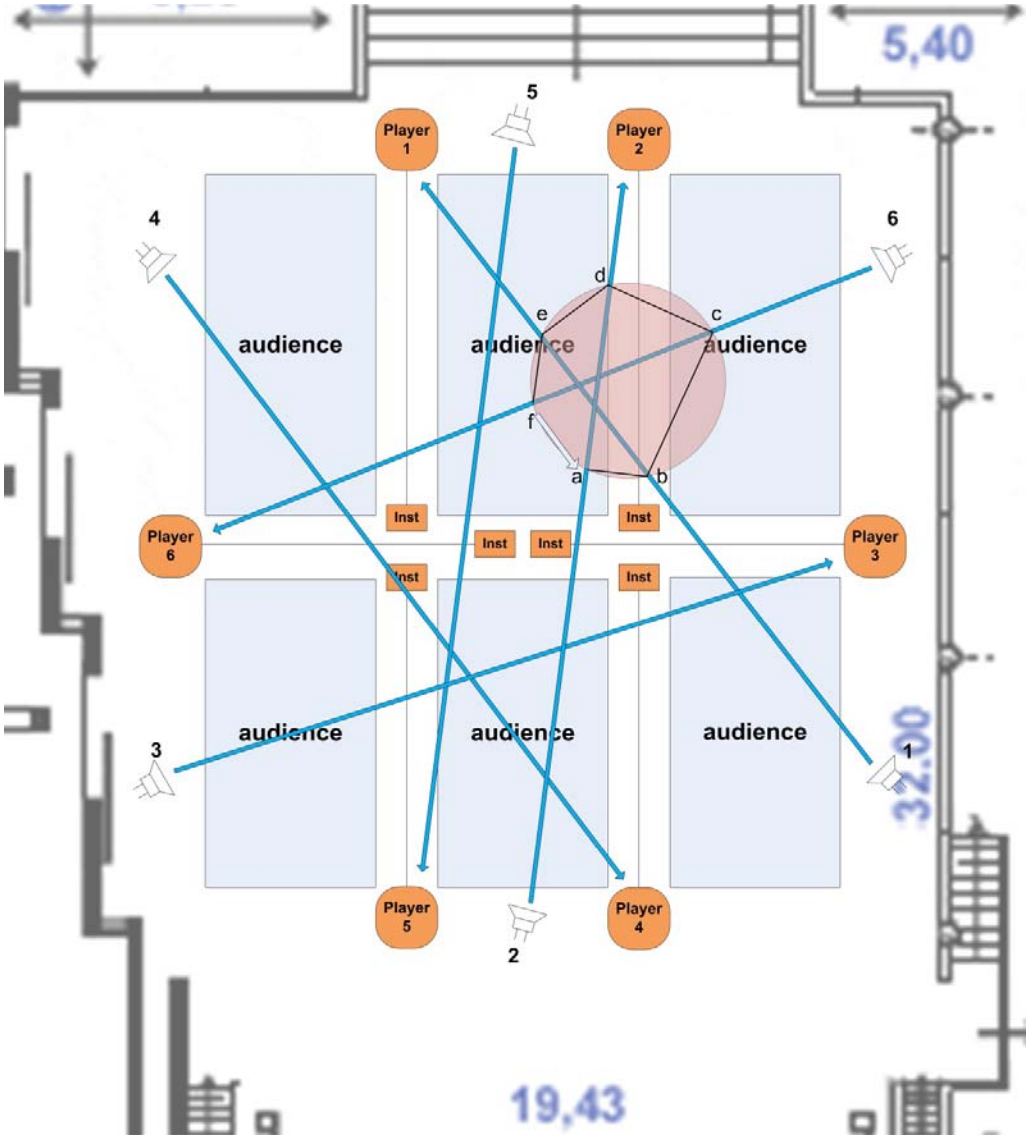

Figure 4 Circle 1 (Polygon rotation).

Each loudspeaker is activated by its corresponding crossing point in the circle, and the sound cross-fades towards the beginning of the next letter. Each angle vertex of the polygon is marked by an accent. The polygon rotation seen in figure 5 below represents the real projection of the rhythmic, spatial and dynamic changes over time.

