

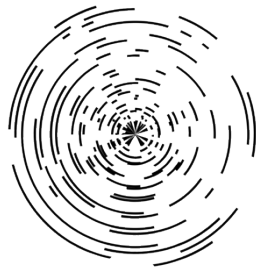
Rhythmanalysis:

an expressive method for environment/aesthetics relationship

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Introduction

Just before the dawn of the 21st century, Henri Lefebvre envisioned an act that sought to analyse the world as a moving complexity. Originating from Pinhero dos Santos' *phenomenology of rhythm* and its revision by Gaston Bachelard (1950), Lefebvre's *Rhythmanalysis* aspired to transform the abstract concept of rhythm into a method. By conceiving rhythm as interactions between places, time and expenditures of energy, Lefebvre invoked the subject as the sculptor of rhythmicity and the axis of its study. Upon this conception, he proposed a method which through the study of rhythm would reveal the relationships that compose the world. Rhythmanalysis, by studying periodic temporalities through subjective prisms, carries the vision to allow its practitioners *to listen to a town or a street, in the same way as an audience listens to a symphony* (Lefebvre, 2004).

The evolution of music, that marked the last half of the previous century, already indicated the environment not only as a source of musical inspiration, but also as a source of musical material. Nowadays, in contemporary music, the environment is frequently considered as a vessel for the expression of the musician. Despite the valuable contribution of this tendency to musical practice, in most of the available examples the musical utility of the environment is restricted to its materiality. Along these lines, Lefebvre's vision may be able to reveal an alternative path towards environment oriented music.

With the publication "Elements of Rhythmanalysis" (1992), Lefebvre proposed the capture, analysis and representation of perceptible motion, through the analysis and representation of the motion perception process by an individual. His theory uses the subjectively gained empiricism as interpretation axis. The following thesis, progressing on the same axis, hypothesises that the application of Rhythmanalysis on the musical domain would contribute a counter-proposal to established practices of environment oriented music. The discussing method does not aim to be restricted to the expression of an observed environment, but aspires to express the way that an individual is affected by the process of observation. The present study carries the ambition to form a methodology, able to express sonically the intersection between the subject and the environment.

The following thesis aims to cover the trajectory followed over the course of a two-year study that was carried in-between Rhythmanalysis and music. By following a path from abstract theories to a concrete methodology, this study begins with the syllogisms motivating investigation. The first section presents the reasoning that

pointed the interest towards Rhythmanalysis. However, this part does not aim to constitute a philosophical enquiry or an aesthetic proposition. Subsequently, Lefebvre's conception and its prospects are examined. The technical experimentations and developments that raised through Lefebvre's ideas and accompany the present study, are discussed in the third chapter. This thesis concludes with compositional experiments, integral to this period of investigations.

The following pages aspire to study whether Rhythmanalysis, when applied to the intersection between the subject and the environment, is able to reveal a source of musicality.

Aesthetics and musical communication

1.1 Music as a form of communication

Despite various attempts to delimit a form by which sound should be organised in order to be perceived as music, the act itself still remains undefined. Adorno's aesthetics theory already suggests that all pure creative processes evade definition while their concept is located in a historically changing constellation of elements (Adorno 1997, pp.3-4). A historical analysis on those elements would also be inadequate to conclude a definition due to rapid and continuous evolution that characterises sound organisation. Alternatively, an analysis of the laws of movement based on the elements that are excluded from that process could lead to useful findings. This approach has been used in a variety of theoretical frameworks aspiring to generalised definitions of music. But even those frameworks, cannot be proven diachronically. Hegel's triune analysis on music, despite its historical importance, is incapable of describing contemporary musical forms. The triptych melody-harmony-rhythm seems inadequate for modern sound organisation and ignores foundational elements of contemporary music, such as timbre and spatiality (Houlgate, 2016). Adorno's theory, which applies a method of historical analysis via exclusion to music, seems outdated when it refers to pieces that do not obey binary divisions of genres. The early work of R.M.Schafer (1969) already tried to summarise the need for new music—which was on the rise in the last century—that should be liberated from its former definitions. Incorporating the perspective of John Cage and his reference to H.D. Thoreau, Schafer was expressing the urgency of formulating new, abstract definitions. More recent approaches, like those formulated by Kivy (2012) are narrowly occupied with analysing individual elements without concluding in findings that can be perceived as general comprehensive definitions. The historical continuity of the above contemplations may have been proved insufficient to formulate a framework by which a specific organization of sound concludes to perceived music. However, they have contributed valuable theoretical tools for understanding music's social impact. A comparison of these ideas could provide a toolbox for formulating generalised principles—which are rarely useful in the field of music—aiming at investigating not the act itself, but music as a social product.

Comparisons between different perspectives in the philosophy of music may reveal contradictions. Although these contradictions are usually predominant, the similarities that can be found are of foundational nature. The application of a deductive syllogism based on these correlations may reveal common presupposed frameworks that characterise most of these ideas. Both Hegel's expression of the

ideal and Adorno's autonomic music refer to the semantics values in music. Contemporary music analysis, as described in the collection of essays "The Language of Electroacoustic Music" by Emmerson (Emmerson, 1986, pp.17-39) employs terms borrowed from linguistics to serve its purpose. Terms such as *grammar* and *syntax* are widely used for modern music analysis. Furthermore, even in the discipline of cognitive science, most recent studies also tend to find correlations between music and language; both in utility and perception. Aniruddh Patel states indicatively:

The comparative study of music and language is drawing an increasingly amount of research interest and like language, music, is a human universal involving perceptually discrete elements organised into hierarchically structured sequences.
(Patel, 2003, pp.674-675)

The interdisciplinary correlations between music and language, as the philosophical investigations on music semantics document *music, as a form of communication*.

Schafer's work constitutes a substantial contribution to the establishment of music as a form of expression without getting obstructed by previous comprehensive definitions. This also provided the groundwork for Barry Truax's later work (1986) that negotiated music as a form of communication; but this time characterised by specificity. In his approach, music is presented as a way of exchanging information (Truax, 2001, pp.9-10). The role of verbal communication and music is clearly distinguished. Verbal communication aims at transferring specific information while music aims to communicate a *context*. The demarcation between specificity and abstractness can be attributed to the history of music's philosophy. Hegel had already divided forms of music by context when Adorno faced music's autarky, in the same terms. Based on this justification, Truax placed music between speech and soundscape in his continuity by clarifying it as a human form of communication that is based on "abstract" sounds (Truax 2001, pp.50-51).

A sequence of the aforementioned ideas, indicates that the act of definition by itself has been proven to be historically suppressing for music. Comprehensive definitions, aiming to be perceived as general truths, interfere with music's historical continuity by an *a priori* exclusion of possible integrated elements. A definition, as any other generalisation, may not have much to offer to musical practice but it appears as a necessity for communicating *about* music. It also serves as a basic description of the act, indicating a general concept for its understanding. A comparison between different aspects in the philosophy of music and their countless revisions by composers and theoreticians, prove nothing more than, that the only

prerequisite in order for music to be perceived is a reference to a *non-verbal sonic form of communicating contexts*. This commonplace can be used as an abstract definition, or at least music in its majority could be treated as such.

Addressing music as a form of communication implies that composers during their practice aim to communicate. Regardless of how specific or abstract is the context that needs to be communicated, it determines the strategy that would be followed for its realisation. Succession is treated individually as the strategy is based on the intention and not necessarily on the accomplishment of the communication process itself. Aesthetics as means for communicating contexts has a primary role in that formulation process.

The etymology of the term aesthetics can be traced in the greek word “aisthētikos”, which describes “perceptible things” (aesthetics, n.d). Already, in Kant’s work, despite his unsuccessful attempts to formulate general aesthetic principles, there was a clear distinction between aesthetic and various judgments; referring to those made aesthetically as concerning pleasure while the rest concern more specific decisions, characterised by logic and practicality. Through the criticism to Kant’s hedonistic approach and his dualistic views is apparent that the line between those judgments is blurred while aesthetics appeared to be empty of cognitive content (Ginsborg, 2014). Later, Hegel revised this division by clarifying aesthetics as judgments concerning contexts such as beauty and ugliness. In his work he was treating aesthetics as an internal process giving to objects the only ability to produce an effect that will liberate receiver’s imagination (Houlgate, 2016). More recent theories like Adorno’s, tried to deduct from this division, by describing aesthetics as a way of perception able to be applied in any context. Adorno also expressed the need of aesthetics to be autonomic and liberated from social subjection.

The dimension of aesthetic’s autonomy was also described by Guattari. In an interview by Oliver Zahm (1992) Guattari stated:

Aesthetic machines are productive of mutations in subjectivity in the same way as social machines, or technological information or communication machines, by the extraction of deterritorialized percepts and affects, of mutant affects.

(Quoted in Alliez et al, 2011, p.41)

Guattari stresses the urgency for a liberated approach to aesthetics, as a form of perception that leads to subjectification. This need for liberation can summarise the history of musical aesthetics and conclude to describe them as an abstract, subjective form of perception occupied with contexts. Linguistically, recent definitions

tend to describe aesthetics as “a set of principals governing the idea of beauty at a specific time and place” (aesthetics, n.d).

As music is occupied with communicating abstract concepts, any form of perception that is characterised by specificity, isn't easily applicable. Aesthetics as an abstract way of perceiving contexts constitutes a vessel for the perception of music. The usage of aesthetics in music —both for the analysis and the creation— through history indicates their utility for communicating contexts characterised by abstractness. Based on the above it is possible to assume that music as a form of communication is expressed through aesthetics.

1.2 From environment to aesthetics through empiricism

The subjective and situationally dependent nature of aesthetics raises a legitimate argument regarding music's communicational utility. The justification of how a form of sound organisation based on subjectivity and abstractness is able to express a concept also conceived subjectively, is significantly related with music's communicational character. Nevertheless, as subjectivity refers to qualitative and phenomenal aspects of consciousness (Van Gulick, 2016), it does not imply absolute arbitrariness. Denis Smalley (1997) in his music analysis theory “Spectromorphology” stated:

Music is not created from nothing. If a group of listeners finds a piece of electroacoustic music ‘rewarding’ it is because there is some shared experiential basis both inside and behind that music.
(Smalley, 1997, pp.107)

By this he indicated an empirical correlation, justifying the connection between subjectively formed expressions and the receiver's perception. This proposition, which may be able to justify the above argument, implies *empiricism* as a point of departure for music's communicational characterisation.

Empiricism as rival to nativism¹ is occupied with the origination of knowledge (Samet et al. 2016). As a theory is rooted in the view that concepts are about, or applicable, to things that can be experienced. In addition, it suggests that all rationally acceptable beliefs or propositions are justifiable or knowable through experience, concluding in a proposition that all concepts originate in experience. Furthermore, empiricism is established as a theory of knowledge and justification. It

¹ The theory that is considered to be the rival of empiricism defined as: “The theory that concepts, mental capacities, and mental structures are innate rather than acquired by learning”. Nativism (n.1). In *OED online*

addresses beliefs, —or at least, some vital classes of belief— depending ultimately and necessarily on experience for their justification, and concludes that all human knowledge derives from experience (Quinton et al, 2015).

While aesthetics are occupied with the idea of beauty, under specific dimensional circumstances, it is possible to be approached as decisions concerning matters of taste. The dimensional aspects of those judgements can indicate a primordial material for a process of associating ideas between an abstract form of sound organisation and receptor's imagination. David Hume (1748) as a radical empiricist and forerunner of cognitive sciences, already speculated principles concerning this process of association. His work, dedicated to the mind's ability to associate certain ideas, described this association not as an "inseparable connexion", but as a "gentle force, which commonly prevails", referring to a process of which one idea naturally introduces another (Moris et al., 2016). Aesthetics, despite the fact that are characterised by abstractness, can still obey to these association principles while being time and place dependent. The supposition which was mentioned in the "An enquiry concerning human understanding" (1999) described three association principles. *Resemblance* refers to association via idiosyncratic similarities. *Contiguity in time and place* regards the associating through dimensional analogies while *Causation* applies to cause-effect associations (Hume, 1999). According to Hume, those principals concerns a secret tie or union among particular ideas, which causes the mind to conjoin them more frequently, and makes the one, upon its appearance, introduce the other (Moris et al, 2016). Aesthetics, as principles driving the idea of beauty, or its dialectic contrast, can be a product that concludes to associating processes. The structure of elements which constitutes this set of principles can reveal idiosyncratic similarities within already empirically gained knowledge. Furthermore, the dimensional dependency of those principles, also obeys the contiguity of time and place associations. The hierarchical structure of elements, which constitutes an aesthetic framework can lead to continuous cause-effect associations. The same principals are also widely used for the categorisation of aesthetics. Different aesthetic genres are characterised by their timing contiguity, their similarities in terms of form and their purpose depending on the historical socioeconomic circumstances. Empiricism has been a highly important inspiration for the evolution of cognitive sciences based on the fact, that as a theory, it suggests a way that primary cognition behaves. Aesthetics as a matter of/for perception can not be excluded from these behaviours. If aesthetics is the answer to a dilemma of what beauty is and what is not, then aesthetics constitutes a personal knowledge, which according to empiricism derives from experience.

The broad philosophical distinction between subject and object indicates an observer-observed relationship. The term object concerns anything that can be perceived by the senses (Laycock, 2014) and depends on the existence of a subject that correlates with consciousness and therefore the ability of perception (Van Gulick, 2016). The intersection of those notions reveals the origination of experience *per se* and by extension, construes empiricism's fundamental formation. Experience, defined as "*a practical contact with and observation of facts or events*" (experience, n.1) refers to subject-object interaction. The existence of both notions is a prerequisite in order to be an experience. This precondition, creates an additional need for more extensive justifications related to experience origination. The object, defined as the perceivable and distinguishable from the ability of perception signifies that, it can be anything outside a person. The surrounding stimuli constitute a notion essentially correlated with *environment*. Environment, defined as "*the surroundings or conditions in which a person, animal, or plant lives or operates*" (environment, n.1), encapsulates the surrounding material—which is potential stimuli—and consequently provides the least significant part for the formation of experience. While aesthetics derives from empiricism, which presupposes the presence of stimuli, it implies that there is *an inextricable connection between environment and aesthetics*.

This supposition is consistent with music's evolution during the twentieth century. Already by 1913 Russolo, had indicated a new direction in music; a direction that moves around an environmental axis. Referring to environmental sounds as *noises* and to musical forms as *sounds* Russolo states:

Noise accompanies every manifestation of our life. Noise is familiar to us. Noise has the power to bring us back to life. On the other hand, sound, foreign to life, always a musical, outside thing, an occasional element, has come to strike our ears no more than an overly familiar face does our eye. Noise, gushing confusedly and irregularly out of life, is never totally revealed to us and it keeps in store innumerable surprises for our benefit. We feel certain that in selecting and coordinating all noises we will enrich men with a voluptuousness they did not suspect.
(Russolo, 1967, p.09)

By invoking the subjects connection to the environment he suggested a new approach to music which would directly take advantage of this interconnection. The appearance of *music concrete* in the middle of the previous century, was also based on a similar preoccupation. Pierre Schaeffer, the instigator of *music concrete* describes his work as:

...a commitment to compose with materials taken from “given” experimental sound in order to emphasise our dependence, no longer on preconceived sound abstractions, but on sound fragments that exist in reality, and that are considered as discrete and complete sound objects, even if and above all when they do not fit in with the elementary definitions of music theory.
(Quoted in Kane, 2014, pp.15-16)

The birth of this new aesthetic tendency begun to construct the foundations for an additional and solid connection between environment and aesthetics. This enriched interconnection characterized environment not only as the origin of aesthetics but also as a new, controllable medium for musical communication. The application of this development imparted an additional attribute to music by rendering it as an environmental mimetic discourse, able to transform, enrich and distort the semantics that are already carried by the environment. Later, the work of R.M. Schafer (1977) indicated the importance of Russolo’s suggestion in the arising of twentieth century music, referring to the works of John Cage and Pierre Schaeffer as a payment of an unacknowledged debt to Russolo. (Schafer, 1993, pp.110-111). In Schafer’s work, besides an environmental sound analysis, there can be found an example of music as mimetic discourse under the term *programmatic music*. While this term refers to music which is imitative to environment, it stresses the additional utility that twentieth century introduced to organised sound (Schafer, 1993, pp.100-103). Truax (1986), while revisiting Schafer’s thesis, he indicated the communicational importance of this utility by clarifying contemporary sound composition as having the

effect of changing the listeners awareness and attitudes towards the soundscape and thereby changing the listeners relationship to it. The aim of the composition is therefore social and political as well as artistic.
(Truax, 2001, pp.235-237)

While the interconnection between environment and music has an established appearance, a possible indicative graph of this connection, could reveal a structure able to clarify its individual links. Given that music can be defined as a non-verbal sonic form of communicating contexts, it encompasses the necessity of conceiving the context *per se*. As the tendency of empiricism indicates, this conception should arise from an experience which originated in stimuli and therefore the environment. When stimuli are transformed to experiences, empiricism is formed. While aesthetics are considered to be the personal knowledge of beauty, it is implied that they are driven by empiricism. As long as aesthetics constitutes a vessel in which music is

expressed, it is possible to assume that every element included in the process of conceiving music arises from an interaction with the environment. Taking into consideration the addition of environment oriented music (*programmatic music* in Schafer's glossary) an additional link in that flow is revealed. Once aesthetics, and by extension musical concepts, succumb to subjectivity, the musical outcome constitutes a stimuli which carries the ability to shape experiences. The described syllogism suggests that, the interconnection between environment and aesthetics can be perceived as self-regulated and can not be characterised by starting or ending points. More recently, Åke Parmerud used a similar approach to environment-music interrelationship in his piece *La Vie Mécanique* (2004). In this specific expression, the historical continuity of the industrial revolution and its extensions are indicated as concepts. During the piece's progression, the aesthetic impact of this continuity is intentionally expressed. According to Parmerud's program notes:

Using only sounds from various kinds of machinery (mechanical, electric etc) the piece is built as a kind of story line describing the birth, death and rebirth of a mechanical life structure. The piece also in a sense alludes to the birth and death of aesthetic values connected to the use of machines as tools for making music.
(Parmerud, 2004)

La vie Mécanique is just one of the many compositional examples that expressed interest in the environment-aesthetics relationship. Starting with Russolo and continuing with *music concrete*, a new aesthetic tendency is revealed. A tendency which is strongly influenced by the above interrelationship and points towards a phenomenological approach to music.

1.3 Towards phenomenology and aestheticization

The practice of *music concrete* introduced two notions which concerned sound as an entity and listening as an act. Schaeffer approached sound from a materialist perspective. His notion of the 'sound object' described a sonic material which was to be appreciated for its acoustic properties and the qualities that carries without regard to traditional music values. The existence of the sound object was concerned as highly depended on an active mode of listening that was referred as listening *acousmatically*. During this act the listener should concentrate only on the characteristics of the presented sound, ignoring its source and its construction process. The introduction of those codependent notions to music were essential to

Schaeffer's vision of *music concrete*. His vision encapsulated the sound signifier which signifies only itself. This reduction implies that Schaeffer's method and aesthetic relied on a disarming of semantics in listening experience (Kim-Cohen, 2009, pp.08-15). Later in his research, and inspired by the theoretical work of Husserl, he described his approach as accidental phenomenology (Kim, 2010). More specifically in his "Traité des objets musicaux" he states:

For years, we have been doing phenomenology without realising it... It is only after the event that we recognised in Edmund Husserl's heroically rigorous definition the concept of the object postulated in our research.
(Schaeffer, 1966, pp.262)

Phenomenology, as a philosophical discipline, it is hard to be defined comprehensively. The different aspects that its practitioners incorporated during its evolution may be confusing and even contradictory. Nevertheless, an analysis of the elements that are usually encapsulated in its practice, may define it initially as the study of structures of experience or consciousness. A more literal interpretation of phenomenology defines it as the study of the "phenomena"; while this term refers to appearances of things, or things as they appear in our experience and thus, the meanings things have in our experience. One encapsulated conclusion could be the pre-assumption that phenomenology studies conscious experience as experienced from the subjective point of view (Smith, 2016). At the end of the nineteenth century Husserl's work introduced phenomenology as the science of the essence of consciousness. His ideas were focused on defining the trait of intentionality as approached explicitly in the first person. Later, he developed his theory by incorporating a specific focus on the essential structures that allow objects, naively taken for granted in the natural attitude, to manifest themselves in consciousness. These ideas, strongly influenced by Descartes and Kant, described a resulting perspective on intentional consciousness that was supposed to challenge the practitioner of phenomenology to develop a justification of his/her basic views on the world and explore their rational interconnections (Beyer, 2016). Husserl's methodology employed the term *epoche* that he himself coined. The term describes a method that advances without consideration of the "real world". Through his methodology he encourages practitioners to make no distinction between fact and fiction. The perceived stimuli should be accepted as they were received and be analysed without taking in account time, place, intention or method of production (Kim-Cohen, 2009, pp.08-15). The aforementioned isolation and emphasis on the stimuli in itself potentially explains the reason why Schaeffer identified his methodology in Husserl's theory. Reduced listening is an implementation of *epoche*

while it isolates sound in its materiality and its perceivable dimensions (Kim, 2010). For Schaefferian phenomenology, *epoche* was mobilised by technology. The listening of recorded sounds isolated from their dimensions created the proper circumstances for the concrete reduction that led to acousmatic listening (Kim-Cohen, 2009, pp.08-14).

Subsequent theories of phenomenology revealed an extensive critique of Husserl's ideas and methodology. Heidegger's rendition of phenomenology places individuals and their activities always "in the world" proposing an opposition to Husserl's neo-Cartesian bracketing of subjectivity (Beyer, 2016). Later, Merleau-Ponty resisted the Cartesian separation of mind and body concluding to a new method of phenomenology. His proposition was focused on correlations between sensation and stimulus rather than isolated materialistic analysis without taking into account the physical dimensions (Toadvine, 2016). The work of Sartre also expresses a critique to Husserl. Sartre denied the separate notion of "self" while he was describing it as a sequence of acts of consciousness, including free choices (Beyer, 2016). The historical continuity of phenomenology —that is briefly described above— inevitably led to a criticism on Schaeffer's research. Brian Kane (2007) in his critique of Schaefferian phenomenology put emphasis on methodology that places its ontology prior to experience. Kane proposed that Schaeffer's method implied that the phenomenology itself is making experience possible (Kane, 2007, pp.15-24). Based on the above, reduced listening was characterised as involving a blank reception of the auditory. The acousmatic implementation of *epoche* is presented as responsible for bracketing out all information that links experience with signification, historical contingency and social importance (Kim-Cohene, 2009, pp.8-14). Consequently, Kane concludes "Once Schaeffer commits to reduced listening, there can be no essential difference between imagined hearing and actual hearing" (Kane, 2007, p.22). An amendment of these throwbacks points towards a phenomenology that would focus on the *linkage* between the qualitative and subjective character of experience (Kim, 2010). The consequence of this direction to sound establishes it as a transmitting medium which necessarily includes the idea of a message or content being transmitted (Kim-Cohen, 2009, p.127).

The disarming of semiotic activity appeared to be the weak link in Schaefferian phenomenology. Later, R.M.Schafer's work (1977) on the Soundscape project showed more consistency to its contemporary phenomenological ideas. Despite the fact that in his analysis he rarely mentions the term itself, the soundscape analysis, while it is based on sound semantics and signifiers can be correlated with a phenomenological method. Nevertheless, Schafer did not include any specifics for the implementation of his environmental approach to the compositional act. His

phenomenology appears to be constrained mainly in the theoretical and analytical domain.

Despite the various critiques most of the phenomenologists approached their discipline more as a concept than as a method. Heidegger refers to it as a “concept of a method”² while his subsequent, Merleau-Ponty, defines it as a “style of thinking”³ (Kim, 2010). Few prerequisites appear as necessities for this concept. The linkage between phenomenology and structures of conscious experience is inevitable. Additionally, the strong subjective character that is implied in consciousness, indicates as necessity that the experience should be studied from the first-person perspective along with its relevant conditions. Those presuppositions place intentionality in the centre of phenomenology while indicating the way that experience is directed through its content or meaning towards a certain object (Beyer, 2016). This interpretation of phenomenology is of particular interest in the current research and in many ways constitutes point of departure.

The proposition that will be expanded in the following pages, besides its influence from the above ideas, does not aim to be constrained as a sound to sound self-purposed analysis. Instead, it regards the application of a phenomenological way of thinking to the intersection between environment and aesthetics that forms a concept, which is to be communicated through music. Another point of interest in this proposition is the incorporation of more recent developments in the discipline of phenomenology. Neurophenomenology, as described by Varela (1996), shifts the interest of phenomenology to the neural substrate of experience (Varela, 1996). An investigation on the utility of Varela’s development in the field of sound organisation may reveal new points of musical interest. The role of sonic expression in the investigation that follows, is intended as the medium for communicating the findings of this particular phenomenological application. As music is occupied with communicating abstract concepts and phenomenology regards the study of the perception, it is hypothesized that the findings of this application may constitute an initial musical concept. While those findings are to be expressed sonically, a verification of this hypothesis may serve as point of departure for delimiting a form of sound organisation. As a conclusion, the following proposition aims to investigate if the practice of phenomenology in the intersection between environment and aesthetics can reveal findings able to serve as musical concepts.

The implementation of the aforementioned proposition aims to study the relationship between the sensory experience as origination of aesthetics and the

² Heidegger as quoted by Kim, Suk-Jun. 2010. Critique on Pierre Schaeffer’s Phenomenological Approaches : based on the acousmatic and reduced listening. Aberdeen. University of Aberdeen.

³ Merleau-Ponty as quoted by Kim, Suk-Jun. 2010. Critique on Pierre Schaeffer’s Phenomenological Approaches : based on the acousmatic and reduced listening. Aberdeen. University of Aberdeen.

subject as their sculptor. To this end, a methodology capable of interpreting the findings of this investigation, appears as a necessity for that purpose. The method in need should be characterised by the ability to study the intersection of interest as a whole without isolating the subjective from the materialistic, or vice versa. The dimensional dependence of aesthetics also indicates an interpretational method suitable for analysing the experience based on its dimensional existence. As phenomenology, experience and aesthetics are inextricably linked with subjectivity, a comprehensive interpretation isolated from the subject would be inadequate. Subjectivity as situational dependence has a primary role in this proposition and suggests an interpretational method that orbits the subject *per se*. Additionally the dimensionally dependent nature of this implementation implies that there is no restriction in the stimuli possibly involved. The lack of this specificity points to an interpreter suitable for analysing any stimuli and thus, able to reduct them before linking them back to the whole. While the elicited findings are to be expressed sonically, the analysis as the interpretation should be able to be *perceptualized*. This raises a necessity for abstracting the findings —regardless of their level of complexity— in order to communicate them sonically and thus encapsulate them to only one of the senses. Henri Lefebvre (1992) envisioned a future discipline titled *Rhythmanalysis* which already considered the aforementioned needs and ideas. The study of Rhythmanalysis as a method for analysing the environment - aesthetics interrelationship and interpret the findings sonically, is a main objective of this investigation.

Rhythmanalysis

2.1 Introduction to Rhythmanalysis

Rhythmanalysis refers to the last work of the philosopher Henri Lefebvre. It regards a collection of interrelated writings published under the title “Elements of Rhythmanalysis”⁴ (Lefebvre, 1992). The common framework between the included essays is the objective to serve as description for a method able to analyse rhythms and their effects to the inhabitants of the urban environment. Despite the fact that the work of Lefebvre during the last decades of the 20th century constitutes the most complete contribution to Rhythmanalysis, the term itself had already been coined in the first half of the century by Pinheiro dos Santos. Unfortunately, dos Santos’ “La Rythmanalyse, Societe de psychologic et de philosophic” was not published commercially and has not been traced until now (Bachelard, 2000). This writing was made known through Gaston Bachelard’s “Rhythmanalysis” essay which was published as the last chapter of his work “Dialectic of Duration”⁵ (Bachelard, 1950). During that essay Bachelard mentions extensively dos Santos’ ideas including quotes and references to the original text, which appears to have been sent privately to Bachelard⁶ (Bachelard, 2000). It is considered that Bachelard’s text worked as the inspiration for Lefebvre’s rhythmanalytical concept⁷ (Lefebvre, 2004).

The first published appearance of the term *Rhythmanalysis* occurred with the “Dialectic of Duration”. In this enquiry, Bachelard took a rival position to Bergson’s notion of duration experienced as continuous time (Bergson, 1913, pp.75-139). Using a dialectic analysis and a materialist point of view, he argues that duration is irreducibly fractured and interrupted, creating in that way a parallelism with material events (Bachelard, 2000, pp.76-77). The reference to dos Santos’ Rhythmanalysis occurred as part of this proposition. According to Bachelard:

The very complex and varied studies by Lucio Alberto Pinheiro dos Santos that we have been able to see are in the form of a sequence of essays described by the author himself as provisional and open to revision ...

Pinheiro dos Santos studies the phenomenology of rhythm from three points of view: material, biological, and psychological.

⁴ Translation from original French title: “Éléments de rythmanalyse”

⁵ Translation from original French title: “La dialectique de la durée”

⁶ End note in: Bachelard, Gaston. 2000. The Dialectic of Duration. Clinamen Press. Manchester.

⁷ From the prologue “Introduction to Rhythmanalysis” from: Lefebvre, Henri. 2004. Rhythmanalysis. Bloomsbury Revelations. USA

(Bachelard, 2000, p.135)

Using dos Santos as point of departure, Bachelard develops in his own theory the relation of rhythms to everyday life. Through an analysis on the spread of material, he argues about a non-uniform duration, upon which he describes the backbone of existence as an “anarchy of vibrations”. The emphasis on the temporality of rhythm is presented through the example of a temporal explosion, which according to Bachelard is described as “an action that synchronises the superimposed times of different elements” (Bachelard, 2000, pp.137-138). The concept of Bachelardian Rhythmanalysis is based on the notion of vibratory energy, a subject quite popular among his contemporaries. His whole description of the act arises from the assumption that, “vibratory energy is the energy of existence”. Based on that, he concludes to a proposition that places “vibration at the heart of time in its original form”, justifying in that way his idea that the “first form of time is time that vibrates” (Bachelard, 2000, pp.137-138). Despite his sequential syllogistical path that encompasses Rhythmanalysis as dialectic of duration, there is no clear definition of the act itself in the text (besides perhaps his reference to dos Santos’ “phenomenology of rhythm”). Bachelard’s overall analysis concludes to the importance of this partially defined act. More specifically he states:

Rhythmanalysis will look anywhere and everywhere in order to discover new opportunities for creating rhythms. It firmly believes that there is a definite correspondence between natural rhythms, or alternatively that they can easily be superimposed, one rhythm imparting momentum to another.

Rhythmanalysis forewarns us then of the dangers of living at odds with such rhythms, and of failing to understand our fundamental need for temporal dialectics.

(Bachelard, 2000, p.151)

In these words he emphasises the utility of this proposition in order to point out the crucial role of “rhythmanalysing our mental life, in order that the mind may regain its mastery of all the dialectics of duration” (Bachelard, 2000, p.154). Despite the assertive character of his wording and lack of detailed definitions, the theme and objectives nonetheless are clearly stated. However, the absence of a clear methodology to investigate Rhythmanalysis meant that, to a large extent, the realm remained unexplored. This is possibly the reason that prevented more research in

the field for several decades; but it is safe to assume that Lefebvre based his work exactly in these shortcomings of Bachelard's theory.

Lefebvre began developing his own notion of rhythm in the third volume of the "Critique of Everyday Life" (1981). Two more essays appeared in the following years co-authored by his wife Catherine Régulier⁸. Nevertheless, he had already mentioned Rhythmanalysis earlier in his book "The Production of Space" (1976), proposing it as an act that would contribute to the constructive critique of the production of space (Lefebvre, 1976, p.205). "Elements of Rhythmanalysis" (1992) was published posthumously, one year after Lefebvre's death and constitutes the first work dedicated exclusively on the concepts of rhythm and Rhythmanalysis.

2.2 Lefebvre's conception of Rhythmanalysis

Lefebvre's theory constitutes a method for analysing the world as a multifariousness of periodical entities. Despite the fact that the book was published after his death—and is considered to be incomplete—he had already managed to express his ambitions for this theory. For Lefebvre, the exploration on Rhythmanalysis was seeking to take "the concept of rhythm and turning it into a science, a new field of knowledge with practical consequences" (Lefebvre, 2004, VIII). By setting rhythmicity as the orbital point, he declared his conception of Rhythmanalysis as a method that does not aim to isolate a subject or an object, but seeks to grasp the world as a *moving complexity* (Lefebvre, 2004, p.12).

Developing Bachelard's idea about vibratory energy (Bachelard, 2000, p.137), Lefebvrian Rhythmanalysis places motion in the centre of existence, arguing for the documentation of its periodic substances. Lefebvre initiates his theory by clarifying his notion of rhythm, as the normative use of the term at the time of his writing contained multiple meanings and was strongly linked to post-industrial society. In the essay "The critique of the thing", the elementary characteristic of rhythm is given as *repetition in time and in space*. This constitutes the condition that introduces rhythm as *measure* (Lefebvre, 2004, p.06). In this case the concept of repetition does not imply an absolute character; on the contrary, it constitutes the process of differentiation. Lefebvre argues that *absolute repetition* is fictional. Repetition is rather a tool, that was developed by mathematicians in order to evolve logical thinking. Specifically he states:

⁸ Lefebvre, Henri. Régulier, Catherine. 1985 'Le projet rythmanalytique', *Communications*, 41, pp. 191–9.
Lefebvre, Henri. Régulier, Catherine. 1986. 'Essai de rythmanalyse des villes méditerranéennes', *Peuples Méditerranéens*, p.37.

Absolute repetition is only a fiction of logical and mathematical thought, in the symbol of identity: $A = A$ (the sign reading 'identical' and not 'equal'). It serves as a point of departure for logical thought, with an immediate correction. The second A differs from the first by the fact that it is second. The repetition of unity, one (1), gives birth to the sequence of numbers.
(Lefebvre, 2004, p.06)

It is upon these words that he described the “thread of time” as “differences induced or produced by repetitions” (Lefebvre, 2004, p.08).

The utility of periodicity, under these circumstances, seems to be inspired by Bachelard's proposition on fragmented perception of time. Rhythm, as measure, implies a thread of time that is distinct and can be perceived as temporal. This approach probably derives from a dialectic perspective on *time scales*. A temporal time thread—which is described as rhythm—constitutes a depended and relative measure. In Rhythmanalysis the reference point that determines this measure is located in the biological subsistence of the subject. Lefebvre referred to the human body as a “bouquet of rhythms”, through the diversity of which, we contain ourselves (Lefebvre, 2004, p.20). This idea, strongly influenced by Chronobiology⁹ (Gillette, 2013), is based on the assumption that human body constitutes a highly-complex rhythmical instrument (Meyer, 2008, p.150). The rhythmmanalitical process suggests that through an awareness of our biological rhythms, it is possible to explore and understand the surrounding rhythms which constitute the world. For Lefebvre, rhythm exists everywhere that “there is an interaction between a place, a time and expenditure of energy” (Lefebvre, 2004, p.15). The exploration of the *relationships which compose the world, through the study of rhythm* is the first goal that Lefebvre sets. Furthermore, and through the development of his method, he declares another, more philosophical one. By expressing an interest in “the relation of the logical and the dialectical”, he opens a new perspective in Rhythmanalysis: *to study through rhythms, the identical and the contradictory* (Lefebvre, 2004, p.11).

The incomplete nature of this work as well as the tone of the author, suggest that the discussed concepts refer more to the *elements* of a theory than to a theory itself (Meyer, 2008, p.150). Nevertheless, the common framework between the essays, may allow to conclude that Rhythmanalysis' proposition can be summarised as following: *The world can be analyzed as a moving determinate complexity, and*

⁹ Chronobiology is the discipline that studies the fundamental property of life through the circadian rhythms of biological processes (Gillette, 2013).

during the observation of the periodicity that this complexity produces, it is possible for a spectator to elicit findings related to the operating principle of a specified environment.

An analysis of the above should start with the concept of motion in relation to existence. A long history in science and philosophy indicates an inextricable connection between those concepts. From Aristotle and Newton to relativity and spacetime theories, existence has been attached to motion (Huget et al., 2017). An urgency off further analysis on this conception can be seen as Bachelard's motivation for the application of dialectics to the perception of duration. Lefebvre's conception of the world derives from that. The idea of motion, reduced to the summation of a diversity of periodical entities, constitutes the world as "moving complexity". Despite the usage of the world "determinate", Lefebvre clarifies that this does not entirely¹⁰ correspond with *Determinism*. — His essay "Rhythmanalyst: A previsionary Portrait" (Lefebvre, 2004, pp.19-27) elaborates more on this differentiation

As motion is inevitably correlated with existence, Bachelard and Lefebvre approach time (duration) as a relative measure of motion. Repetitions of motion in time are perceived as rhythms. This approach to periodicity implies the concept of *pattern* defined as : "*a regular and intelligible form or sequence discernible in the way in which something happens or is done*" (pattern, n.1.2). This notion of pattern, strictly correlated with science, has been used for studying a variety of phenomena for a long time. Ian Stewart, the British mathematician, used patterns as a point of departure in order to describe an idea that ends up showing many similarities with Rhythmanalysis. In his book "Nature's Numbers" he states:

Nature is nothing if not rhythmic, and its rhythms are many and varied. Our hearts and lungs follow rhythmic cycles whose timing is adapted to our body's needs. Many of nature's rhythms are like the heartbeat: they take care of themselves, running "in the background." Others are like breathing: there is a simple "default" pattern that operates as long as nothing unusual is happening, but there is also a more sophisticated control mechanism that can kick in when necessary and adapt those rhythms to immediate needs.
(Stewart, 1995, p.95)

¹⁰ "determination not entailing determinism" (Lefebvre, 2004, p.12)

Similar ideas have also been expressed by John Adams. In the first chapter of his book “Mathematics in Nature”, he described his motivation that reveals great similarities with Rhythmanalysis’ point of departure:

The idea for this book was driven by a fascination on my part for the way in which so many of the beautiful phenomena observable in the natural realm around us can be described in mathematical terms (at least in principle).
(Adams, 2007, p.01)

Through the above examples, it is visible that mathematics —which is referred by Delvin as *the science of patterns*¹¹ (Delvin, 1994)— and generally science often apply periodic temporalities, patterns or rhythms, in order to study and understand various phenomena and through them, the world. Lefebvre’s idea is no different in that level. It is maybe possible to assume that he got even inspired by scientific procedures. Another area of social praxis that could be scoped by Rhythmanalysis is education. The idea of pattern repetition in order to memorise information, and become able to recognise it in the future, is characteristic of multiple educational methods. Repetition, as educational technique can be traced back to ancient Egypt and Greece and it can still be found in national education protocols of various countries (Aspinwall, 1912, pp.1-3). Lefebvre seems to be aware of this fact. During his essay “Dressage” (Lefebvre, 2004, pp.38-46) and through his critique on various educational procedures, he clarifies the common characteristics between Rhythmanalysis and education but also their crucial oppositions.