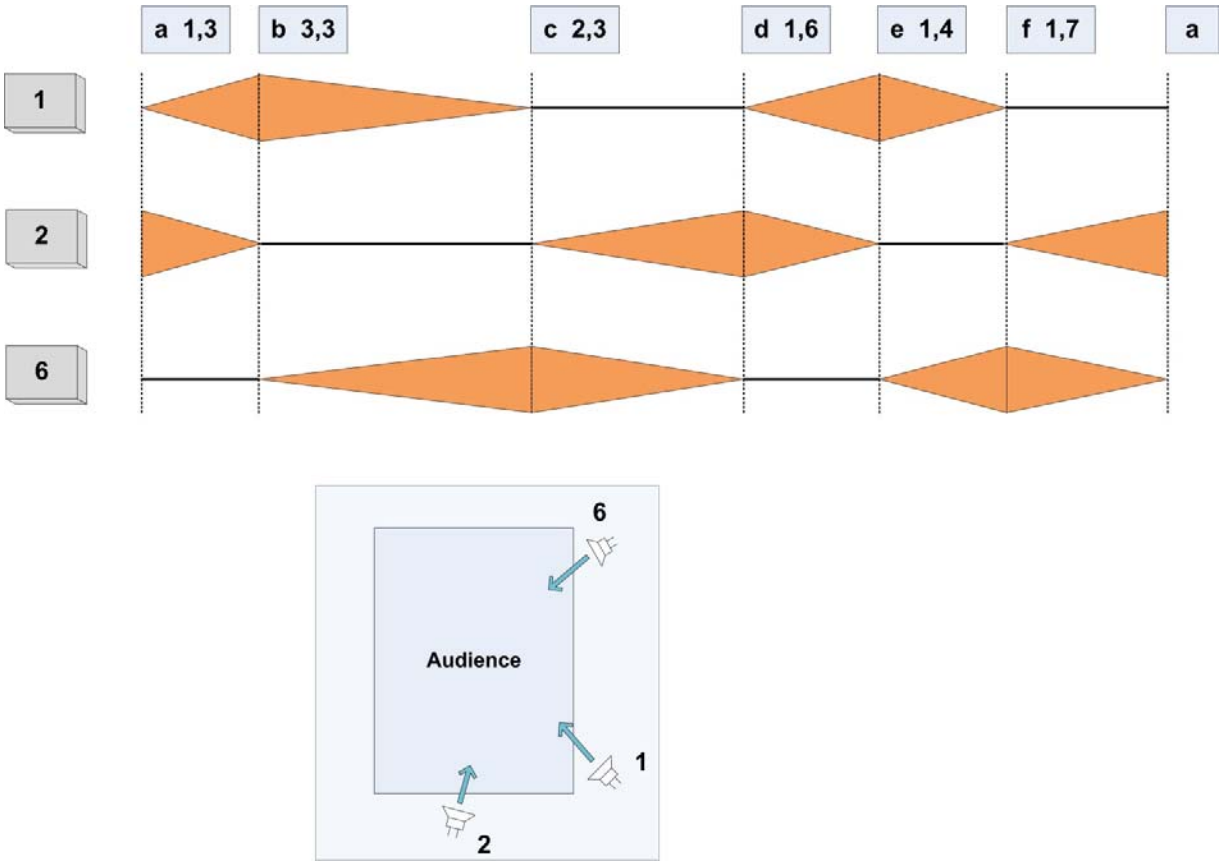

Figure 5 Rhythmic, dynamic and spatial pattern derived from Circle 1.

The figure above shows a transformed rhythmic pattern that I consider to be an external projection of the proposed inner figure (circle). The rotation of the circle as seen in the map in figure 4 is not physically perceived. The real sonic outcome is the irregular rhythmic pattern that occurs between speakers 1, 2 and 6 (red arrows in Figure 6).

Figure 6 Speakers participating in the rotation of Circle 1.

This reveals that the actual movement of sound does not resemble the rotation that is represented in the circle on the map. The real sounds are actually a transformed rhythmic projection of the mapped rotation (imaginary space). The resulting rhythmic patterns and the real physical movement of sound are accidentally derived from the composing process. This reveals that the spatialization is not designed by using the sound sources as a

reference but from an imaginary space where the rotations are supposed to occur. I idealize that the projected rhythmic patterns transport the listeners into the imaginary space, with them taking an active role in externally projecting the sounds into their own physical area, although this will be difficult to prove. The aspect of the compositional process that interests me most is the inverted logic (the departure from an imaginary space rather than from the real sound sources) that gives form to the spatialization. In *Persephassa* and *Terretektorh* of Xenakis, the spatial design is more traditionally constructed departing from the actual sound sources. In both of Xenakis' pieces the rotations are actually perceived. From Xenakis' perspective the spatial design is directed "towards" the audience, while in *Eufótica* it is directed towards the sound sources.

In any case, the listeners perceive sounds as coming from the sound sources (musicians and speakers). This argument might lead to the conclusion that my proposals are just idealizations or an excuse to develop musical processes. However, the visual non-correspondence between the seen and the heard, described earlier, aids in blurring the perception of the real sonic spatialization. This creates a spatial uncertainty that allows the listener to diversify their spatial sensations. Considering how people perceive visual illusions like the "ventriloquist effect" suggests that the audience might relocate the perceived sounds according to what they see. In this way, it is possible to propose that in *Eufótica,* three spatial layers coexist: an imaginary spatialization related to the processes designed on the map, a real spatialization related to the projection of sound departing from the sound sources, and an illusory spatialization that results from the visual-aural incongruities. The combination of these three layers offers a different perceptual space that can be related to the special and different conditions of sound perception underwater, despite the spatial characteristics of the piece not producing an exact simulation of underwater aural conditions.

Further on in the piece, I repeated the circular rotation (described above), relocating the circle within the audience twenty three times. Each circle produces a different rhythmic and spatial pattern of different durations. Throughout this section, the circles appear in sequence but they overlap their endings and beginnings. The complete path of the circles is shown in Figure 7. The large dark arrow shows the overall direction of the path. The small white arrows indicate the initial direction of each circle's rotation. The green circle is the first rotation, and the red circle in the center of the audience's area is the last one. The path shows a resulting G shape.