The above facts argue that the innovative character of Rhythmanalysis is not located in the usage of periodicity as a tool for studying the world. Rhythmanalysis reveals its innovative perspective through Lefebvre’s methodology. The discussed collection of essays presents the study of rhythms using the *subject*, instead of specified protocols, as its axis. The differentiation between *deterministic* and *subjective* has a primary role in this proposition. Through that it may be more accurate to describe Rhythmanalysis as a discipline more related with a *phenomenology of rhythm* instead of a pure science, as its objective is to urge the practitioner to explore new ways of perceiving and interpreting the surrounding environment. The present exploration is motivated by this subtle, yet essential aspect of this approach as it suggests that the application of Lefebvre’s methodology

¹¹ “Mathematics: The Science of Patterns” is the title of Keith Delvin’s book.

to sound organisation may reveal a counter-proposal to phenomenology-based composition as it has been applied until now.

The description of the rhythm analytical methodology is introduced by discussing a systematic way through which, the practitioner would elicit findings from the study of rhythms. In the essay "The critique of the thing" (Lefebvre, 2004, pp.05-19) two possible paths are examined. A direction from *concrete to abstract* is presented as the procedure in which the observation starts with specificities in order to generalise its findings through abstraction. This method, described as being closer to science, is characterised by the risk of errors, occurred during the leap from particular to general. The opposed path, describes an *abstract to concrete* procedure. By starting with concepts and definitive categories a full consciousness of the abstract can be achieved. The specific observation here has a utility role as it contributes the tool for subtracting the specific findings from the abstraction. This passage comes also with a warning, while speculation and arbitrary subjectiveness constitute its main risks. Lefebvre declares the concrete to abstract approach as more related to science while the opposed one as closer to philosophy. Besides his choice to follow the second path, he does not exclude the possibility that one method may contain the other (Lefebvre, 2004, p.05).

The usage of this subtractive syllogistical path led Lefebvre to define his own, definitive categories. Under the influence of dialectics, rhythm is divided in *cyclical* and *linear* repetition. Natural rhythms, like day to night changes, are characterised as cyclical. On the other hand, the social practice exhibiting a monotony of actions, is declared as linear repetitions due to its imposed structures (Lefebvre, 2004, p.08). Taking into account Lefebvre's commitment to Marxism, it is possible to relate his analysis to the Marxist distinction between organic and inorganic as an antagonistic conception of the relationship between human and nature (Foster et al. 2001, p.451). These opposed categories may be divided for analysis purposes but in reality they continuously interfere with each other. Lefebvre presents the dialectical relation between them as the *measure of time* (Lefebvre, 2004, p.08).

Time and space, the cyclical and the linear, exert a reciprocal action: they measure themselves against one another; each one makes itself and is made a measuring-measure; everything is cyclical repetition through linear repetitions. A dialectical relation (unity in opposition) thus acquires meaning and import, which is to say generality. One reaches, by this road as by others, the depths of the dialectic.
(Lefebvre, 2004, p.08)

The rhythm analytical notion of measure is strictly correlated with rhythm. Appearing as an axiom, measure, is consistent with the fulfilment of an expectation (Lefebvre, 2004, p.08). Expectation, as an integral part of rhythm, implies that measure and *anticipation* are interdependent. In Rhythm analysis this expression is the strong link that “reunites quantitative aspects and elements, which mark time and distinguish moments in it” (Lefebvre, 2004, p.09). The dialectic perception of duration, introduces rhythm as regulated time, which is formed by *rational* laws. This is the same formation that derives from the awareness of the human body, described and classified as *natural*. Here, another opposition is revealed, that is consistent with the dialectic nature that characterises Rhythm analysis. The rational and the natural distinction refers again to the Marxist division between organic and inorganic. Nevertheless, Lefebvre states that this classification has a limited role in his conception as the boundaries between rational and natural are hard to distinguish, since they are overlapping (Lefebvre, 2004, p.09).

A series of oppositions constitute the backbone of the rhythm analytical methodology. Rhythm is described as the tool that reveals: *repetition and difference, organicity and in-organicity, continuity and discontinuity* as the relationships which compose the human perception of the world (Lefebvre, 2004, p.09). Furthermore, Lefebvre provides some examples as a theoretical tool for classifying the diversity of rhythms. First, he distinguishes the introvert behaviours as *secret rhythms* that they don't display their existence in public. To the contrary, he characterises the periodic elements of a schedule *public rhythms*, justifying in that way their extrovert character. In addition, he speaks about *fictional rhythms*, which refer to constructed actions, like verbal and gestural ones. Finally, he mentions the rhythms that are completely manufactured, having long-term or short-term effects, such as music and speech. Those are described as *dominating-dominated rhythms* (Lefebvre, 2004, p. 11).

The above classification raises a series of reasonable questions. As rhythm is a relative measure, a reference point is needed. Additionally, an applicable methodology that is able to study the discussed oppositions, is required. Lefebvre, under the influence of Chronobiology, indicates the human biological substance as an answer to those questions. “We know that a rhythm is slow or lively only in relation to other rhythms (often our own: those of our walking, our breathing, our heart)” (Lefebvre, 2004, pp.10 -11). The usage of circadian rhythms, deriving from the conception of the human body as a complex periodical entity, establishes the

surrounding periodicity as a perceivable rhythm. Its perceivable rate is determined by the circadian speed. Based on that, a description of three basic possible findings, occurring during the observation of two or more periodical entities, is presented. The notion of *euhrythmia* —strongly correlated with *isorhythmia*— is introduced first in order to describe the rhythmical unity among the entities. Additionally, the relative synchronicity, that manifests itself in the form of multiple rhythms that are able to be analysed by the same count is described as *polyrhythmia*. In contrast, the notion of *arrhythmia* is introduced, describing the discordance among the entities (Lefebvre, 2004, p.12). This triune analysis, characterised by its elegant simplicity, points again towards Chronobiology. The usage of arrhythmia is being widely used in order to describe a pathogenic character when it refers to circadian rhythms (ex. cardiac arrhythmia).

The aforementioned concepts constitute the cornerstone upon which Lefebvre draws his previsionary portrait of the rhythmanalyst (Lefebvre, 2004, pp.19 - 27). The rhythmanalytical methodology is highly depended on the individual that applies it. This fact works also as the differentiating factor between Rhythmanalysis and various other disciplines equally occupied with periodicity. The utilisation of patterns is strictly correlated with science and is usually accompanied by specified protocols which constitute its methodology. Rhythmanalysis uses the subject's empiricism as interpretation axis. The concepts discussed in the previous paragraph, are introduced as suggestions on general theoretical guidelines which are to be oriented towards the 'knowledge'¹² of the applicant. This is the idea that introduces one's personal beliefs and ideology to the rhythmanalytical methodology. More specifically, in his description of the rhythmanalyst Lefebvre states:

He must arrive at the concrete through experience. In fact and in practice, an already acquired 'knowledge' [savoir] enters onto the scene and delineates the game. (Why the inverted commas around 'knowledge'? Because it is difficult to know whether knowledge goes as far as science – and consequently whether it avoids ideologies, interpretations and speculative constructions; in such a way that the entrance of ideology is doubtless inevitable, as many recent, and certainly exemplary, cases have shown: psychoanalysis, Marxism and even information technology. (Lefebvre, 2004, p.22)

¹² The quotes around the word are attributed to Lefebvre's text, as he uses them in order to describe the subjective character of knowledge.

In the section above, he introduces subjectivity as the kernel of the rhythm analytical procedure. In addition he clarifies that this mobilisation of subjectivity should aim to *reason*. In this way, he excludes possible metaphysical tendencies from Rhythm analysis (Lefebvre, 2004, p.25). The discussed description distinguishes Rhythm analysis from positivism through subjectivity, and simultaneously, it excludes an interpretation based completely on belief. Lefebvre's vision locates the rhythm analyst in the perfect balance between positivism and subjectivism while he attributes to the practitioner the character of the *observer*. This is clarified in the following statement: "In short, he is not a mystic! Without going so far as to present himself as a positivist, for someone who observes: an empiricist" (Lefebvre, 2004, p.25).

The notion of empiricism, strongly correlated with subjectivism, implies that the rhythm analytical procedure is based on an interpretation able to metamorphose the *present* into *presence*¹³. This act, does not imply the alternation of the present while is referred to its subjective interpretation. The ability to set the *present in motion* — thus to integrate even the immobile into the moving complexity— is the main characteristic of this act. Under this circumstance a parallelism between the art of painting and the rhythm analytical process is given. Based on the example of post-impressionism¹⁴, Lefebvre argues that the subjective interpretation of a stimulus constitutes the medium through which someone studies the world (Lefebvre, 2004, p.25). A parallel comparison between the musical harmony and the rhythmical substance of the human body, is also revealed in this idea. The description of the human body as a "bundle of rhythms", motivates Lefebvre to suggest that the interpretation of rhythm, is accompanied by an aesthetic arrangement (Lefebvre, 2004, p.21). The observation of the surrounding periodicity places the practitioner in the middle of the rhythmical diversity. Furthermore, through the interpretation of the observed "*the rhythm analyst performs a verbal action, which has an aesthetic import*" (Lefebvre, 2004, p.24).

Lefebvre, upon the above discussed ideas, described his vision of the rhythm analyst as following:

¹³ This differentiation is attributed to Heidegger's revision on the Aristotelian notion of time (Heidegger, 1953, p.26)

¹⁴ "The work or style of a varied group of late 19th-century and early 20th-century artists including Van Gogh, Gauguin, and Cézanne. They reacted against the naturalism of the impressionists to explore colour, line, and form, and the emotional response of the artist, a concern which led to the development of expressionism." Post-Impressionism. (n. 1) In *OED Oxford Dictionary*

Will he have to set up and direct a lab where one compares documents: graphs, frequencies and various curves? ... He will first have to educate himself (to break himself in or accept training), to work very hard therefore, to modify his perception and conception of the world, of time and of the environment. His emotions will consequently also be modified, in a coherent (in accordance with his concepts) and non-pathological way. Just as he borrows and receives from his whole body and all his senses, so he receives data [données] from all the sciences: psychology, sociology, ethnology, biology; and even physics and mathematics. He must recognise representations by their curves, phases, periods and recurrences. In relation to the instruments with which specialists supply him, he pursues an interdisciplinary approach. Without omitting the spatial and places, of course, he makes himself more sensitive to times than to spaces. He will come to 'listen' to a house, a street, a town, as an audience listens to a symphony. (Lefebvre, 2004, p.22)

This description suggests someone able to perceive the rhythmical substance of his/her body as well as the environmental surroundings when being a practitioner. The multidisciplinary nature of the above act suggests that knowledge from different disciplines, is occupied with periodicity and constitutes a prerequisite for developing a rhythm analytical understanding. The described objective of this effort appears as the enrichment of the experience in order to interpret the world as moving complexity. The interpretation of the observed periodic relationships is based on the subjectively gained empiricism and implies, as subjectivism usually does, an aesthetic import. The idea of observation, aiming to the understanding of the relationships which compose the world, in order to express it through subjectivity, is coherent with the description of music as discussed in the previous chapter. A series of observing, understanding and then expressing findings through aesthetics is capable to describe a considerable amount of compositional strategies. Rhythm analysis differs in relation to that, through its holistic approach of the senses. Nevertheless, the strong emphasis on audibly perceived periodicity and the multiple references to music, may suggest that a limitation on the expression of possible rhythm analytical findings to the auditory domain, could reveal a new perspective in phenomenologically approached composition.

It remains to be proven that Rhythm analysis may contribute to aesthetics as a compositional strategy. Studying the observation of the relationship between the cyclical and the linear, as a methodology able to express its findings sonically, is main objective in this thesis. Furthermore, it is hypothesised that the concepts of

polyrhythmia, eurythmia and arrhythmia can be integrated in the acousmatic process as intentionalities. Additionally, the utilisation of Lefebvre's classification of rhythms as an addition to soundscape compositional methods, is to be discussed. The following chapters are dedicated to studying whether Rhythmanalysis, when applied to the intersection between aesthetics and environment, is able to express its relationship sonically and reveal a perceivable musical meaning.

2.3 Rhythmanalysis and musical prospects

The work of *Groupe de Recherches Musicales* in the middle of 1900's introduced music to the broad and diverse discipline of phenomenology. This historically important approach to music, liberated it from its previous restrictions as it appeared to rearrange the pre-established hierarchy of pitch and rhythm and construe all sound qualities as equally important expressive mediums (Wishart, 1996, pp.45-71). Despite its significant contribution to music and aesthetics, this new tendency appeared to be vulnerable to misunderstandings. As a method aiming to study the subjective perception of sound phenomena, it is easy to be understood as a tautology of sound. This conception implies a process in which sonic observation is transformed to a subjective sonic manifestation in order to reveal how sound, as a phenomenon, is perceived. A reasonable argument upon this misconception derives from Susanne K. Langer's poetic description of music as "the tonal analogy of the emotive life" (Langer, 1953, p.27). In "Feeling and Form: A theory of art" Langer discussed a logical similarity between the forms of human feeling and music. Upon this, she presented the second, as a "pattern, or logical form, of sentience" (Langer, 1953, p.27). In her analysis, music constitutes an expressive tool which serves as a *symbol* for communicating subjectivity, without an obligatory self-reference to the sound phenomenon itself (Langer, 1953, p.27). However, the diverse character of phenomenology, is not necessarily restricted to the material substance of the phenomenon. Its purpose is based on the concept of consciousness through which it aims to study how phenomena are subjectively perceived. David Clark (2011) in his article "Music, phenomenology, time consciousness: meditations after Husserl" uses the concept of *temporality* as point of departure, in order to elaborate on the relationship between music and consciousness.

First music models, moulds, and makes audible the flow of our inner, subjective life — the sense of our being-in-the-world, 'the patter, or logical

form, of sentience', as Susanne Langer famously put it — Secondly, these process and their musical analogies are by definition temporalities. To be conscious is to know one's being from one moment to the next and to generate some apprehension of unity — an enduring self, and enforcing world (whether real or illusory) — out of the experience. And while much in the everyday business of human doing furnishes such conditions for consciousness, the making of music might be argued as distinctive in these respects, since 'musicking' captures in its very temporal essence the temporality that is essential to the knowing of being — i.e. Consciousness (Clark, 2011, p.01)

Music as a capture of temporality, is inextricably connected with consciousness. Upon this idea, a logical connection between music and phenomenology is formed. Composition, as an act which communicates a previously conceived context, constitutes the subjective expression of how this context was originally perceived. Supposing that compositional ideas derive from the observation of the world, their realisation constitutes a subjective interpretation of the observed. This supposition reveals a logical similarity with phenomenology (as is described in [chapter 1.3](#)), while the subjective interpretation of the world constitutes its cornerstone.

The correspondence between music and phenomenology, can draw a parallelism with Rhythmanalysis. Consciousness, arising out of temporality awareness, is consistent with the rhythm analytical concept. Observation, declared as music's point of departure, has also a primary role in Lefebvre's idea. A series of observing, synthesizing¹⁵ and interpreting subjectively can characterise composition and Rhythmanalysis, under the same terms. The differentiation factor in this comparison, is revealed in its methodology. While composers find their observation medium in sound, Lefebvre's rhythm analyst's medium is located in periodicity, without further restrictions.

Lefebvre seemed to be aware of this comparison as in his essay "Music and Rhythms" (Lefebvre, 2004, pp.57-67) analyses these commonplaces. Describing music by a series of oppositions he draws his own parallelism between the rhythm analytical methodology and composition. Through the opposition of *low and high*, pitch and its relationships are introduced. The role of *measure* in music is also discussed as the relative scale which determines the opposition between *vivace* and *adagios* (Lefebvre, 2004, p.58). Already by those two oppositions the dialectic character of his musical analysis is revealed. Oppositions, as Rhythmanalysis' main

¹⁵ The philosophical notion of synthesis.

utility, are applied to music in order to analyse its structure. It can be assumed that the reversion of this method may also imply a compositional strategy. Lefebvre continues by discussing the musical terms of *tied and staccato* as an opposition that differentiates the state of the pitch. To that point, his analysis points towards a more philosophical path. Using the German musicological terms *Logogenic* and *Pathogenic* he draws a division between meaning and emotion; attributing the first to the expression of the composer's subjectivity through interpretation, and referring to the second as an intuitive expression, which reaches the listener more directly. Upon this idea, Lefebvre introduced his last musical opposition between *sacred* and *profane*. The term *profane* refers to music that has "a popular origin in dances" while *sacred*: "linked to rites, gives place to complex codes" (Lefebvre, 2004, pp.58-59).

The above analysis presents music by the aforementioned oppositions. Nevertheless, it is reasonable to argue about the utility of such a dualistic approach. Lefebvre, in order to overcome this boundary, introduces Hegel's triune analysis of melody, harmony and rhythm. Invoking the triadic nature of dialectics, he argues that: "Binary (term-to-term) oppositions given as evidence enable us to determine the object but not to penetrate into it. The triad melody–harmony–rhythm grasps musical life by heart" (Lefebvre, 2004, p.61). This statement, expressed at late 1980s, seems asynchronous with its contemporary musical tendencies. Already by this time, Hegel's analysis was inadequate to describe a considerable amount of modern compositions, as it was considering the crucial elements of timbre and spatiality as non-relevant. The usage of this triad as a description of music in Lefebvre's work, confirms that he was a philosopher with a theoretical interest in music, rather than a practicing musician.

Based on the exclusion of timbre and space, Lefebvre's dialectics are proved to be inadequate to analyse contemporary music. The invocation of a pre-existing hierarchy of musical elements seems retrograde in music's evolution. Another point of interest in the triune character of the above analysis is the separation among melody, harmony and rhythm. As Lefebvre's point of departure in this circumstance is Rhythmanalysis, it seems reasonable to argue that a deductive process which approaches all of these elements as periodical entities may be more consistent with his initial conception. The theory that music can be analysed and perceived as elementary relationships between vibrating systems is an ancient and established approach (Wishart, 1996, p.45). Lefebvre's choice to exclude this supposition from his analysis indicates that he was more persistent in maintaining a dialectic feature than to approach music directly through his Rhythmanalysis. Based on the above, it

is possible to assume that the reversion of this analysis, when used as a compositional strategy, would still carry this inadequate character.