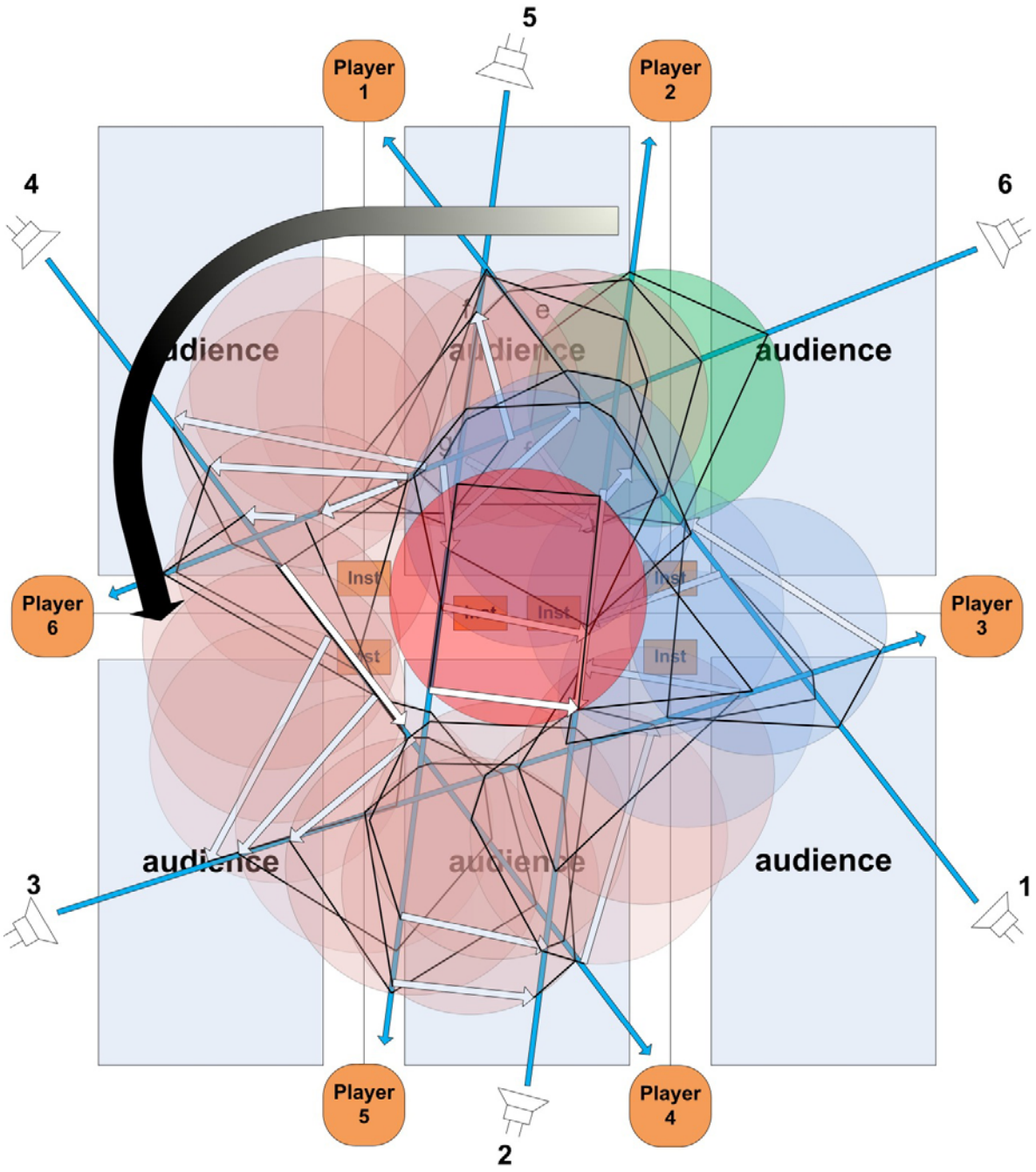

Figure 7 Rotation path of the 23 Circles.

The larger circular path of the circles through the audience does not represent the actual spatial patterns that are heard. As mentioned before, each circle projects a different rhythmic and spatial pattern similar to the one seen in figure 5. As a result, the overall path of the circles is also not perceived as a spatial rotation. The circular path of the circles works as an imaginary process.

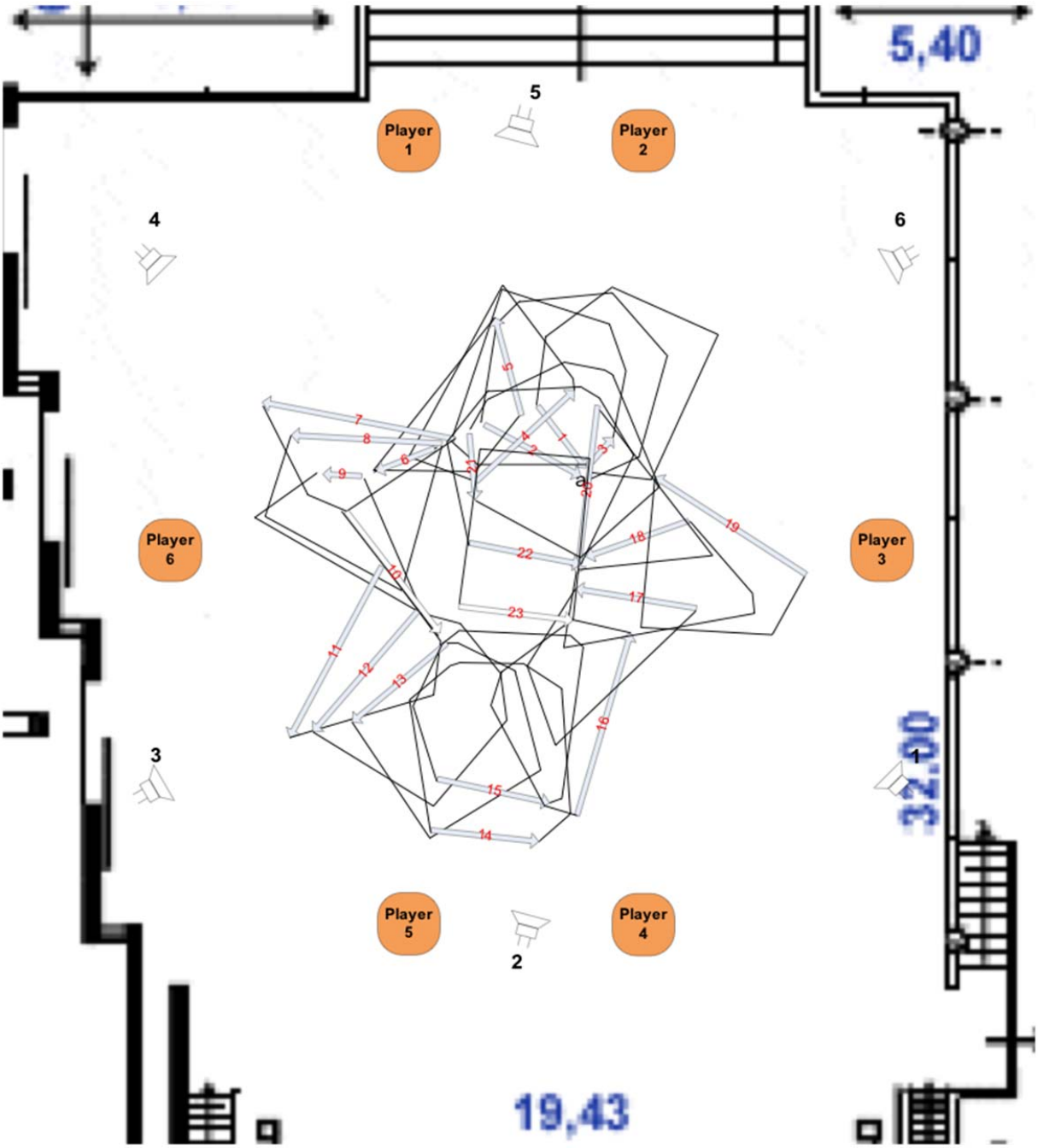

Figure 8 Overlapped polygons resulting from the 23 Circles.

As mentioned before, the aspect of *Eufótica* that interests me most is the projection of a spatial design that departs from the audience's perspective. The figure above represents the composition of the spatial design and an imaginary movement of sound within the audience. This representation also relates to the localization of sounds underwater. As described earlier, perception of sound underwater is mediated by one's flesh and bones. This makes the listener to perceive sound as coming from, and happening within himself (earlier

mentioned as "from nowhere"). From this perspective, I imagine that the resulting sonic spatialization, derived from the imaginary circles, is perceived as a projection of oneself into an externalized sonic image. Sounds underwater can be perceived as an unintelligible jumble, and as a result the sources do not clearly reveal their positions in space. This notion is mainly represented in the imaginary space of the composition. Therefore, the non-obvious relation between the musical process and the resulting actual spatialization represents the underwater jumble. Despite the fact that the sounds in *Eufótica* are perceived from specific points in space, the idea of externalization is mainly intended to produce a sense of resonance between the audience and space. The actual spatialization results from a process that is designed beginning from this intention.

Further on in the composition, when the last circle (23rd) of the first cycle of rotations reaches the center of the audience, the circumference starts to increase in size with each successive rotation of the subsequent five full rotations (second cycle of rotations, from the 24th to the 28th circle). From this point onwards, the rhythmic patterns start to slow down as the lines of the polygons get longer. From the 26th circle (3rd in the second cycle) all speakers participate in a single rotation pattern for the first time. This increase in size intends to transform and enhance the external focus of the listener. The imaginary spatial growth aims at expanding the spatial perception. Through the use of the term expansion, I imply that as the circle increases in size and reaches further out, the audience's spatial awareness corresponds to this expansion. This expansion occurs within the imaginary characteristics of the composition. The slowing down of the movements of sound in space also has a real spatial transformation that affects the listeners' spatial perception (explained in the paragraph below). This process again reveals that the processes of the piece belonging to the imaginary space are translated differently into the physical reality.