Nevertheless, the shortcomings spotted in Lefebvre's musical analysis do not necessarily imply that the rhythmanalytical findings can not be perceived as music. The phenomenological tendency in composition may serve as a linkage between Rhythmanalysis and musical perception. The acousmatic process aims to interpret sonic stimuli, which, in music, usually constitute an expression of subjectivity. Through that, it may be possible to utilise the rhythmanalytical method as the tool of this expression. Rhythm and periodicity as primary characteristics of music, may serve as foundations upon which the rhythmanalytical findings would be perceived as music. This supposition hypothesises that the rhythmanalytically observed periodical relationships are able to be presented sonically and be perceived acousmatically. A subjective interpretation of the world may be seen as a musical purpose. Rhythmanalysis, being a method for interpreting subjectively the observed, fulfils this requirement. The usage of Rhythmanalysis as carrier of musical meaning, presupposes that the elements of polyrhythmia, eurythmia and arrhythmia, that Lefebvre set as elementary deductions, should be intergraded into the process of active listening.

In order to examine the aforementioned supposition, another parallelism between acousmatic music and Rhythmanalysis may be utilised. The essay "Seen from the Window" (Lefebvre, 2004, 27, p.38) provides the only practical example of a rhythmanalytical application. Using the previously discussed elements, Lefebvre realises a written Rhythmanalysis of an observed environment. A comparison between this essay and an acousmatic composition, may be able to reveal a common framework simultaneously with the crucial differences between those acts. Aiming to limit the amount of complexity that such a comparison may carry, an early historical example of electroacoustic composition is chosen as representative of acousmatic music. The following paragraphs constitute an attempt for a comparison between Lefebvre's "Seen from the Window" (Lefebvre, 2004, 27, p.38) and Pierre Schaeffer's "Étude aux Chemins De Fer"¹⁶ (Schaeffer, 1948).

Schaeffer's railroad study is the first of the five studies in sound and it is considered to be one of his most famous compositions. The composition is based on multiple recordings of trains which have been processed through electroacoustic equipment of Radiodiffusion-Télévision Française. (Pursley, 2014, p.05). On the

¹⁶ Pierre Schaeffer's *Railroad Study* is considered as the first piece of music concrete and one of the first examples of electroacoustic music

other hand, Lefebvre's "Seen from the Window" constitutes a written study of the neighboured streets of Hôtel de Ville in Paris. An initial similarity on the specification of an observed environment may be revealed here. Schaeffer, initiates his piece with the sound of a whistle, followed by a circular churning. These elements introduce the source of the sound: the railroad which is the specified environment that Schaeffer sets (Pursley, 2014, p.01). For Lefebvre, the specification of the environment is also introduced by a physical object: a window. "Seen from the window" begins with a description of Lefebvre's view from his house in rue Rambuteau. Centre Pompidou, Hôtel de Ville, and Arts et Métiers appear as the limit that Lefebvre's window sets (Lefebvre, 2004, p.28). Schaeffer positions himself —and thus the listener— outside of the utilised train, adopting in that way the role of the observer. Using technology as his Pythagorean curtain, he reduces the utilised character of the train and requires the listener as an observer, who has to deduct his own impression of this specified environment (Kim-Cohen, 2009, p.09). Lefebvre positions himself —and through that the reader— in a similar place. He acquires the role of the observer through the distanced position that the window offers. In this circumstance, the window is the apparatus that serves reduction. Specifically he states:

He who walks down the street, over there, is immersed in the multiplicity of noises, murmurs, rhythms (including those of the body, but does he pay attention, except at the moment of crossing the street, when he has to calculate roughly the number of his steps?). By contrast, from the window, the noises distinguish themselves, the flows separate out, rhythms respond to one another.
(Lefebvre, 2004, p.28)

In both cases, reduction seems essential as it provides the logical tool both for the acousmatic process and Rhythmanalysis. Although the representation of the observed is crucial, it is not recalled linearly. In "Railroad study" at 0:16 the initial rhythmic churning is replaced by another one, introducing in that way a timbral transition. Through that the listener realises that this does not serve as a replica, but as recording of the world that has been mediated in some fashion (Pursley, 2014, p.01). Similarly, in "Seen from the Window" at the second page, a rapid change occurred. The general description of the window is transformed into the behaviour of the pedestrians (Lefebvre, 2004, p.28). This fact argues that the representation of the observed appeared alternated in both circumstances. The specified environment is not characterised by a linear continuity, but it is presented as a sequence of

temporalities, introducing in that way the consciousness of the writer and the composer in the process of observation.

Another focal point of this comparison is revealed in Schaeffer's work after the first minute. The variety of rhythms that are presented from 1:00 to 1:30 challenge the listener to follow Schaeffer's constructive space. The jumps from inside to outside of the train suggest an incentive to study these spatial relationships (Pursley, 2014, p.5). This form of representation is highly consistent with Lefebvre's work. During the majority of his essay, rapid jumps occur in order to create a space for comparison between relationships. Lefebvre elaborates on that by stating that "the attentive ear begins to separate out, to distinguish together by perceiving interactions" (Lefebvre, 2004, p.27). In this particular point of his analysis, the 'ear' is presented metaphorically as the responsible apparatus for perceiving periodicity. This seems highly consistent with the case of "Étude aux Chemins De Fer", as the contracted sequence of the presented temporalities, challenge the ear to seek for relationships amongst them. While approaching the end of the piece, the recognisable sound of train is transformed to a matter almost unidentified. This part constitutes the end of the composition (Pursley, 2014, p.05). The discussed alternation introduces even more deeply the consciousness of the composer by exhibiting the power, not only to construct the space of the observation, but also to affect the perception of time and thus, the totality of the experience. This progression can be analysed through Lefebvre's similar conception. While referring to *simulacra*, Lefebvre sets consciousness as point of departure for interpreting the world.

You are there! . . . but no, you are not there; your present is composed of simulacra; the image before you simulates the real, drives it out, is not there, and the simulation of the drama, the moment, has nothing dramatic about it, except in the verbal.

(Lefebvre, 2004, p.32)

The above comparison does not aim to constitute an equalisation of the discussed works. Their different chronological framework and the fact that both works were realised on different mediums and to serve different purposes prevents such a holistic approach. However, it can be mentioned that the common framework between them is the ability to describe them both under phenomenological terms. Schaeffer's notes on Railroad study define his objective to create a piece of music in which the art is hidden in the process of listening. He discussed about an absolute reduction in which "the train must be forgotten" and the piece should be considered

only as “sequences of colour, changes of time and the secret life of percussion instruments” (Schaeffer, 1952, p.14). This absolute reduction, is the causation for the criticism to Schaefferian phenomenology. The disarming of semiotic activity as a phenomenological practice is considered anachronistic while it separates the phenomenon from the signifier (Kane, 2007, p.22). To the contrary, Lefebvre’s vision is based on signification. The idea of studying the world through perceived relationships in order to avoid ambiguity, is more consistent with the contemporary phenomenological tendencies. For Lefebvre, opposites re-find each other (Lefebvre, 2004, p.37) while for Schaeffer the phenomenon is self-defined (Schaeffer, 1952, p.14). Furthermore, *music concrete* finds its meaning in listening, invoking listeners imagination for the interpretation of the observed. Rhythmanalysis, on the other hand, challenges the readers to ‘listen’¹⁷ for interactions taking their time as a first reference. By this, Lefebvre mobilises the receiver’s empiricism as a subjective form of interpretation that is not based completely on arbitrariness.

The observer in the window knows that he takes his time as first reference, but that the first impression displaces itself and includes the most diverse rhythms, on the condition that they remain to scale. The passage from subject to object requires neither a leap over an abyss, nor the crossing of a desert. Rhythms always need a reference; the initial moment persists through other perceived givens. The philosophical tradition has raised half-real, half-fictitious, problems that are badly resolved by remaining within speculative ambiguity. Observation [le regard] and meditation follow the lines of force that come from the past, from the present and from the possible, and which rejoin one another in the observer, simultaneously centre and periphery. (Lefebvre, 2004, p.37)

Even the study of the above, which is based on their correspondence to phenomenology, reveals crucial differences. Beside these deviations, there is a general idea that works as a link between them. Schaeffer’s vision, that music exists in listener’s perception of environmental sounds seems coherent with Lefebvre’s idea that the city, filtered by the perception of the observer, produces its own music.

Rhythms: the music of the City, a scene that listens to itself, an image in the present of a discontinuous sum. Rhythms perceived from the invisible window, pierced into the wall of the façade . . . But next to the other windows, it is also within a rhythm that escapes it . . .

¹⁷ The quoting here indicates the metaphoric usage of the word in Lefebvre’s work.

(Lefebvre, 2004, p.36)

The previous comparison finds its sources in the common approach to phenomenology. It is essential to mention, in this respect, that Lefebvre's vision to create a concrete method for the subjective interpretation of the world, prevented him from describing Rhythmanalysis under this term. The diverse nature of phenomenology, implies a theoretical arbitrariness which is not coherent with Lefebvre's rhythmanalytical conception. More specifically he states:

A philosopher could ask here: 'Are you not simply embarking on a description of horizons, phenomenology from your window, from the standpoint of an all-too-conscious ego, a phenomenology stretching up to the ends of the road, as far as the Intelligibles: the Bank, the Forum, the Hôtel de Ville, the embankments, Paris, etc.?' Yes, and yet no! This vaguely existential (a slightly heavy technical term) phenomenology (ditto) of which you speak, and of which you accuse these pages, passes over that which quite rightly connects space, time and the energies that unfold here and there, namely rhythms. It would be no more than a more or less well used tool. In other words, a discourse that ordains these horizons as existence, as being.

(Lefebvre, 2004, pp.17-18)

Despite Lefebvre's will to separate Rhythmanalysis from phenomenology, its objective and described methodology can be referred back to dos Santos' description of "phenomenology of rhythms". The specifics that Lefebvre's theory provides may be classified as phenomenology, but do not depend on the existence or the reference of this term. To this point, it may be useful to deduct that the same diverse character that invited Pierre Schaeffer to speculate that *music concrete* constitutes phenomenology, prevented Lefebvre from using the same term.

It is clarified that Rhythmanalysis does not constitute a compositional strategy. Its purpose is to utilise any mean in order to grasp a multifariousness of periodical entities as it considers that this diversity is responsible for the understanding of the world. What is referred as a phenomenological tendency to music has been documented and discussed since the middle of the previous century. Phenomenology, based on consciousness and through that subjectivity, has been considered to be a discipline that fulfils the expressive character of music. Supplementary, periodicity has been utilised as one of music's main characteristics; from analysis theories to the very act of composing, periodical relationships have an eminent role. A perception of the world based on rhythm seems consistent with this

characteristic of music. Lefebvre's persistence to metaphorically use the word 'listen' in order to describe the process of perceiving rhythms, indicates the connection that characterises periodicity and music. Those facts, may imply a potential usage of Rhythmanalysis as a counter-proposal to what is referred as Schaefferian phenomenology; not as a compositional strategy *per se*, but as elements that can form a methodology through which the perception of rhythm will present a musical and subjective interpretation of the world.

Developing a ‘Rhythmanalyst’

3.1 Sonification as tool for reduction

...He will come to ‘listen’ to a house, a street, a town, as an audience listens to a symphony.
(Lefebvre, 2004, pp.22)

Lefebvre’s vision of an act that allows its practitioners to listen to the everydayness in the same way as they listen to a symphony, seemed to be abstract and imaginative for its time of writing. Nowadays, technological innovation coupled with industrial and scientific demand allows a similar vision to become an established and well-documented technique that can be found under the term *sonification*. Defined as: “...the transformation of data relations into perceived relations in an acoustic signal for the purposes of facilitating communication or interpretation.” (Kramer et. al, 1999, pp.03), sonification exhibits by definition an agreement with the prerequisites of Lefebvre’s vision for the rhythmanalytical act. Based on this correlation, it is hypothesised that the utilisation of sonification in order to develop a method, based on Lefebvre’s elements and limited in the auditory domain, will allow Rhythmanalysis to become a medium for musical expression, and conversely, for music to become a vessel for the practice of Rhythmanalysis.

The rhythmanalytical act circles around the exploration of perceivable periodic relations. Despite Lefebvre’s holistic approach to the senses, his writing displays strong tendencies towards a metaphoric use of the phrase ‘to listen’ when describing the process of grasping rhythmicity. This idea seems compatible with ongoing research in auditory segregation (Jones & Boltz, 1989, pp.459-491; Bergman 1990, pp.411-455). The published ideas of Boltz and Bergman about auditory segregation documents the superior ability of the human auditory system to recognise temporal changes and patterns (Walker & Nees, 2011, p.10). The work of John Neuhoff (2011), in particular, focuses on the paradox that the auditory system performs better than visual mechanisms when it comes to the perception of rhythm, despite the significantly larger mass of cortex dedicated to optical processing (Neuhoff, 2011, p.74). Based on this phenomenon he argues that

... Auditory display is particularly well suited for domains in which rhythmic perception and temporal discrimination are critical and domains in which the underlying data lend themselves to rhythmic and temporal variation...
(Neuhoff, 2011, pp.74-75)

Given that Rhythmanalysis is concerned with the ability to discriminate temporalities and elicit their relations, the usage of auditory displays may be able to limit a rhythmanalytical methodology in the auditory domain. The term *auditory display* refers to processes that seek to translate relationships in data into meaningful sonic streams, while exploiting the abilities of the human auditory perception (Walker & Nees, 2011, p.09). Such an approach offers a fertile ground for the sonic expression of the surrounding periodic complexity that Rhythmanalysis seeks to grasp. Lefebvre's elements suggest a focus towards the periodic nature of the observed. This task demands the ability to reduce other perceptible qualities that are considered to be of low-priority or non-relevant to rhythm. Environmental complexity increases the difficulty of this task due to the physical limitations of the human brain and the cognitive load it is able to process (Sweller, 1988, p.266). Under these circumstances, sonification may serve as a reduction tool, that abstracts the non-relevant qualities of the observation and emphasises its periodic elements.

Another aspect of sonification that exhibits coherence with the rhythmanalytical act, is the aesthetic import that can characterise the designing process. As sonification concerns the design of models that are able to transform data into sound, it requires a series of decisions. The range of justifications upon which these decisions are made may vary from practical to aesthetic ones; but sonification itself does not imply an absolute correspondence with music. In contrast to music, its main objective is to convey the data of interest (Walker & Nees, 2011, p.15). The priority between aesthetic and practical decisions that drives a sonification model can characterise it as a musical or non-musical one. Nevertheless, Vickers and Hoog (2006) have argued for an overlapping definition when it comes to sonification (Vickers & Hoog, 2006, p.06). Despite the 'verbal action'¹⁸ that Rhythmanalysis may constitute, its main character is not restricted in aesthetics. Lefebvre's conception was based first on the interpretation of periodicity which acquires an aesthetic import through its subjective prism. Carla Scaletti (1994), who gave one of the first

¹⁸ Verbal action, which according to Lefebvre constitutes an aesthetic import (Lefebvre, 2004, p.24).

definitions¹⁹ of sonification, divided it in two parts: the *method* by which someone transforms data into sound and the *intent* to understand or communicate something about the world (Scaletti, 1994, p.224; Worrall, 2009, p.313). It is upon this intention that the utilisation of sonification in order to restrict Rhythmanalysis in the audible range is hypothesised. Rhythmanalysis as sonification does not constitute music *per se*. Their objectives meet under the common intention to understand something about the world while the aesthetic import is implied through this intentionality.

Sonification appears as a suitable tool for the realisation of Lefebvre's conception to analyse and interpret the world as a "moving determinate complexity" (Lefebvre, 2004, p.12). The ability to reduce the observed environment into sonic periodic relations offers the possibility to exploit the superiority of the human auditory system in order to perceive and interpret the rhythmic relationships under study. Furthermore, the design process that sonification demands introduces subjectivity, through which the practitioner can perform a "verbal action", characterised by an "aesthetic import" (Lefebvre, 2004, p.24). The sonic and technical decisions that the sonification designer should take, under the role of rhythmanalyst, constitute a subjective addition to the grasped situation. This process is accompanied by a creative responsibility to communicate subjectively the environment of interest.

The aforementioned ideas, suggest that the sonification of the observational process will emphasise its periodic elements. Such a realisation will allow Lefebvre's theory to be integrated into the discussing methodology.

Lefebvre's conception that the human body constitutes a highly complex periodic instrument (Meyer, 2008, p.150) stands as the justification, upon which he suggests the body rhythms as the main reference point for perceiving surrounding periodicity (Lefebvre, 2004, p.20). This idea may imply that the extraction of periodicity from the human body can also be used as a basic indicator for the observer's reactions to the observed. Under these circumstances, the biological indicators of the subject constitutes a cyclical repetition due to their organic character. Furthermore, the way of human perception which is based on empiricism—that is considered in its majority a social construction (Samet et al., 2016)—constitutes a linear repetition. It is a main objective in the following methodology to sonify the correspondences among the cyclical and linear, in order to express sonically the intersection between the observer and the observed.

¹⁹ "...a mapping of numerically represented relations in some domain under study to relations in an acoustic domain for the purpose of interpreting, understanding, or communicating relations in the domain under study" (Scaletti, 1994, p.224)

3.2 On grasping the intersection between Subject and Environment.

The implementation of the aforementioned methodology is highly depended on the ability to grasp and analyse relevant qualities of both the subject and the environment. The ideas of Nobert Wiener (1948) introduced the world to the possibility of grasping and communicating temporalities (Cubitt, 2001, p.22). Nowadays, similar systems are attached to daily life. The evolution of mobile and wearable technology allowed a variety of devices to be used as extensions of the human senses (Brey, 2000, p.02; McLuhan, 1996, p.19). Cameras and microphones, attached to mobile phones, are used in daily basis to grasp and communicate short fragments of everyday life. Steve Mann, while being a forefather of this utilisation, had already introduced by 1999 a camera-based wearable technology that was designed to be an extension of the human eyes (Mann, 2012). This idea may suggest that cameras and microphones could be mobilised as a starting point in the practical exploration of Rhythmanalysis. Aiming to simulate the auditory and visible field of the observer, these sensors were utilised in order to grasp periodic information related to an observed environment.

The task of grasping information related to the observer appears as more demanding in this case. The evolution of cognitive sciences offers a fertile ground for this purpose. Nevertheless, the plurality of available procedures, as well as their laboratory nature, increases the complexity that this task may carry. A way out of this complexity can be found in Varela's proposition of Neurophenomenology (1996): under the influence of philosophy, Varela introduces the philosophical discipline of phenomenology applied to the cognitive sciences. More specifically he describes this proposed discipline as following:

Neuro-phenomenology is the name I am using here to designate a quest to marry modern cognitive science and a disciplined approach to human experience, thus placing myself in the lineage of the continental tradition of phenomenology.
(Varela, 1996, p.330)

By approaching phenomenology as "a style of thinking" (Varela, 1996, p.355), he suggests that through the extraction of biological indicators from the human body, it is possible to elicit reaction patterns that correspond to a specific stimulus (pp.341-343). This methodology implies the application of neuro-scientific procedures to the

individual's experience. Such an approach seems promising for grasping and exploring the periodic nature of the observer's biological reactions. In order to examine this possibility, the method of electrocardiography (ECG) is utilised to provide information related to the autonomic responses of the body. Furthermore, in order to extract more detailed biological data, an electroencephalograph (EEG) shall be examined as a provider of basic brainwave activity.