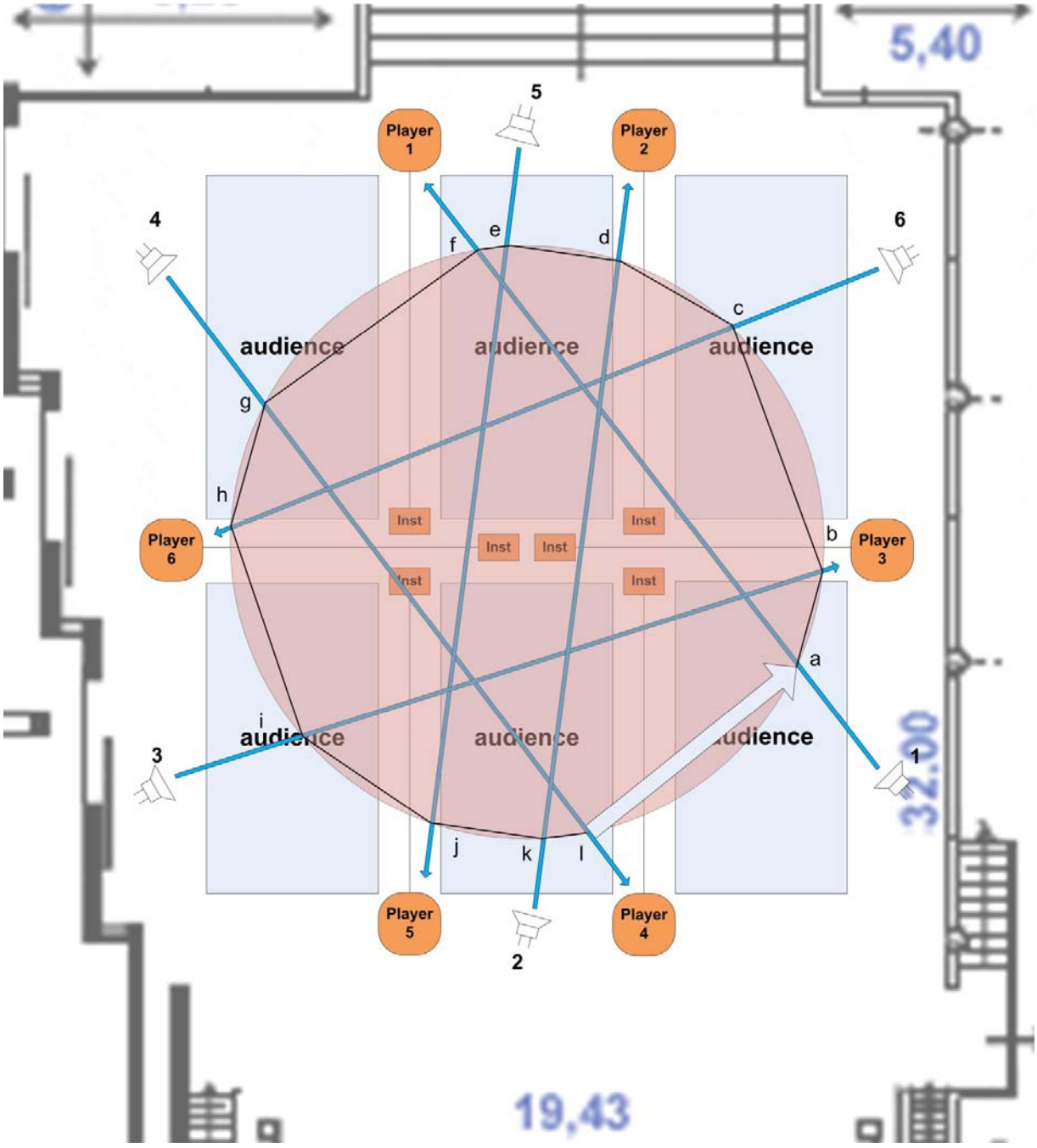

Figure 9 Circle 28: last circle.

As seen in the last circle (Figure 9) all loudspeakers participate twice in the full rotation (both in correspondence with the placement of the sound source on the circle and its respective player). This creates for the first time a progressive pattern between speakers. This pattern intends to persuade the listeners into focusing more on the space that surrounds them. The definition of an external pattern induces the listeners to recognize characteristics that belong to the sound sources. For this reason, in this moment I imagine

the listeners to perceive the sound sources as being something external to themselves for the first time in the piece (rather than the sounds locating themselves within the listener as earlier experienced). The previous smaller circles are heard more as fragmented spatial patterns that are associated with particular imaginary spatial areas. The gradual growth of the central circle (through the imaginary process) intends to make the listeners gradually perceive the sound as opening outwards. As the circle gradually grows, more speakers participate in the combined rhythmic pattern. As a consequence, there is a spatial effect in the sonic reality. As the imaginary circles get closer to the speakers, a real physical sonic surrounding occurs. This does not mean that an actual rotation is heard, but as all the speakers are constantly sounding the listeners are able to feel themselves completely surrounded by sound.

During the final circle, the electronic tape part fades in and overlaps with the last played gestures of the circle. At this point, the performers start playing crotales with a bow producing high long notes. These sounds are not amplified, so in this part the physical gestures correspond with the sonic outcome. This correspondence brings back a more conventional visual relation to the sound source. Nevertheless, the overlapped electronic sounds are not related to any of the visual events, so an extra layer of experience is added to the aural-visual comfort produced by the performers. When the electronic tape part begins, lower frequencies and louder sounds appear simultaneously from all the speakers. These sonic characteristics relate to sounds that are better localized underwater. Once again I overlap the imaginary world with the real. In this case, I overlap the imaginary underwater world, where the low frequencies are better localized, with the real surface world, where the low frequencies are harder to localize. These two worlds can be thought of as a coexisting entity where localizations occur not just "there" but also "here". From this perspective, this section of the piece represents the moment when the audience is ready to listen to themselves as being both inside and outside.

In this way, the incongruities between the imaginary and physical events, as described earlier in this chapter, work as a reflection of a resonant listening experience of the world. Listening is not an act of localizing a sound nor perceiving its separation and distance from the source. As Jean-Luc Nancy states:

> To listen is to enter that spatiality by which, at the same time, I am penetrated, for it opens up in me as well as around me, and from me as well as towards me: it opens me inside me as well as outside, and it is through such a double, quadruple, or sextuple opening that a "self" can take place (Nancy 2007: 14).

The audio/visual incongruities of *Eufótica* intend to dismantle introjected listening behaviors and to approach through experience a sense of listening like the one Nancy describes.

3.4 Openness and the impossibility of precision.

In the previous chapter, I described how in *La linea desde el Centro* the timbral reference to a guitar tradition was blurred by the use of scordaturas and continuous sound textures. In the process of composing and listening to the piece, the guitars changed their traditional

role; the new sound context gradually moved my attention away from my referential expectations. I stopped listening to the guitars as guitars. The twelve guitars offered far more and diverse sonic opportunities than what I initially had imagined. I also perceived a sensational effect by acknowledging the difference between the instruments and the new overall sonic result.

The visual and physical presence of guitars invites listeners to make referential associations. In *Eufótica,* I intended to avoid this kind of referential associations by working directly with an invented instrument: a bowed metallic wire. I tied a metallic wire between two legs of a chair and started playing it with a contrabass bow. This instrument can still be related to a bowed string instrument, but this new wire-instrument has no technological sophistications. The chair is the resonance box and the tension of the wire is randomly adjusted. The wire is fixed on one leg of the chair, and on the other leg the tension can be changed by pushing a ring knot up and down. The hand grasping the ring knot always has to hold it in order to keep the tension of the wire (as seen in figure 1 at the beginning of the chapter). These qualities make it very difficult to control the pitch and the precisely indicated timbral variations. The instrument can be perceived as a physical object that produces a homogeneous metallic sound color. These characteristics can easily create a sound texture where the listening emphasis is not placed on the instrument itself but on the gestural movement of sound.

To describe this sonic nature of the instrument, I imagine a hand drawing figures in the water. The overall path of the figure can be recognized, but the contours cannot remain well defined. This analogy also refers to the conflict that appears between the well-defined musical gestures, which are precisely written in the score, and the impossibility of controlling the resulting details. Every performance of the piece presents uncontrollable timbral variations.

These characteristics correspond with those of mobile works. In the case of *Eufótica,* the resulting openness is not reflected in structural possibilities, but in the variability of sonic results that occur due to the impossibility of precision. In John Cage's words, it is a composition "which is indeterminate with respect to performance" (Cage 1999: 35) as opposed to indetermination with respect to composition. Cage refers to pieces in which material or form are clearly determined on the score, but that reveal unknown variants and indeterminate elements throughout their performance. The indeterminate nature of *Eufótica*, its impossibility of precision, contributes to Cage's argument.

To contextualize the similarities and differences between my approach and the sense of indeterminacy that Cage talks about, I compare *Eufótica* with Brian Ferneyhough's solo flute work *Cassandra's Dream Song* (1970/71). *Cassandra's Dream Song* is a mobile work that was long considered to be impossible to perform due to its instrumental complexity. Nowadays it is not considered impossible anymore as modern flute technique has developed. Nevertheless, I have chosen this piece to contextualize my argument because the issues that arose from its early performances triggered my concern on instrumental complexity and impossibility. Furthermore, I chose this work because it combines two sorts of open approaches. The first one is a more traditional approach towards an open work related to structural mobility, which is acknowledged by the performers as an active

element of the work. The second approach is related to the passages that are (almost) impossible to perform, which I consider to be the musical fragments that can incite the player to have a performative open attitude. In this second case, the indeterminate mechanism is not communicated to the performers in advance but revealed and perceived through the performance.

In *Cassandra's Dream Song*, the score is composed of two big sheets. The first one presents six sequences to be read in the given order. The second sheet presents five interpolations that are to be played in any order. On the instructions page of the score appears only "These may be played in any order". The use of "may" is supposed to be giving a free choice, but this also gives the possibility to the performer to fix the piece and read the piece always in the same order. The second sheet is the one that may give mobility to the resulting form in an open way. However, there is still a chronological order to the six sequences on page one (intercalating with an open use of the sequences on the second sheet), which will always begin and end the piece. In this work, there is a very limited range of choices. These limitations impose a manner of approaching a relative freedom. This imposition will always reflect a diversity that still maintains the structural balance that the composer is aiming for. For Cage, this kind of mobility also corresponds to indeterminacy with respect to performance. However, for me it is important to differentiate between structural indeterminacy in which performers acknowledge and consciously play with the indeterminate elements, and compositions in which indeterminacy is not revealed in the score but in and through the performance. This is also the case with *Eufótica*.

A composed control over open proposals is also clear in Lutoslawski's aleatoric fragments where there are always clear instructions on how to interpret the material given. The sonic results of these fragments always have a clear musical effect in relation to the macro-form. At the same time, the musical fragments that are produced through aleatory processes resemble musical passages that are not mobile. In Lutoslawski's open fragments, such as the ones appearing in *Livre* for orchestra or his *String Quartet 1964,* there are no liberties in influencing the formal narrative of the piece.