3.2.2 Initial Experimentation

The exploration of the possibilities that the recruited devices may provide, appears as an initial step for the discussed development. The limitation of possible analysis methods, that can be applied to the incoming data, seems essential in order to achieve an established relationship between them and their sonic outcome. Due to the variety of available analysis methods, this procedure can be characterised by a considerable amount of complexity. In order to avoid such effects, a series of analysis methods, that can be characterised by simple operating principles, were selected to be initially tested. A light exposure analysis was recruited in order to analyse the camera input. This decision, aimed at a simplistic extraction of the periodicity that light changes introduce to the environment under study.

In the audio domain, spectrum and dynamic analysis were attached to the audio input. Such approach aims to extract periodic information deriving from pitch and loudness sequences. Furthermore, the ECG data were calculated in order to provide tempo information (bpm). This analysis was recruited in order to provide information related to the autonomic responses of the body. Finally, the EEG input was attached to 'Emotiv's control panel'²⁰ software to detect facial expressions and provide *performance metrics*²¹.

In order to examine the musical expressive possibilities and the periodic quality of the collected data, a series of sonification experiments have been conducted. A combination of ten different sound synthesis techniques, was realised for that purpose (figure 1.1). Aiming to explore different qualities between different analysis methods and sound synthesis engines, an analysis platform was implemented in a Max/msp patch (figure 1.2). This implementation aimed to provide graphical environment, able to transmit wirelessly the analysis' out-coming data through Open

²⁰ Emotiv Xavier Controlpanel 3.1.19 (build 200)

²¹ The term "performance metrics" is attributed to a classification algorithm provided by Emotiv Company.

Sound Control (Wright, 2002). Initially, a trial and error experiment on the combinative potential between sound and data took place (figure 1.1).

The aforementioned experiment, can neither be characterised as a compositional tool, nor as a functioning prototype for rhythm analytical composition. Its purpose was to provide a framework for experimentation. Through the development and various experiments on the discussed system, its combinative

Surrounding Environment	Sonification Engines
Camera: Colour/Light Analysis	Subtractive Synthesis
Microphone: Spectrum/Dynamic Analysis	Additive Synthesis
Subject's Reaction	Concatenative Synthesis
ECG: Heart Rate Analysis	Frequency modulation Synthesis
EEG: Brainwave Activity	Formant Synthesis
	Vector Synthesis
	Scanned Synthesis
	Granular Synthesis
	Wavetable Synthesis
	Phase Distortion (PD) Synthesis

Figure 1.1: Trial and error combinative approach



Figure 1.2: Analysis platform in Max/Msp

approach proved to be inadequate to satisfy Lefebvre's prerequisites of Rhythm analysis. The arbitrary nature of this method tends to result in complex sound outcomes that are not characterised by the qualities of the grasped rhythmicity. The

analysis methods, that initially appeared to be characterised by simplicity, increased the amount of complexity of the sound results, as they were unable to provide a satisfying amount of periodic information. Such findings echo other sonification experiments. As an example Need et al. (2007) indicated the consequences of arbitrary decision-making in their research on auditory graphs.

Auditory graph design and implementation often has been subject to criticisms of arbitrary or atheoretical decision-making processes in both research and application.
(Nees et al., 2007, pp.266)

As a final step in this initial set of experiments, a compositional attempt was realised ([sound example: 1.1](#)). This attempt was based on sound material collected from the above experimental procedure. The objective of this process was to combine different experiments between analysis methods and sonification engines in a form of collage, in order to test their musical utility. The first finding that was observed during this procedure was that the initial sonic material proved to be inadequate to communicate the aspects of the grasped environment. Furthermore, due to the complex character of the sound results, the initial sound sources were unable to be characterised by the periodicity of the source data. As an attempt to overcome these shortcomings, the sound sources were heavily processed and edited. Although this decision aimed to attach an aesthetic value to the musical outcome, it was proven unable to communicate musically the initial interactions of interest.

The above experiments proved deficient to form a framework by which Lefebvre's elements would be utilised for musical composition. However, this period of experimentation contributed to the clarification of possible methods that can be utilised for the discussed purpose. The unsatisfying results of this experimentation excluded an empirical approach to sonification based on atheoretical decisions. Additionally, they indicated a path based on concrete and documented decision-making towards the design of sonification models (Walker & Nees, 2011, p.23). The inadequate character of the selected analysis methods also constituted an argument for more coherent analytical procedures, drawn directly from Lefebvre's elements. The urgency for a more documented approach appeared as a general conclusion of this period. In that approach, Rhythmanalysis would stand as point of departure for designing specified models, able to analyse and sonify the periodic relationship

between biological data, referring to the observer, and data grasped from the observed.

3.3 From Analysis to Synthesis

Initial experiments indicated the urgency for a new design based on conscious decisions and theoretical justifications. The following Rhythmanalysis implementation was based on a more methodological approach that utilised Lefebvre's elements as a point of departure for analysis design. Based on this utilisation, the sonification engines are build as extensions of the analysis methods. This approach aims to exploit the theoretical background of Rhythmanalysis, in order to formulate a methodology for grasping specified interrelationships between observers and observed environments. In similar situations, Grond and Berger (2011) indicated that "Both the analysis of the data domain and analysis of the data preparation must be based on conscious and rational decisions" (Grond & Berger, 2011, p.367). Taking this consideration into account, the overall development of the method has been divided to the design of four different units. This decision aims to provide a framework that allows careful control over the overall sound results. The division is based on the differences between the input devices and their role in the overall outcome. The following pages aim to provide a description of the procedures that have been followed during the discussed development.

3.3.2 Visible motion unit

The first unit to be discussed is based on a camera input. Emanating from Lefebvre's ideas about the prominent role of motion in existence, it was hypothesised that an analysis able to grasp visible motion would allow rhythmanalytical elements to be integrated into this methodology. The development of such procedure refers to the human mechanisms that are responsible for motion perception. A borrowal from the operating principles of these mechanisms seems crucial for the implementation of a visible motion analysis in the digital world.

The human motion perception mechanisms obey to a binary division between *First-order motion perception* and *Second-order motion perception*. First-order motion is cued by the spatial distribution of luminance (O'Keefe & Movshon, 1997, p.305). This process describes a mechanism that calculates differences between successions of illuminated points (Adelson & Bergen, 1985, p.284). This aspect

applies to close-distance stimuli and it is characterised by a considerable amount of accuracy (Chubb & Sperling, 1988, p.2985). To the contrary, the second-order mechanism regards long-distance stimuli, or stimuli that are characterised by complex structures (Chubb & Sperling, 1988, p.2985). This mechanism refers to the ability of the human brain to classify different visible qualities, that are not related to luminance and treat them as one entity (Adelson & Bergen, 1985, pp.385-386; O'Keefe & Movshon, 1997, p.305). For the discussed purpose, a digital simulation of the operating principle responsible for the first-order motion perception may be able to extend its accuracy to a large-depth frame.

A similar implementation was presented by Lucas and Kanade (1981). During their research in *computer vision* they proposed an “image registration technique that uses spatial intensity gradient information to direct the search for the position that yields the best match” (Lucas & Kanade, 1981, p.121). This proposition was based on the calculation of intensity differences between successive images; a principle that seems inspired by the first-order model. In order to evaluate the utility of this implementation for the discussed subject, the cv.jit library²² (an OpenCV built for Max/msp) has been recruited (Pelletier, 2010).

The next step was the sonification of the analysis results from Lucas-Kande algorithm. For this task, the sonic ability of percussive instruments to communicate the motion of the instrumentalist's hand was applied. Aiming to simulate and experiment with this ability, a jar filled with sugar cubes was recruited as a model of percussive instrument. During a short period of experimentation with this object, its ability to communicate the movements of the hand through its sound was revealed ([sound example: 2.1](#)). Furthermore, the ability of the same object to communicate specific motion patterns sonically was examined ([sound example: 2.2](#)). The high amount of musical expressivity that characterised these experiments, contributed to the design of a sonification method based on a similar principle.

Already by 1996, Perry Cook introduced a physical model for percussive instruments under the title *PhISEM* (Physically Informed Stochastic Event Modelling). The main utility of this algorithm is to simulate percussive instruments through granular synthesis procedures. In the case of PhISEM the granulation is determined “by modelling the physical interactions of many particles by their statistical behaviour” (Cook, 2011, p.222). This development contributed to the formation of a sonification method based on a similar working principle. For the discussed task, it was hypothesised that the replacement of the statistical model by

²² Pelletier, J.M. 2010. cv.jit, version 1.7.2. for OSX (Universal Binary).

the analysis results of Lucas-Kanade, as the source that determines the granulation, would be able to express the analysed motion sonically. This conception was realised by following a *one-to-one mapping* methodology (Grond, Berg, 2011, p.370). Each data output from the Lucas-Kanade algorithm was mapped respectively to the parameters of a granular synthesiser, as presented below (figure 2.1). In this development, each located intensity difference between two images generates a sound grain. The duration and the rate of the grain are determined by the coordinates of the detected motion. In this way, a continuous motion generated by 24 successive frames creates a sequence of sound grains which is usually referred to as *cloud* ([sound example: 2.3](#)). In addition, this implementation aimed to transfer the ability of percussive instruments to express motion patterns in the sonification domain.

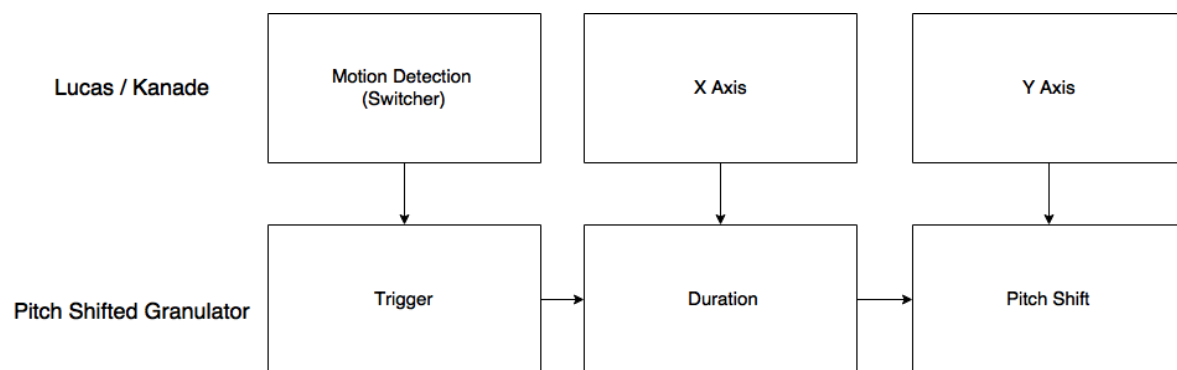


Figure 2.1: Visible motion unit, parameter mapping graph

The further development of this idea was based on small additions aimed to increase the expressivity of the algorithm. The first step was the addition of a 'sensitivity' control in the Lucas-Kanade algorithm. By this addition, the user can apply a preferable amount of intensity, above which the algorithm indicates motion (*threshold*). Furthermore, in order to express the density of the grasped motion, a method that calculates the time in which continuous motion is detected was applied. This addition was divided into two functions. In the first one, the amount of density returns to the initial state every time that there is no successive motion between two frames. In this way the short-term density of the motion is indicated. The second function refers to the long-term density of the motion by calculating the overall amount of successive intensity differences in a given window of time. The time windows that those functions are based on are determined and controlled by the user. The analysis results of those functions are assigned to the parameters of a band-pass filter that processes the granulation output in parallel (figure 2.2). As last

implementation on the discussed development, a graphical user interface was designed in order to provide basic visual feedback for the real-time operation of the algorithm (figure 2.3). This implementation aimed to allow the user to apply specified control and monitor the analysis during the recording.

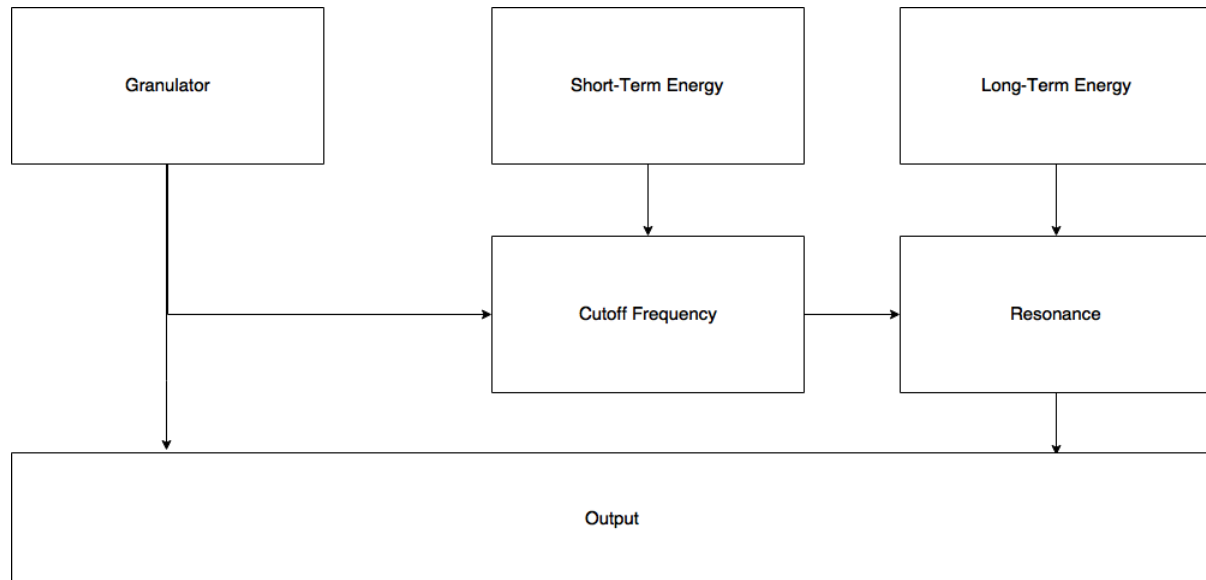


Figure 2.2: Parallel filtering, parameter mapping graph

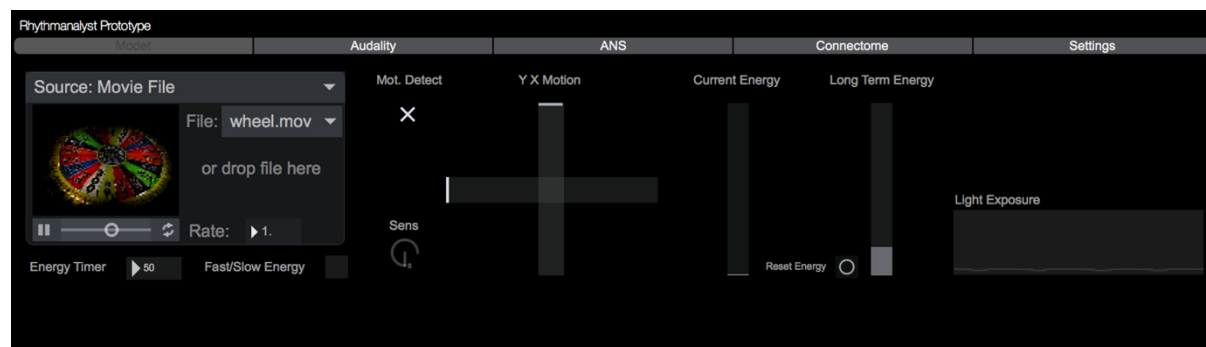


Figure 2.3: Visible motion unit, GUI

3.3.3 Audible motion unit

The Chimaera was a beast in Greek mythology with the head of a lion, the body of a goat, and the tail of a serpent. We use the word chimera metaphorically to refer to an image derived as a composition of other images. An example of an auditory chimera would be a heard sentence that was created by the accidental composition of the voices of two persons who just happened to be speaking at the same time. (Bregman, 1990, p.456)

The mythological beast of Chimera was used by Albert Bregman (1990) in order to describe metaphorically the way that the human auditory system organises perceived sounds in meaningful elements. (Grond & Berger, 2011, p.373). The terms *grouping* and *stream* have an important role in *Auditory Scene Analysis*, as they are used to study the mechanisms responsible for the perceptual classification of individual sounds in the natural world (Bregman, 1990, p.03). As the formation of this classification is based on simultaneous and sequential groupings, it appears to be responsible for the perception of motion, occurring by alternations of sounds in the auditory field. Such motion exhibits a consistency with Lefebvre's idea of rhythm as alternations of temporalities. It is hypothesised that a methodology able to locate and express the motion occurred by different audible streams will contribute to the discussed implementation of Rhythmanalysis. The following paragraphs are dedicated to the documentation of the process followed for the realisation of this methodology.

According to the work of Albert Bregman in *Auditory Scene Analysis* (ASA), the mechanisms responsible for the auditory a exhibit considerable similarities with the previously discussed, second-order motion perception model. ASA describes the ability of the human brain to classify different audible qualities and treat them as one entity (Bergman, 1990, p.11). This knowledge has already contributed to the sophistication of a variety of *machine listening* techniques. However, this field of study is still characterised by some unexplored points. The amount of existing audible qualities as well as the priority by which the human brain classifies them under different circumstances remain undefined (Bergman, 1990, p.696). This lack of knowledge, combined with the enormous amount of perceivable audible qualities, suggest that the discussing implementation should adopt a more situational-depended approach. Nowadays, the ability to train a computer with specific features in order to classify different qualities is already an established and well-documented method. The discussed development is based on this ability as it aims to provide a unit by the indication of which the user can seek for different audible streams or qualities under different circumstances.

As a starting point, the audio input is analysed in *MFFC* (Mel-frequency Cepstrum Coefficients) in order to obtain information related to the spectral components of the incoming sound. This implementation, has been realised through the *zsa.descriptors* (Malt & Jourdan, 2008) library for Max/msp. Furthermore, in order to extract information, related to the periodic elements of the incoming sound, an auto-correlation function has been implemented via the *gen~* object. The analysis

results are utilised as feature inputs for a supervised classification algorithm. For that purpose an implementation of *Support-Vector Machines* (Cortes & Vapnik, 1991) has been mobilised through the “Wekinator” (Franklin, 2009) platform. The choice of this algorithm lies in its probabilistic nature. Human auditory perception can not be characterised in binary terms, thus, the usage of an absolute-classification algorithm seemed inadequate to satisfy the prerequisites of this implementation.

The main objective in the sonification of the above process, is to emphasise the differences between the grasped sounds, reducing, at the same time, the bulk of details that each sonic stream carries independently. For this purpose a method derived from Homer Dudley’s (1938) conception of Vocoder has been realised (Bode, 1984). The selection of a “non-phase vocoder” may seem as an anachronistic decision; but as it carries the ability to reduct a considerable amount of details from the incoming sound, it was considered as an appropriate method for the discussed purpose. In order to adopt this methodology in the present implementation, the audio input is re-analysed to the *Bark scale* (Zwicker, 1961) to provide spectrum information through a division that exhibits consistency with the human auditory perception. This extraction has been realised through the “analyser~” Max/msp library (Jehan, 2001). The amplitude data from the 24 Barks were assigned to the amplitude parameters of 24 band-pass filters, tuned respectively in the Bark scale. In this way, the main operating principal of a vocoder has been simulated. The sound input of the unit can be divided in a finite number of sound sources corresponding to the number of the SVM classes, the amplitude of which is determined through the probability distribution of the SVM algorithm. Through this procedure, the probability distribution of the incoming sound classification creates a mix-balance between the different available audio sources (figure 3.1; sound examples: [3.1](#), [3.2](#)). Finally a GUI has been designed for visual monitoring. (figure 3.2).

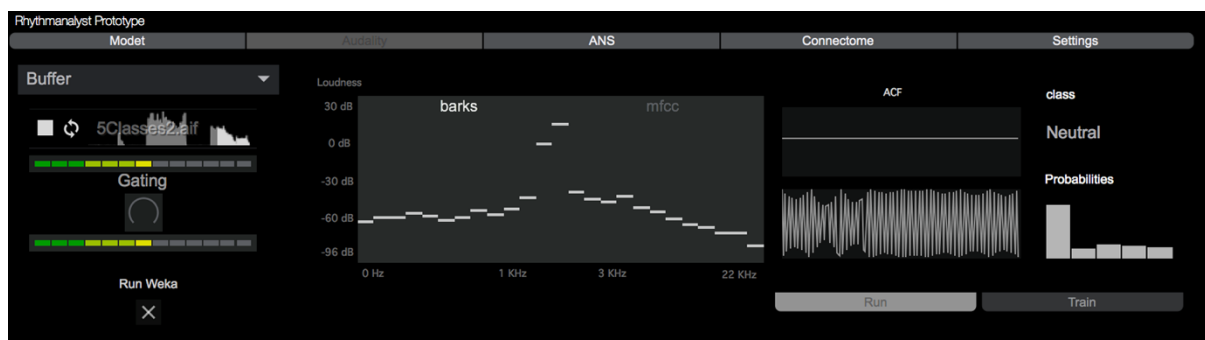


Figure [3.2](#): Audible Motion unit, GUI

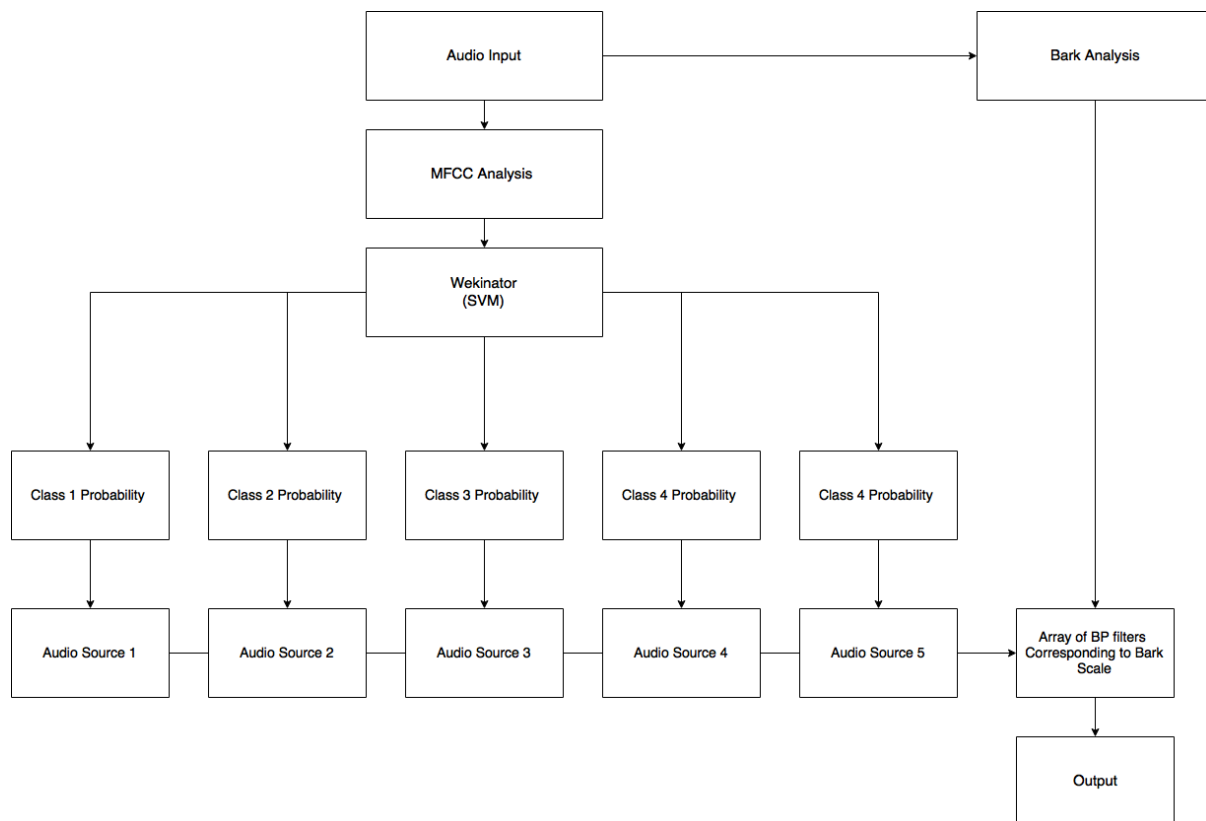


Figure 3.1: Audible Motion unit, flow graph

3.3.4 Heart rate unit (A.ANS)

Heart rate constitutes one of the main circadian rhythms of the human body. Heart rate sonifications exhibit a consistency with Rhythmanalysis by nature, as they are inextricably connected with the conception of the human body as the main rhythmical reference point. Despite the suitability of this unit with Lefebvre's conception, the monotonous nature of heart signals usually appears as a considerable restriction for musically oriented sonification. In order to overcome this boundary, the following implementation utilises the heart rate as an indicator of the Autonomic Nervous System, upon which a sonification model has been developed.

Among other utilities, heart rates are used in medical research in order to provide indicators regarding the autonomic functions of the body, which are also known as the functions responsible for homeostasis (Robinson et al., 1966; Purves et al. 2001). The mechanism that regulates that function is the *Autonomic Nervous System* (ANS). This term refers to the part of the nervous system that is "responsible for control of the bodily functions not consciously directed" (OED, n.1). The ANS consists of two antagonistic states that provoke specific functions in order to achieve homeostasis. The *sympathetic nervous system* (SNS), which is also known as *fight*

or *fight*, describes a tensed state of the body. To the contrary, the *parasympathetic nervous system* (PSNS) —*rest and digest*— indicates a relaxed state. There is an antagonistic nature between those systems that can be described in binary terms. Both the SNS and PSNS release different neurotransmitters towards the vital organs. These transmissions have different rates and are characterised by different reactions (figure 4.1). It is hypothesised that the design of a model, based on the ANS, would be able to apply sonic variations to the monotonous nature of a heart rate sonification, without affecting the communication of interest.

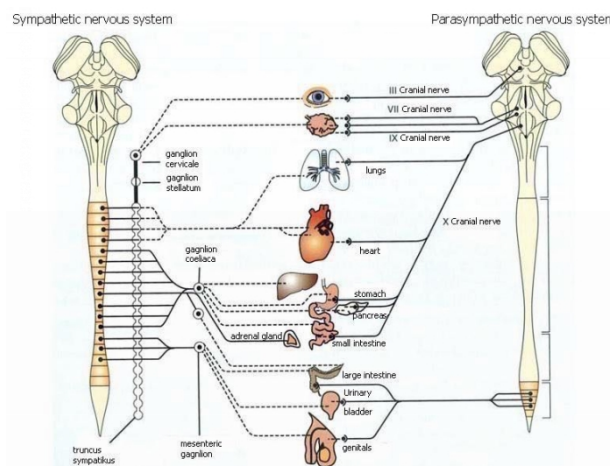


Figure 4.1: Divisions of the Autonomic Nervous System (Sovijärvi, A. et al. 2003)

The following implementation, regards a *model based sonification* method that was inspired by the operating principle of the ANS. As an initial step in that process the heart rate is calculated in beats per minute. The output value of this calculation determines the dominance of SNS or PSNS. This division is assigned to two tendency masks. The first part of this division is limited to low values, in order to simulate the functionality of the parasympathetic system. In contrast, the second part generates values limited to the high part of the spectrum, following the operating principle of the sympathetic system. The output values from these systems are assigned to four different parameters of a synthesis technique inspired by Max Mathew's *Scanned Synthesis* (Mathews & Verplank, 1999) as presented below (figures 4.2, 4.3).

The synthesis technique that was recruited for this implementation is based on an array of physical modelled springs. When force is applied to the springs, their motion is scanned in time. The output of the scanned motion determines the frequency and the amplitude of the generated sound. In this case, a specific amount of force is applied every time that a single heart beat is detected. The scanning rate,

the amount of damping, the number of springs and the fundamental tone of the synthesis are determined by the discussed model ([sound example: 4.1](#)). The main objective of this development is to overcome the monotonous nature of the heart signal, preserving at the same time its initial tempo, in order to sonify the heart rate in a musically oriented way.

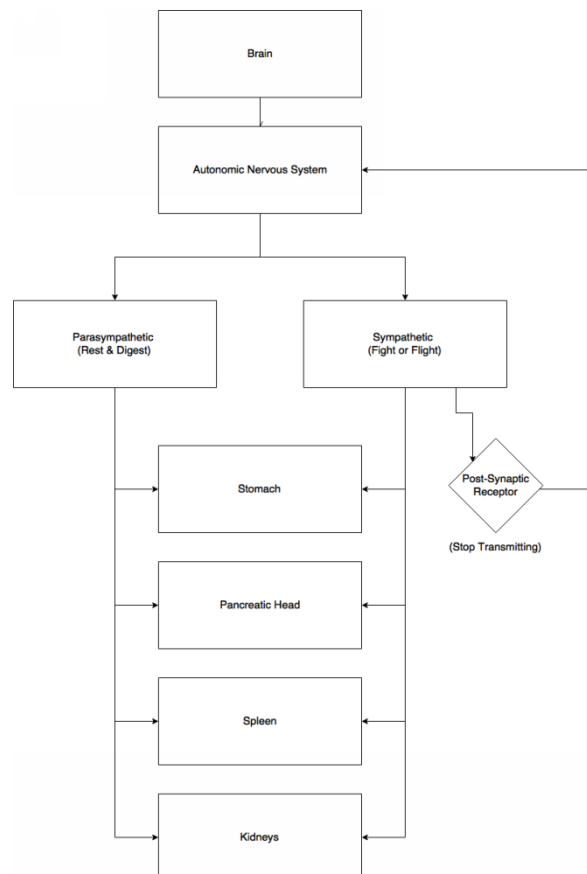


Figure 4.2: Simplified ANS graph

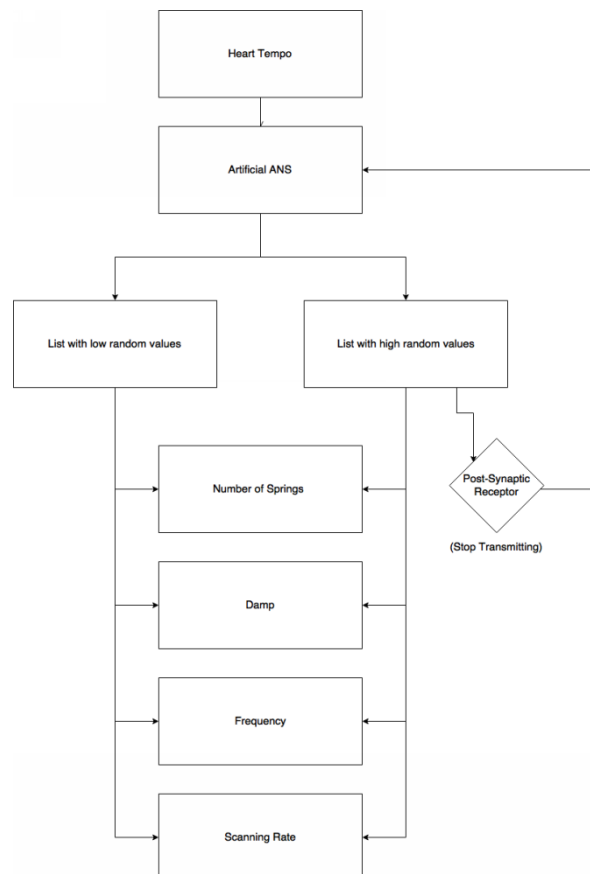


Figure 4.3: A.ANS sonification model

3.3.5 EEG Sonification unit

The development of the electroencephalograph by Hans Berger (1929) gave rise to a series of experiments regarding the ability of sound to express the electrical activity of the brain. One of the first published papers in this domain was authored by Adrian and Matthews (1934) and described a method able to transform EEG signals into sound (Adrian & Yamagiwa, 1935). The objective of this methodology was to study the electrical activity of the brain that “consists of a rhythmic oscillation of potential with a frequency in the neighbourhood of 10 a second, appearing when the subject lies quietly with eyes closed and disappearing if the attention is fully

occupied” (Adrian & Matthews, 1934). This specific activity range was referred to as the “Burger’s rhythm” and today it is usually found under the term “Alpha waves”. The periodic nature of the EEG signal, as well as the innovative character of the device that this paper revealed, initiated a considerable amount of EEG sonification attempts. Thirty years after the publication of the aforementioned paper, Alvin Lucier in collaboration with Edmond Dewan (1964) started to explore EEG as a musical instrument. This experimentation inspired Lucier to compose “Music for solo performer”, a piece of music based on the electrical activity of the performer’s brain (1965). A few years after the realisation of this composition, David Ronsenboom (1971) founded the “Laboratory of Experimental Aesthetics” at York University in Toronto; a place that hosted a variety of music related EEG experiments. After this initiative, the amount of literature regarding this topic increased to a level that the present thesis is not able to cover comprehensively. Among others, the names of Pierre Henri, John Cage, Manfred Eaton and Steve Mann appear in this literature. The variety of the techniques and objectives used in those experiments deserve a dedicated study (see Novello, 2012²³). The present chapter does not aim to cover comprehensively this aspect as its main objective is to study the utility of the EEG sonification in the discussed implementation of Rhythmanalysis.

EEG systems carry the ability to grasp and indicate the complex multi-dimensional, pulsating, electromagnetic field that the human brain produces (Rosendoorn, 1990, p.26). Various techniques have been developed in order to extract meaningful indications from the brain’s electrical activity. In the present implementation such system has been utilised in order to provide the pulsating quality of the observer’s brainwave activity. This conception aims to draw a parallelism between Lefebvre’s proposition of the human body as main rhythmical reference point and the periodic nature of electrical brain activity. In addition, the extraction of brainwaves can be used as a basic indicator for the observer’s reactions to the observed environment. This utilisation carries the same amount of abstractness as the conception of the brainwaves itself. Manfred, in his “Bio-Music” manifesto (1973) considered the abstract nature of EEGs as a limitation. In his case the utilisation of the system aimed to provide a musical instrument which the performer would control. In contrast with Manfred’s proposition, in the discussed implementation, the EEG is not considered as a performing instrument, but as a tool that indicates abstractly the reactions of the subject through periodicity.

²³ Novello, A. (2012). *From Invisible to Visible: the EEG as a tool for music creation and control*. The Hague: Institute of Sonology.

The main method recruited for decoding EEG to specific indicators is the brainwave classification. This classification regards the isolation of different parts of the spectrum that indicate different states of the body. The main parts of this separation are four. The Alpha waves (Berger's rhythm) indicate a state of high attention whilst Beta waves are considered to be an indicator of conscious states. Deep meditation states are indicated by Theta waves while unconscious states, like deep sleep or anaesthesia, are indicated by Delta waves (Rosendoom, 1990, pp. 32-33). David Rosendoom, in his experiments on "brainwave music", refers to the brainwave division as a representation of "what might be termed *idling states* of the brain" (Rosendoom, 1990, p.34). This fact may be perceived as limitation in a *bio-feedback* approach of sonification by which the subject has the role of the performer. In the discussed implementation, it is hypothesised that this abstractness may serve as reduction in order to point the attention of the listener towards the periodic relation between the observer's biological sonification and the sonified observed stimulus, instead of providing a more specific signifier.

The initial step in order to test these hypotheses, was to divide the spectrum of the EEG signal respectively to brainwaves. This process has been realised through digital filtering. The objective of this development is to obtain different indicators for Alpha, Beta and Theta waves. Delta waves were excluded, as their utility appears to be minor to the discussed purpose. The next step in this process, was the development of three different sonification strategies that would correspond to the above waves. This decision aimed to provide a sonic result that would indicate the dominance of each wave in time. Inspired by Lucier's (1965) methodology, the phase of each signal is utilised as the parameter responsible for the sound generation.

In the case of Beta waves a PCM granulator is recruited for sonification. The purpose of this decision lies in the ability of granular synthesis to provide present sound transients. In this way, the periodic nature of the wave is emphasised. The generation of each grain is determined by the phase of the Beta signal while for the rest of the parameters, a *one-to-many* strategy (Grond, Berg, 2011, p.370) has been adopted. In this method, the amplitude, rate and duration of each grain is assigned to the amplitude of Beta waves (figure 5.1; [sound example: 5.1](#)). For the Alpha waves sonification, a similar approach has been followed. The sonification is based on a frequency modulated, sine fed granulator. The addition of a frequency modulator is recruited as a differentiation factor between the two sonification methods (figure 5.1; [sound example: 5.2](#)). At last, a Karplus-Strong (Karplus & Strong, 1983) synthesiser has been mobilised in order to sonify Theta waves. The selection of this synthesis

method is based on the quality of its transients, similarly to the above implementations (figure 5.1; [sound example: 5.3](#)).

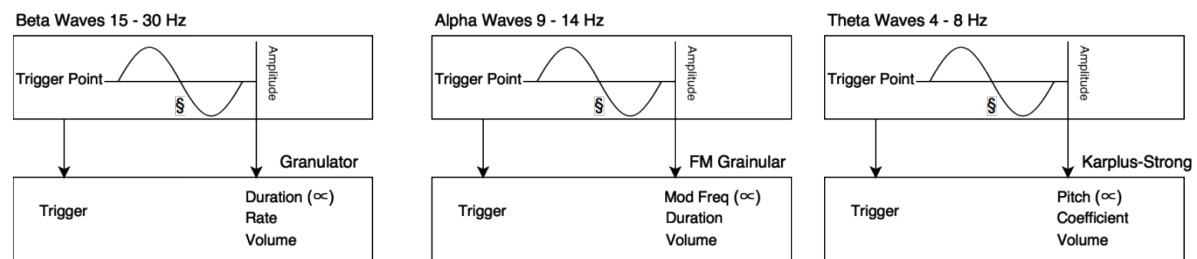


Figure 5.1: EEG Sonification unit, parameter mapping graph

The last addition in the above implementation is inspired by the “Brain Research through Advancing Innovative Neurotechnologies (B.R.A.I.N.)”. This recent development in brain science aims, amongst others, to study the spatial functionality of the brain. By reconstructing the activity of single neurons the “B.R.A.I.N.” project intends to reveal specific parts of the brain and the tasks that they are responsible for (Rojahn, 2013). Inspired by this idea, a model based on localisation has been developed. This procedure separates the incoming EEG signals to quadrants on the subject’s head. Each part of this division is sonified individually in a quadraphonic loudspeaker setup (figure 5.2).