In Ferneyhough's *Cassandra's Dream Song* there is a narrative dialogue between controlled chronology and aleatoric ordering of interpolations. As a result, there is a narrative openness and a counterpoint between the linear fragments and the interpolations. The chronological fragments of *Cassandra's Dream Song* show a clear directional path like driving on a highway to a known destination. This directionality maintains the piece on a safe track of certainty. The interpolations are like a way of stopping and getting off the highway to explore or to buy some food before getting back to the already expected track. The performer also knows at which stops to get off. He/she only has to decide their order. The path and direction which have to be taken are clear. These dialoguing attitudes are not even an obligation, as the performers are instructed that they "may" play the interpolations in any given order. The instructions do not necessarily induce the performer to have an open attitude.

The performance of this piece can also be influenced by taking into consideration the literary elements that the composer had as a reference. The story can be deduced by the structure of the piece and by relating the title to the possible literary references. The title refers to

the Greek myth of Cassandra. The piece represents the conflict between Apollo and Cassandra. Apollo was infatuated with the beauty of Cassandra, and he promised her that if she gave him her love he would grant her the ability to see the future. Cassandra agreed that she would and Apollo granted her this power, but she did not keep her word. In punishment, Apollo cursed her by making no one believe her prophecies. The flute player Andrew Darlison describes his interpretation of Cassandra's story in the program notes.

> The battle between the oppressed Cassandra (represented by the powerful linear drone of page one) can be violent and aggressive but this tension is at the root of Ferneyhough's composing technique. One pole sets up the system for the generation of structure. The other pole 'cheats', disobeys the system (Darlison 2014: n.p.).

Darlison clearly relates the extra-musical literary elements to the performance practice of the piece. I question whether it should be an obligation for the performer to research literary elements that are not obviously referred to in the score to know how to perform the piece. As Darlison relates to the story, he connects the attitude of the practice with the literary elements and their meanings:

> The struggle both technically and emotionally is intense throughout the piece. This represents Cassandra's attempts to speak once again with her own voice. The piece draws energy from the struggle of the performer to come to terms with the technical demands of the piece. It contains sections which the composer himself admits are 'not literally realisable'. It is a work that moves away from perceived notions of speech resemblance in music and threatens even to replace the gesture as the critical structural element, the gestural object itself threatens to break up, being replaced with a shimmering web of energy exchange (Darlison 2014: n.p.).

It seems clear that Darlison was able to elaborate this experiential description after studying the myth and the literary references made by the composer. As he specifies in the program notes, the quote above relates to a scene of the novel *Cassandra* by Christa Wolf. This further demonstrates the importance of the literary elements for the performance practice of Ferneyhough's composition. Was it necessary for Darlison to do this research? Is it an obligation of the performer to do all of this to relate to the performance attitude that the composer expects? Or, does the performer discover this attitude by solving the problems of the score itself? It is difficult to know what the composer actually expects just by reading the instructions in the score. There are literary references made by the composer in interviews and articles that seem totally necessary to understand the meaning of the proposal, and probably some of the flute players who have performed it know of these references. This extra information might be something that is already a tradition in the performance of this piece as it is an archetypal piece of complex music. For the performers to achieve an open attitude in the performance practice of this piece, it seems necessary to be aware of these extra-musical elements. However, the score's formal and structural aspects on their own do not necessarily make the player relate to it in an open manner.

In the score, Ferneyhough does not explain clearly what he expects from the mobile structure, but he describes clearly, in his section "remarks" on the instructions page, how to approach the technical difficulty of certain passages:

> The piece as it stands is, therefore, not intended to be the plan of an 'ideal' performance. The notation does not represent the result required: it is the attempt to realize the written specifications in practice which is designed to produce the desired (but unnotatable) sound-quality.
>
> A 'beautiful', cultivated performance is not to be aimed at: some of the combinations of actions specified are in any case either not literally realizable (certain dynamic groupings) or else lead to complex, partly unpredictable results. Nevertheless, a valid realization will only result from a rigorous attempt to reproduce as many of the textural details as possible: such divergences and 'impurities' as then follow from the natural limitations of the instrument itself may be taken to be the intentions of the composer. No attempt should be made to conceal the difficulty of the music by resorting to compromises and inexactitudes designed to achieve a more 'polished' result. On the contrary, the audible (and visual) degree of difficulty is to be drawn as an integral structural element into the fabric of the composition itself (Ferneyhough 1975: n.p.)

These remarks specify the attitude needed when confronted with the addressed technical difficulties. After reading these comments, the performer's confrontation with the "pseudo-impossible" passages invites performers to discover the sonic results for themselves. In this case, performers are oriented to think that the sonic result is not an exact representation of what appears in the score. Through the instructions and complex passages, Ferneyhough intentionally directs the attention of the performer towards the non-correspondence between score and action (sonic result). Of course, this non-correspondence is common to all musical scores; there is always a friction between the visually imprint (the score) and the actual sonic outcome. However, Ferneyhough's score presents for me substantial differences with other kind of scores. The physical impossibility of the complex passages increase the perceived difference between what the performer can visually imagine and the sounds produced. As a consequence, the discovery of sound belongs to their personal ability to solve these passages. Also, the material in *Cassandra's Dream Song* invites performers to accept the possibility that the technical difficulties can lead to new results in each performance. This acceptance is related to the diversity of the sonic results, and not to a sort of laziness that might be caused due to the performers' awareness of its impossibility. Ferneyhough specifies that "a valid realization will only result from a rigorous attempt to reproduce as many of the textural details as possible".