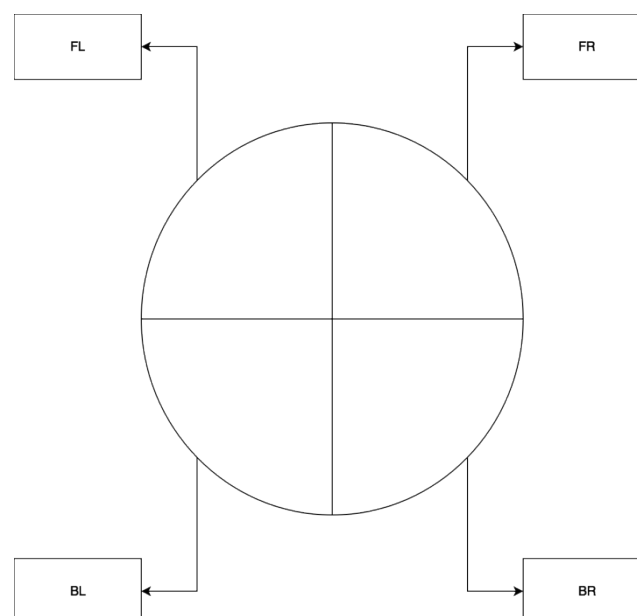


Figure 5.2: EEG Sonification unit, Spatialisation model

3.3.6 General operating procedures

The units may have been divided for the designing procedure, but the main intention of these developments is to work as a unity, in order to grasp and sonify in the same time, the observed stimuli and the biological rhythms of the observer. Aiming to allow such parallel procedure, a framework able to host all of the units has been developed. This implementation was dependent on the ability of this framework to share information with different platforms. For this purpose the OSC (Wright, 2002) protocol has been recruited. Also, a graphical interface was designed in order to allow immediate control of the network (figure 6.1).

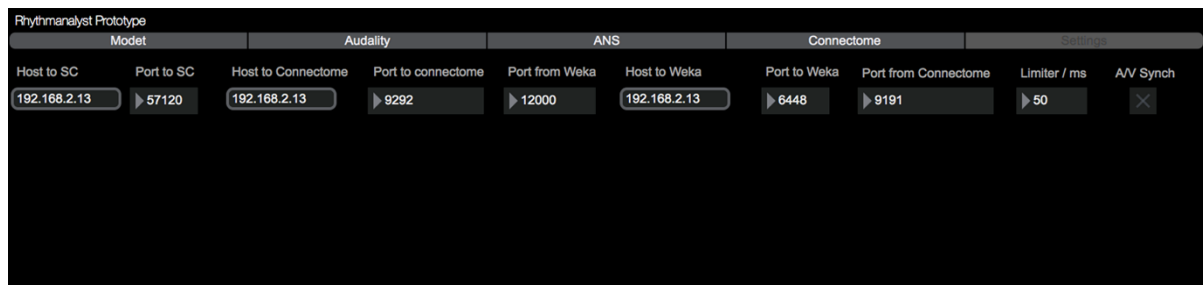


Figure 6.1: Network settings panel

One of the first features that this environment hosts is the ability to record a sound grain in real-time. As many of the utilised sonification engines are based in PCM processing, such feature was considered as necessary in order to allow the user to integrate the environment of interest in the recording. This feature provides two options: a manual and an automated one. In the first mode the user can record a new input to the granular synthesisers by pressing the button corresponding to each unit. In this way the timbres of the sounds can alternate during a recording, without affecting the periodic qualities of the sonification. The second option is based on an automated process. This method was realised in the "Audible motion unit" and consists of the possibility to record a new sound every time that the audio input is considered as "unclassified" by the SVM algorithm. Following this, when the probability distribution of the classification algorithm presents uniformity, a new sound is recorded.

Various tests on this development have showed its high demands of processing power. In order to overcome this boundary, a network between two computers was utilised. Using this method, every computer is responsible for one task. The analysis is realised in the first computer while the second unit is responsible for the synthesis (figure 6.2). Aiming to limit the amount of complexity that this process may carry, a

common interface responsible for both analysis and synthesis was built. This framework constitutes an attempt to organise and unify the independent designs in order to provide the ability of synchronous analysis and synthesis.

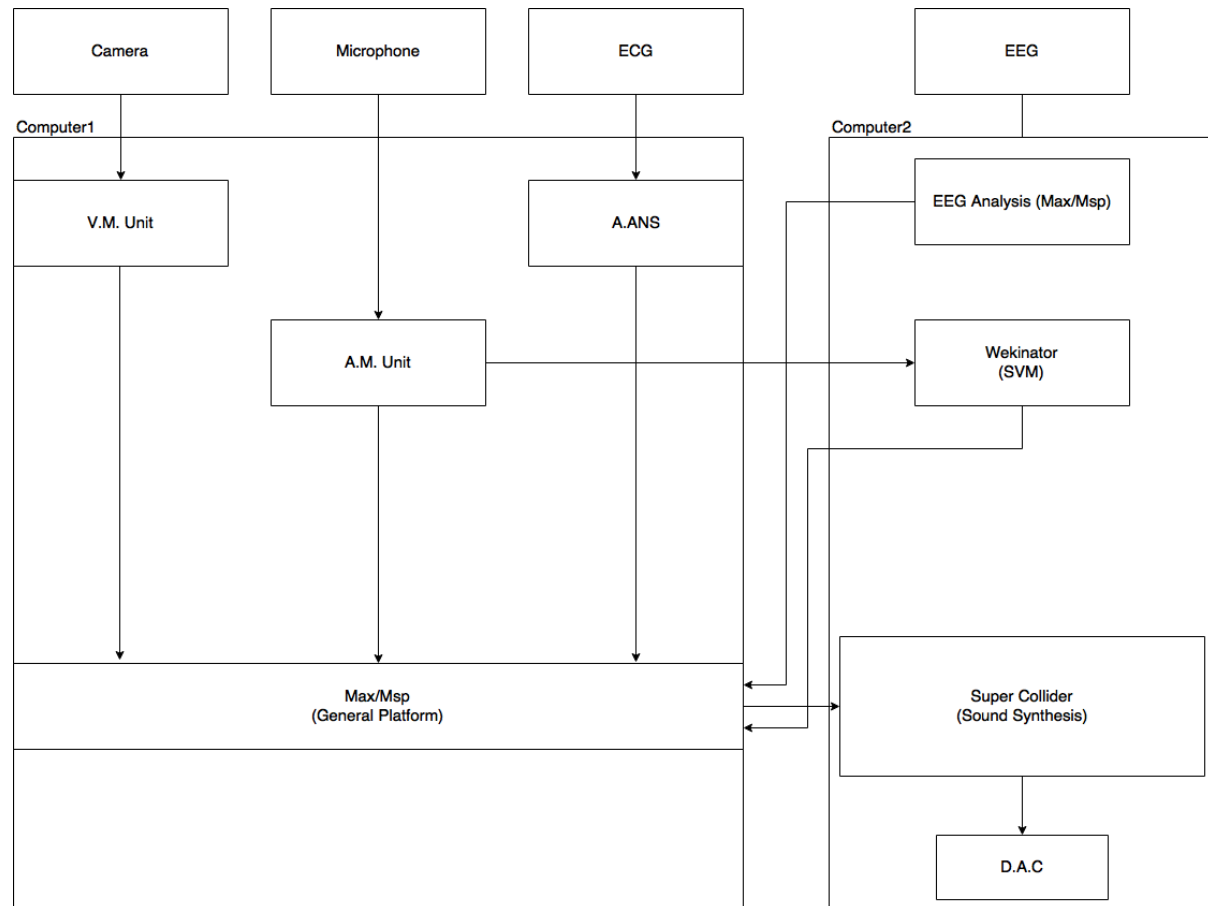


Figure 6.2: Rhythmanalyst, network flow graph

The main objective of these various developments is to adopt the rhythmanalytical elements in the compositional domain. The discussed system aims to provide a tool based on rhythmanalysis and able to apply those elements in the intersection between the subject and the environment. The musical utility of this tool is still to be tested through corresponding compositional techniques and music oriented experiments.

Compositional experimentation

4.1 Musical Applications of Rhythmanalysis

The main ambition of the presented implementation is to constitute a counter-proposal to what is usually referred as schaefferian phenomenology. This idea finds its origins in the act of field recording. The presented syllogisms and the accompanied development aim to propose that the qualities which characterise a surrounding sound as attractive are not located in the sound material itself. To the contrary, it is suggested that those qualities are revealed through a temporal interaction between the subject and the environment in which this material is located. Recent interest in “site-specific” compositions point already in a direction where the characteristics of the environment are vital for musical expression (Demers, 2009). Based on this proposition, the discussed development aims to communicate features of temporal interactions, while in the same time it reduces a considerable amount of surrounding information, which considers as low-priority for this specific approach to musical expression. Rhythmanalysis provided a series of interconnected elements that makes possible an analysis of bi-directional relationships between the observer and the observed. Subsequently, sonification appears as a tool for reduction in order to emphasise the periodic elements of this grasped interaction. The sonic material that this development provides, aspires to be treated as initial sound source for the realisation of fixed-media compositions. This ambition highlights the urgency to overcome the expression of the environment through its materiality. By following this path, this methodology aims to communicate a situation grasped through the subjective prism of the composer ([video example: 1](#)).

Through conducted experiments multiple findings implied further possible applications of this development. The utilisation of the above system in real-time situations can initiate a performance method by which the performer does not affect the sound results directly. This application suggests that the performer can affect the concert environment by setting objects in motion, while the music reflects how this process affects back the musician. Furthermore, the application of the discussed development to site-specific installations, can be utilised in order to apply an interactive element to sound results. The possibility to invite the audience to wear the system and simultaneously listen to its results implies a form of cognitive feedback that can conclude to a musical quality which its based on the audience while it reflects its reactions. Another possibility that this system could offer, regards the

realisation of notated, reproducible compositions. Following a methodology by which the composer notates sequences of environmental events able to be reproduced, she can allow the composition to be performed by various performers in a variety of situations. This conception, introduces the performer as an active part of the composition, while the audience is challenged to locate the differences that different subjects introduce to preconceived music.

Most of the above expressed ideas carry the form of speculations and require further practical research. The expressive capabilities of such propositions cannot be proven in a writing form, while their ambitions are located into compositional procedures. The following pages are dedicated to describe some initial experiments that were realised in the compositional domain and aim to investigate a small part of the above speculations.

4.2 Seen from the Window 0.3

The following compositional attempt is inspired by Lefebvre's homonymous essay (Lefebvre, 2004, pp.27-38). "Seen from the window" is a written Rhythmanalysis that the author realised with the aid of a window (as described in chapter 2.3). By invoking the intimate nature that characterises the relationship among observers and their windows, Lefebvre, attributes reductive capabilities to the object itself. The nature of this relation constitutes the premise of this attempt, that aims to utilise the space in-between windows and observers. This composition carries the ambition to communicate the consonants and dissonances that can be found in such relationships.

The realisation to be presented is based on four different rhythmanalytical recordings in various locations in The Hague. The busy ambience that during rush hours fills the commercial part of "Fahrenheitstraat" is grasped through the recording of the first realised observation. Subsequently, the more rural behaviour that can be observed in the narrow, sea-side streets of "Scheveningen" contributed the second grasped observation. On the other side of the map, the third observation was grasped in the crowded streets nearby the "Holland Spoor" train station. Finally a peaceful window, located in a side-street near "Juliana van Stolberglaan", provided the environment in which the fourth observation was registered (figure 7.1).



Figure 7.1: Map of recording locations

The recorded material carry the objective to express the differences that the aforementioned environments attribute to the observational procedure. The visual stimuli, filtered by the window, is characterised by its motion qualities ([sound example: 6.1](#)); the same stimuli, when it reaches the eye of the observer, initiates a specific brain reaction ([sound example: 6.2](#)). The interaction between the stimuli and the brain is expressed in the form of a sonic dialogue, a dialogue that can be perceived as musical syntax ([sound example: 6.3](#)). Similarly the interaction occurred between audible stimuli and the autonomic responses of the body enriches this same dialogue. The discussing compositional attempt aims to tame this syntax, that reflects the qualities of the four different observations.

The selection of the recorded material appears as the first necessity of the compositional process. Based on some indicative notes, taken during the recordings, the material is classified according to similar behaviours (figure 7.2). Furthermore, the initial sonic elements have been examined based on their sonic relationships. This classification has been treated as a tool for organisation in order to redistribute the material in a new time scale.

Aiming to avoid significant interferences with the initially grasped observations, a limited amount of post-production processes has been applied. Specific parts of the recordings were isolated in relatively long fragments, varying from a few seconds

Rhythmanalyst Recording Report

Recording Technician : Kyriakos Charalampides

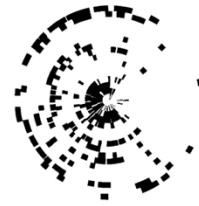
Channels: FL, FR, BL, BR

Production Title: Seen from the Window

Starting Date: 14/3/2017

Report Number: 1

Page: 1/1



Take	Date	Recorder	Window	Time	Duration	Notes
#1	14/3	Kyriakos	Fahrenheitstraat	15:45	15:26	Audality comes in at 08:06 - NDO - Static Buffers (^) - Not useful video
#2	14/3	Kyriakos	Fahrenheitstraat	23:31	08:45	Noisy Background - Con Dropped Connection between 03:12 - 03: 25
#3	17/3	Kyriakos	Fahrenheitstraat	11:15	25:00	Several unidentified audio classes — Data limiter bag
#4	17/3	Kyriakos	Fahrenheitstraat	13:00	06:10	Low battery EEG noise

Figure 7.2: Recording report

to three minutes. As this strategy is characterised by a specific amount of restrictions, the ability to direct the attention of the audience towards specific sound events appears as limited. In order to avoid this boundary, a technique of time manipulation has been recruited. The possibility to time-stretch the recordings has been considered as a method able to zoom into specific temporalities. By this mean, the overall time manipulation of a recording, maintains the periodic relationships among the sounds, while in the same time offers a better articulation to the event of interest. Furthermore, this method allows the subjective prism of the recorder to apply artificial contrasts to the overall composition, thus directing the attention of the audience to the correspondences of interest.

The superimposition of different recordings appears also as crucial, in order to express the relations between the particular observations. This task is characterised by a specific amount of complexity. Usual audio superimposition techniques, based on amplitude and spectral tuning, appear inadequate for this duty, since they suppress the dynamic and spectral qualities of the initial material. Such methods usually conclude to over-complicated results that reduce the expressive possibilities of the initial sound sources. A way out of this deadlock can be found in spatialisation techniques. Every recorded observation is expressed through a quadraphonic loudspeaker setup. Emanating from this point, the usage of multiple quadraphonic systems appears to be able to superimpose the particular recordings without suppressing their initial sonic qualities. This method offers the possibility to assign specific recordings to dedicated loudspeaker setups, while the positioning of the speakers can produce a space of comparison amongst the sources (figure 7.3).

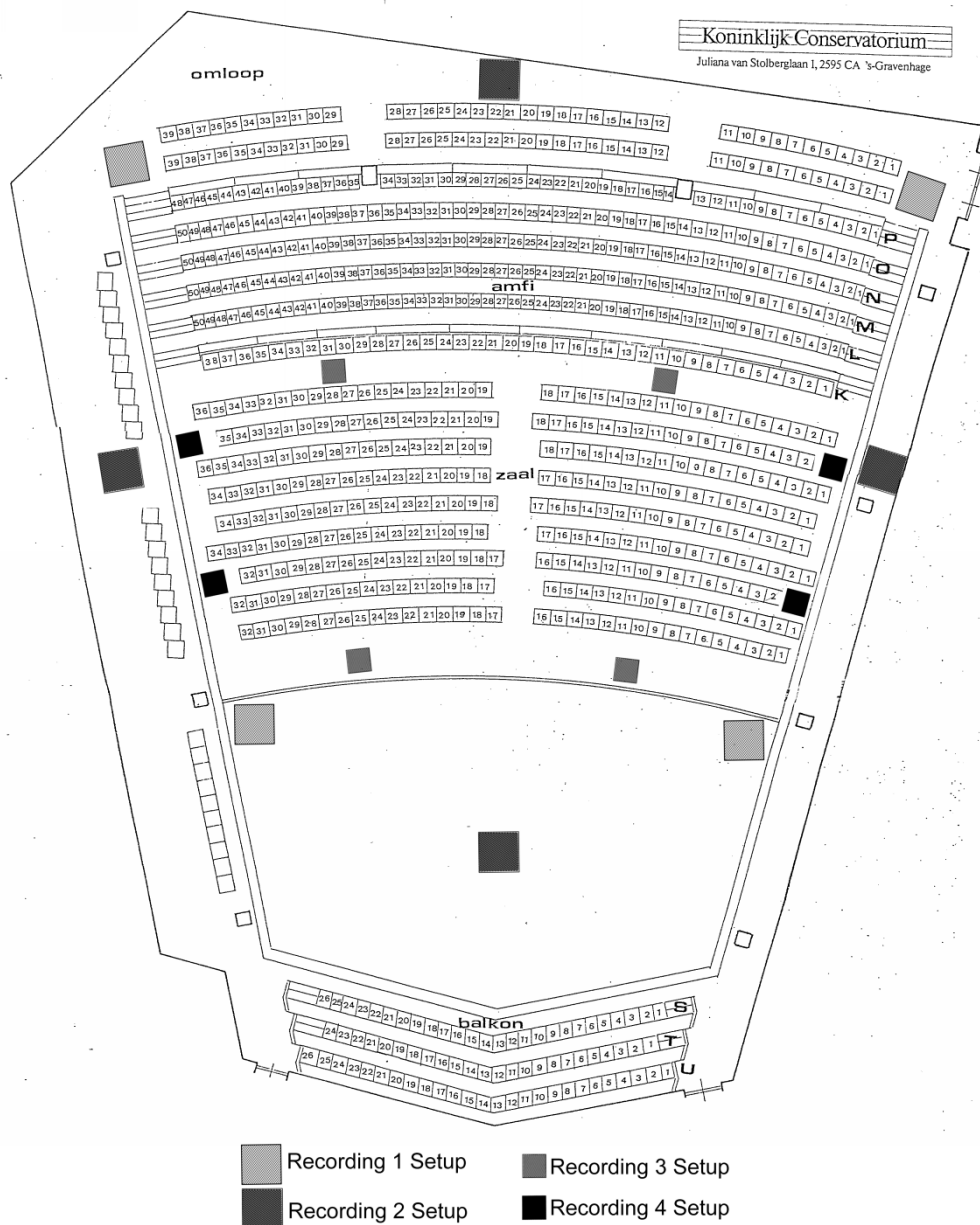


Figure 7.3: Spatialisation plan

Listening experiments are currently underway for this work-in-progress. Any further development will aim to utilise Rhythmanalysis, audio time manipulations and a multiple loudspeaker setup in order to produce a space in-between, where the audience would be challenged to seek for periodic correspondences between different observers and their windows.