The persuasion towards an open attitude is discovered by experiencing the behavior of the material, and not in understanding its structural logic. In this way, I perceive that the "pseudo-impossibilities" of *Cassandra's Dream Song* are what make it an open work, as they induce the performers to have an open attitude and to complete these fragments with their own solutions. On the other hand, in the free ordering of the five interpolations, the perception of openness is more restricted, as it only offers a narrative freedom, which could even be fixed. There are 120 possible permutations of these 5 units. This means that a performer can play the piece in a 120 different orders. This known number of performances is a clear frame.

When the flutists practice the passages that are almost impossible to perform they are able to perceive the differences between the music that appears in the score and the music that they are actually producing. The contrast between the fixed characteristics of the score and the differences of the sonic outcome also reveals the unique result of each performance. This makes the sonic result something of its own which is only suggested by the score, but somehow physically unlinked to it. There is an allowed imprecision framed by a clear gestural intention. This may produce a considerable amount of variations in the details of the sonic result.

The remarks on *Cassandra's Dream Song* are written as instructions. They are not suggestions. In that sense, it teaches the performer the correct attitude to have, which in practice is reflected in the open results. *Eufótica* does not include written comments on how the performer should deal with the score and its sonic result. As a comparison, in Ferneyhough's score, his comments prepare the performers to have a specific attitude. They already know that these fragments have a degree of openness. As a result, the performers discover the sonic outcome knowing that there is something uncertain. This works as a limitation for having an open aural experience through discovery. In *Eufótica,* the lack of instructional information allows the performers to directly experience the variability of the instrument through its performance.

Ferneyhough's instructions inform the performer that openness is part of the work. The openness is contained in the frame of the score. By acknowledging this, the performers can stand at a distance from the structural and sonic result. Their sense of collaboration is acknowledged, but at the same time, it allows them to approach the score comfortably as they are clearly informed of how to deal with this. This could be considered as a convention in western practice, as performers are used to follow instructions as they appear in the score. *Eufótica* describes an openness that refers to an aural discovery in which there is no separation of the work from the actions of the performer. The conventional elements of the score absorb the performer's attention as a point of focus. These elements allow them to listen to the new versions of *Eufótica* as both external sounds and as a reflection of themselves simultaneously. For Jean-Luc Nancy this is one of the characteristics that describes the phenomenon of listening:

> To sound is to vibrate in itself or by itself: it is not only, for the sonorous body, to emit a sound, but it is also to stretch out, to carry itself and be resolved into vibrations that both return it to itself and place it outside of itself (Nancy 2007: 8).

Nancy refers to this phenomenon as a rebound that describes an ontological condition. This condition is exposed in *Eufótica* due to the separation of the sonic outcome from the objective aspects of the score. This exposition appears in conflict with the introjected performative behaviors of the performers. By being aware of their resonance with the environment, performers get into contact with an unknown mode of being that differs from their more habitual and self-referential experiences.

In the process of rehearsal of *Eufótica,* some performers became frustrated through the process of learning how to play the instrument. What occurs is a frustration with the unknown. It is generally more common for musicians to use their acquired tools of

knowledge to perform the proposals of a particular musical piece. In the case of *Eufótica,* they are confronted with uncertainty. This uncertainty makes each performer at a certain point to accept the way in which they play the instrument. The openness occurs through a process of accepting how one performs the instrument. This event can be related to the sense of incompleteness of open and mobile works. However, the score asks for very specific musical figures, and as a consequence in the initial approach towards the score, the performers just try to perform what is written. The openness is not visible nor explained. The incompleteness relies on the clumsy mechanism of the instrument, and the completion is reflected in the diverse and unique ways in which each of the performers confront their instrumental limitations. The personalities of the performers are exposed in this process.

The score presents itself as a conventional object that contrasts with the impossibility of being precise. This contrast works as a limitation for the performers to achieve a habitual immersive mode related to their everyday practice. In the process of learning how to play the instrument, the performers develop a sense of self-awareness that is not necessarily comfortable. However, the aspect that interests me most is that through this process they are induced to achieve a special attention towards the sonic outcome.

When performers are informed about the necessity of being open, they are able to prepare their attitude more objectively. In the case of the mobile aspects of Ferneyhough's piece, they are prepared to take random decisions. Therefore, what the performers and the listeners perceive is not necessarily open. What *Eufótica* suggests is that an "open attitude" can be triggered by the appearance of unknown elements. This directly connects to notions on immersion that describe that objectivity and critical awareness are replaced by the perception of the experience itself. The openness of *Eufótica* appears through experience and not as a presentation of the work itself as open. This sense of openness can be associated to diving experiences. During diving experiences the perceptual differences appear only gradually through experience. These differences do not present themselves in advance, explaining how to approach the new environment. The perception and understanding of the new environment gradually unfolds.