4.3 In memoriam of Cassini's satellite

In collaboration with Giuliano Anzani

On 15th October 1997 Cassini's satellite lunched from the Earth with the ambition to observe Saturn and its surrounding celestial bodies. During the following years, this endeavour explorer discovered no fewer than seven moons and provided more than 300 000 images until its fuel was used up. On 27th April 2017 its final mission, to penetrate into Saturn's atmosphere, was initiated. During Cassini's final plunge the objective will be to observe, for one last time, Saturn's environment. This twenty-year old observer will perform its swansong on 15th September 2017. The "In memoriam of Cassini's satellite" performance is dedicated to the memory of this committed observer.

The discussing performance refers to a collaborative improvisation with Giuliano Anzani and his *ExGen* system. The use of stochastic processes for musical purposes characterises the performative practice of Anzani. By using alternations of the *Gendy* algorithm, he approaches computers, not as passive tools that obey to specific orders, but as active parts of the musical process that determine respectively the actions of the performer (Anzani, 2017). Such approaches have already indicated their expressive potentials. From Second-Order Cybernetics (Foerster, 1977) to "From musical ideas to computers and back" (Brun, 1970) the machines are not confined to the role of the observed. To the contrary, they adopt the active part of the observer. These ideas already implied that music can be located in-between computer and musician. Anzani, develops this idea in his musical practice. By utilising the *Gendy* algorithm as a source, the machine preserves a certain amount of autonomy. This independence ascribes to the computer the ability to surprise and influence the performer (Anzani, 2017). A musical process arises from this conception (figure 8.1). The performer initiates the procedure by an introductory idea, which is communicated to the computer, through physical movements on the surface of a controller. The machine reacts to this communication sonically by transforming its sound results to the sonic stimuli that constitutes the surroundings of the performer. Throughout listening, the performer forms his next action. By this methodology, performance is approached as a circulated process, in which the music is revealed through the intersection between computer and performer.

The aforementioned methodology seems also inspiring from a rhythm analytical perspective. The idea of music, as a product of interaction between two observers

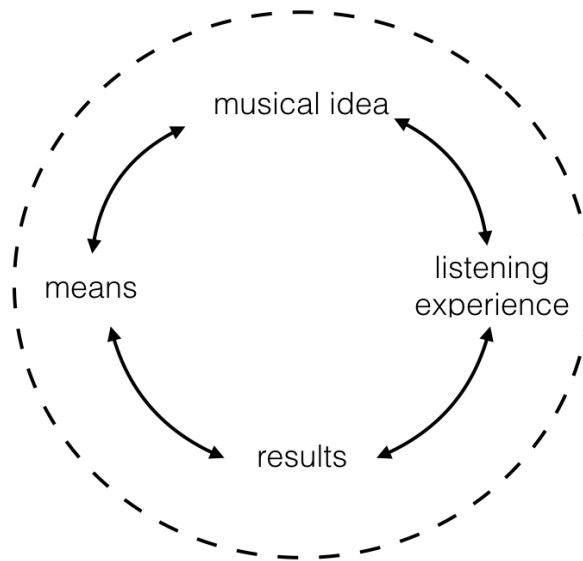


Figure 8.1: Anzani's performative approach (Anzani, 2017)

that observe one another, challenges a variety of elements included in the rhythmanalytical proposition. The possibility to locate and interpret the periodic relations between the musician and the machine appears intriguing for the implemented methodology. The application of Rhythmanalysis in that domain may reveal elements, able to characterise the above relationship. In the discussing performance, Rhythmanalysis adopts metaphorically the role of a satellite that orbits around and observes the circular nature of the performing act (figure 8.2).

The realisation of this performance is based on a combination of the discussed implementation of Rhythmanalysis and Anzani's performative practice. Rhythmanalysis is utilised in order to analyse, periodically, every part of the computer-performer interaction. The physical movements of the performer towards the computer, the sonic reactions of the machine and the biological state of the musician are grasped and sonified simultaneously with the performing act. The objective of this conception is a parallel sonification of the performance, which aims to provide additional sonic stimuli directed to the performer. Along these lines, the interconnected nature of the different sonic elements creates a form of cognitive feedback. The sound results of this practice aspire to express the space in-between the performer, the computer and their periodic relation.

In order to create a musical glossary for this circumstance, an empirical approach has been followed. A series of experiments has been held in order to test the expressive possibilities of the above presented idea ([video example: 2](#)). A

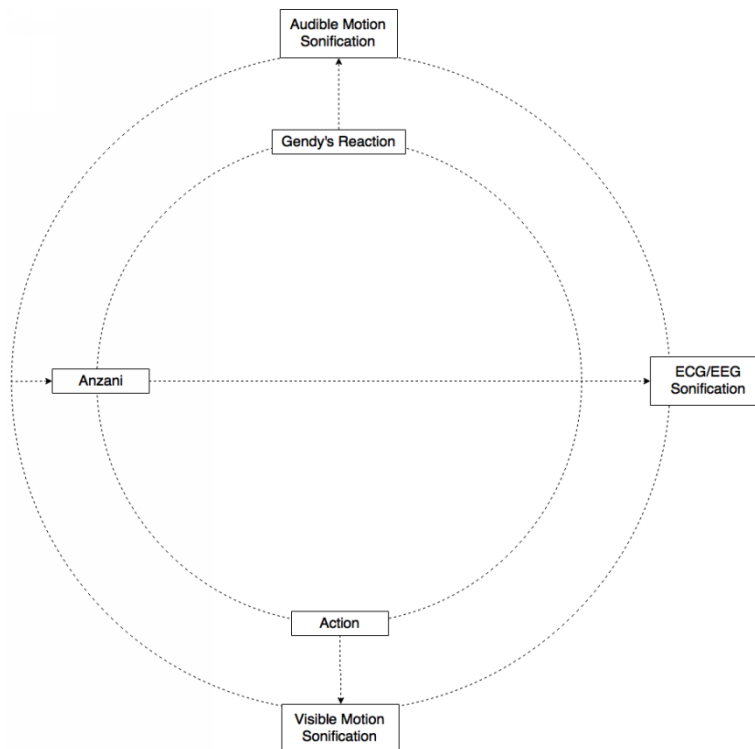


Figure 8.2: Performance flow graph

tendency to complex and indistinguishable sound results appeared as an initial finding. In order to overcome this issue, a spatialisation technique will be recruited (figure 8.3). Aiming to achieve a balance between the sonic outcome of the performance and its sonification, Anzani's system is to be locally amplified, while the rhythm analytical sonification will be projected through a quadraphonic PA system. This distinction aims to create two parallel spaces for the sonification and the act of performance. The initial experiments, also, emphasised the urgency to limit the complexity that the initial sound carried. This need, combined with a preference for a more stabilised musical outcome, appeared as a dilemma. A more interventional approach to performance, by which the different sounds of the sonification units are mixed in real-time, provides the ability to direct the attention of the audience and the performer to specific interactions of interest. This approach demands a sacrifice of the autonomy that the rhythm analytical system exhibits. To the contrary, a methodology by which the sonification system acts unsupervised, exhibits a larger amount of consistency with the initial conception. Despite this consistency, it has been observed that the unsupervised approach usually concludes to highly complex sound results that may confuse the audience. Based on this conclusion the supervised approach was adopted. Its ability to guide the audience through the complexity that the combination of the discussed systems carries, seems essential

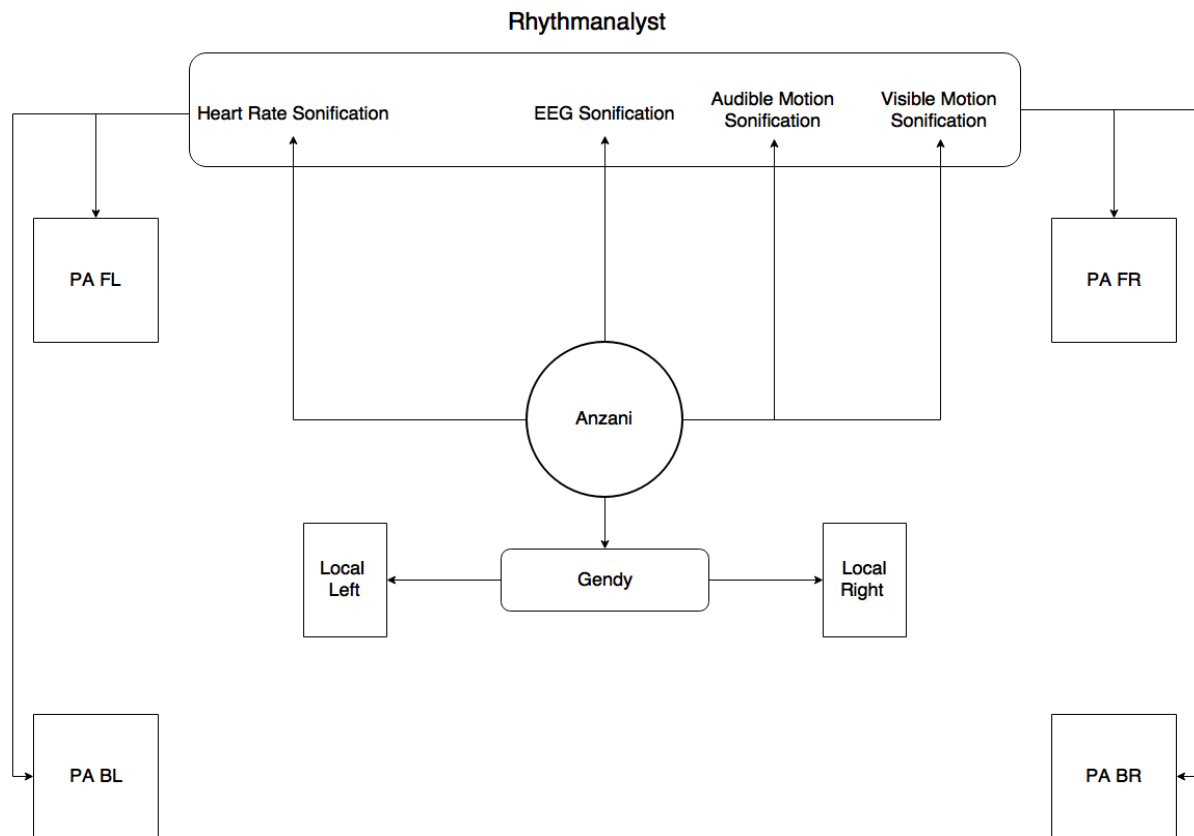


Figure 8.3: Spatialisation graph

for the realisation of this performance. For that purpose an additional interface was implemented for mobile devices. This interface has the form of a two-dimensional surface and provides the ability to interpolate between the amplitude of the four different sonification units (figure 8.4).

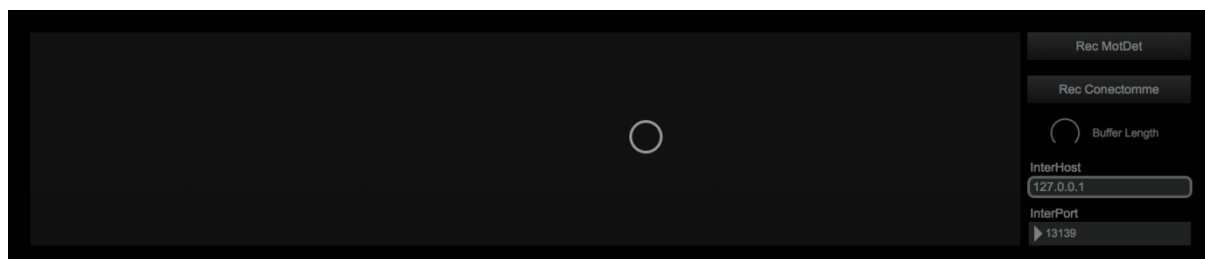


Figure 8.4: Control surface

The presented attempt aims to create a parallelism between the orbital movement of a satellite and the role of observation in electronic improvisation. The organic unpredictability that characterises *Gendy* offers a fertile ground for that purpose while it increases the surprise factor for the performer. The role of Rhythmanalysis in this case is to orbit around the performative process in order to provide a series of indicators regarding the temporal interactions between the performer and the machine. The musical result of this attempt aspires to reveal some

small fragments that constitute the performing act, in a parallel metaphor to how Cassini's satellite revealed the surroundings of Saturn.

This performance marks the end of the present research cycle in the exploration of rhythmanalysis. As an appropriate ending to the last two years of thoughts, research and music, the ideas presented in this thesis will perform their final plunge with the ambition to penetrate into Anzani's performing practice and reveal an insight of the experiences that singed the last years. This journey is an homage to Cassini's flight.

Conclusions

The above pages are dedicated, as a documentation, to a research that was carried during the last two years in the interdisciplinary domain between Rhythmanalysis and music. The main objective of this thesis is to provide a general framework for the utility of Rhythmanalysis in musical composition. The various presented findings and shortcomings aspire to motivate further research in that topic.

The ideas exposed in these pages, carry the ambition to study whether Rhythmanalysis, when applied to the intersection between subject and environment, can reveal musical ideas. Following a path from aesthetics to environment through rhythm, this thesis does not aim to provide restrictive definitions and methodologies regarding the discussed subjects. However, an important part of the expressed ideas is considered to be on the rise and still warrants further research. The propositions included in this writing, aim to present a potential musical framework based on Rhythmanalysis.

The ability to analyse and express sonically the periodic relation between two entities reveals an alternative path towards phenomenologically approached composition. A methodology that aims to grasp and analyse the temporal interactions between the subject and the environment, appears as a counter-proposal to established practices, in which the surrounding material carries the leading role. Furthermore, the utility of sonification as a tool that reduces the surrounding material has shown the ability to shift the aural attention towards the bi-directional flow between a subject and its surroundings, while it exploits the superior ability of the human auditory system to perceive temporal changes. Along these lines, Lefebvre's ideas exhibit the possibility to approach the rhythmical substance of music in order to communicate a situation experienced from a first-person perspective.

A periodic dialogue between the subject's reactions and the responsible stimuli, becomes audible through the presented implementation. The grasped dialogues are transformed into a musical syntax which is driven by temporal interactions between the observer and the observed. Lefebvre's elements of Rhythmanalysis have shown the possibility to be integrated in this process of active listening. The basic findings of eurythmia, polyrhythmia and arrhythmia carry the ability to guide the listener through the complexity that different situations bring to the musical outcome. A documented method that tames the aforementioned syntax, as well as a better articulation of its possible musical applications, still requires much further research. It has been

observed that this task demands a long period of familiarisation. The intuitive practice of seeking for interesting sounds cannot be entirely correlated with the process of seeking for interesting interactions, as this task appears to be more distant from established practices and more demanding in cognitive terms.

For the practical study of the above ideas, a functional prototype has been developed. This development, has been crucial for transferring various theoretical speculations and findings to the musical domain. Despite the valuable contribution of the presented prototype to this research, the technical development is still characterised by some critical restrictions. The followed development plan, ascribes to the system an immobile character. This shortcoming prevents the possibility of immediate recordings and restricts the applications of this method in more prepared situations. Furthermore, the modular nature of the recruited devices is highly perceivable by the user. In various cases, the reactions of the subject can be altered due to the awareness of this unnatural situation. Based on these reasons, the presented development is not considered as an ideal implementation of the above ideas. Nevertheless, its contribution to this research was crucial as it exhibits a consistency with the initial conception and provides an experimental platform for studying and practicing the subject of interest.



Figure 9.1: Future concept design

A general methodological framework is presented through these pages. The various shortcomings, spotted in the initial hypothesis and its implementation, can motivate further developments in order to optimise the application of Rhythmanalysis in the field of music. The possibility to increase the autonomy of the discussed

system through the implementation of unsupervised analysis methods seems able to increase the degree of accuracy to the procedure. In addition to that, a further development of the sonification engines may be able to provide more pleasant and consistent sound results. Along these lines, a more concrete and dedicated design of the recruited equipment may be proven to be able to overcome the immobile nature that characterises the current state of development. For these reasons, an optimised design is considered (figure 9.1, [video example: 3](#)). The shape of this design aims to result in a comfortable, wearable, multi-sensor device that carries the ability to transmit wirelessly the data of interest to mobile devices. This concept rises from the above findings and aspires to provide an easy-to-use method that is able to record instantly any interaction of interest. The implementation of this design is considered as a possible next step to the discussed investigation, but still has a premature and unexplored character.

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Included Material

*Stereo and compressed versions of the included material are also available [online](#)

Video Examples	Title	Description	Reference Page	Duration	Channels
1	Recording Experiment 1	Two individuals playing cards. The image fades out after the first minute. It is suggested to follow the movements of the girl's hand.	58	14:12	4
2	Rehearsal Excerpt	First rehearsal experiment with Giuliano Anzani	64	2:18	4
3	Concept Prototype	Concept Design for a future prototype	69	00:32	
Sound Examples					
1.1	Seen From the Window 0	Compositional attempt based on the initial experimentation period	43	07:50	4
2.1	Jar filled with sugar cubes Motion	Experiments. Jar filled with sugar cubes	45	0:15	2
2.2	Jar filled with sugar cubes Circular Motion	Experiments. Jar filled with sugar cubes	45	0:16	2
2.3	Visible Motion Detection Unit Example	Sound Example VMD Unit	46	0:28	4
3.1	Audible Motion Detection Unit Example Dry	Test Recording of 5 different sound qualities	46	0:26	2
3.2	Audible Motion Detection Unit Example Vocoder	Sound Example AMD Unit (Input: 3.1)	49	0:25	4
4.1	Heart Rate Unit Example	Sound Example A.ANS Unit	52	0:14	4
5.1	Beta Waves Example	Sound Example Brainwaves Unit	54	0:36	4
5.2	Alpha Waves Example	Sound Example Brainwaves Unit	54	0:36	4
5.3	Theta Waves Example	Sound Example Brainwaves Unit	55	0:36	4
6.1	Visible Motion Sonification Isolated	Isolated part of Rhythmanalytical Recording	60	0:24	4
6.2	Brainwave Sonification isolated	Isolated part of Rhythmanalytical Recording	60	0:18	4
6.3	6.1, 6.2 Superimposed	Rhythmanalytical Recording example	60	2:22	4
Prototype					
Software Documentation	Rhythmanalyst Manual	Basic guidelines regarding the installation and workflow of the prototype			
Rhythmanalyst 0.3	Rhythmanalyst 0.3	Max/Msp Patch			
Sound Engine 0.3	Sound Engine 0.3	Set of Super Collider Scripts			

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