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Citation: Bell, Jonathan (2016). Audio-scores, a resource for composition and computer-aided performance. (Unpublished Doctoral thesis, Guildhall School of Music and Drama)

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Audio-Scores:

A Resource for Composition

and Computer-Aided

Performance

Jonathan Bell

Final submission

DMus

February 2016

Abstract

This submission investigates computer-aided performances in which musicians receive auditory information via earphones.

The interaction between audio-scores (musical material sent through earpieces to performers) and visual input (musical notation) changes the traditional relationship between composer, conductor, performer and listener. Audio-scores intend to complement and transform the printed score. They enhance the accuracy of execution of difficult rhythmic or pitch relationships, increase the specificity of instructions given to the performer (for example, in the domain of timbre), and may elicit original and spontaneous responses from the performer in real-time.

The present research is inspired by, and positions itself within traditional European notational practices. Through a reflection on the nature and function of notation in a variety of repertoires, this study examines how my own compositional research – and its reliance on audio-scores – relates to and differs from the models considered. Following the realisation of pieces investigating complex rhythms and the use of recorded samples as borrowed/found material, results have proven to be highly effective with a group of vocalists, with works in which audio-scores facilitated the precise realisation of microtonal material. Audio-scores also proved particularly useful in site-specific ‘immersive’ concerts/installations. In these settings, audio-scores mitigate challenges associated with placing musicians at an unusual distances from one another, e.g. around the audience.

This submission constitutes an original contribution to knowledge in the field of computer-aided performance in that it demonstrates how musical notation and current ubiquitous audio technologies may be used in tandem in the conception and performance of new works. Recent findings include a Web application currently being developed at IRCAM. The application is based on a local server and allows the synchronous delivery of audio/screen-scores via the browser of the performers’ smartphones, tablets, or computers.

Keywords: audio-score, click track, composition, computer-aided performance, earpiece, microtonality, music, notation, performance, screen-score, server, voice.

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p. 25, Figure 4: December 1952 by Earle Brown

p. 56, Figure 12: Time After Time by Canan Tolon

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Acknowledgements

I am very grateful to Dr Richard Baker and Prof. Julian Anderson for allowing me to pursue this doctorate at the Guildhall School of Music and Drama.

My supervisors, Dr James Weeks and Dr Nye Parry, have been immensely helpful in deepening and diversifying the research undertaken in this commentary, and their remarks on my compositions have always been source of stimulation and enlightenment. This research would have never been possible without a scholarship from the Guildhall School.

I am also very grateful to the singers, instrumentalists and dancers who participated in the performances of this folio of compositions:

- Students of the Guildhall School of Music and Drama:
Benjamin Graves, Felicity Hindle, Taichi Imanishi, Filip Jeska, Marta Lagoda, Maria Laskowska, Max Mausen, Igor Michalski, William Newell, Katrina Pett, Alexia Pingaud, Yoanna Prodanova.
- Students of the London Contemporary School of Dance:
Julie Schmidt Andreassen, Mansoor Ali, Robyn Ann Holder, Tim Clark, Emily Crouch, Rickard Fredborg, Victoria Guy, Bridget Lappin, Ellen Nous, Jessica Sim, Elliot Smith.
- The Zafraan Ensemble (Berlin)
- Paul Clift, Ellie Duris, Daniel Figols-Cuevas, Marisa Gupta, Chiawen Kiew, Simone Wang and Lambros Zannettos.

I would like to thank Aaron Cassidy, Martin Iddon, Rytis Mažulis, Pia Palme, Canan Tolon, Babelscore and Alphonse Leduc Editions, for allowing me to display score extracts in the present thesis. Finally, an important part of the work presented here owes its existence to the *De Caelis* Ensemble, which occupies a crucial role in my compositional activity. The vocal works of this folio of compositions, as well as a great majority of the results collected and analysed in the present commentary, were the fruit of an intimate collaboration with this ensemble and its artistic director, Laurence Brisset, who has believed in the potential of this artistic research since 2007.

Introduction

Notation is one of the greatest assets of Western Art Music. Any trained musician is capable of describing the score and its role. Yet, this archetypal object depends, since the Middle Ages, upon a highly abstract chain of communication: initially, the composer's intent is rendered using notational symbols, which are subsequently interpreted into physical gestures by a performer, and finally, perceived as sounds by a listener. My research uses current technology to complement, transform and enhance the information communicated by the composer to the performer. The present study focuses on this transfer of information, and proposes a form of *computer-assisted performance/interpretation*¹, which was devised in the realisation of several new works.

Click tracks diffused via earpieces to each performer facilitate a high degree of rhythmic synchronisation. Similarly, 'audio cues' (transmitted in the same way) may both a) help in the realisation of material which may be very difficult to pitch (as with microtones and spectral harmonies), and b) assist in eliciting, through the use of recorded samples, spontaneous responses from performers, notably in the domains of extended instrumental and vocal techniques. These two notions (click tracks and audio cues, hereafter collectively described as *audio-scores*), also allow the performers to be placed at distance from one other. Finally, the simultaneous use of both auditory (audio-score) and visual (printed notation) materials in the transmission of compositional intent significantly facilitates the recall of the performers' separate parts, expediting the learning and rehearsal process of a new work.

The use of audio-scores tends to reduce differences from one performance of a given work to the next. One positive consequence of this is that technical realisation (as, for example, the synchronisation with other media) is achieved more easily. However, negative consequences, notably the extent to which such technology impinges upon spontaneity/creativity and interpretive nuances of the performer, must equally be examined. At the crux of this research is the

¹ The term is borrowed from Mikhail Malt's term '*interprétation assistée par ordinateur*' (Malt & Sluchin, 2011), itself a derivation from the notion of '*composition assistée par ordinateur*' (computer

endeavour to find a middle-path: one which offers the gains that are brought about through the use of such a compositional/performance-tool, whilst infringing as little as possible upon the ultimate appropriation of the work by the performer.

The audio-score medium strongly influences, in equal measure, the way in which the music is composed, and the way in which it is interpreted. The present study addresses questions about its relationship with notation, which it never tries to substitute, but rather, complement. The first chapter focuses on notation, describing how this notion may be understood from different perspectives, and in different periods in history. I explore its nature and function in various repertoires as well as in my own music. The second chapter is a comparative study of notation in the music of Morton Feldman and Brian Ferneyhough, who were both of central importance in my own development as a composer. Chapter 3 discusses the challenges that the score may present to the performer, and historical strategies that have been devised to address these problems. Finally, after outlining previous uses of electronic means to guide or conduct performers, a list of pieces that employ auditory signals to this end is offered.

I first arrived at the idea of audio-scores through the angle of click tracks and synchronisation. As a result, Chapter 4 deals mainly with rhythm and *polytempi*. During the second year of my doctorate, I started using samples of recorded music in order to stimulate original responses from performers; accordingly, Chapter 5 discusses the implications of borrowing recorded material in my own compositional practice. Chapter 6 corresponds to the vocal works written between Year 2 and 3 of my doctorate. The principal role of audio-scores in this chapter was to facilitate the singing of micro-intervals. Chapter 7 deals with site-specific composition, immersive installation and placement of performers in a particular space. These works, of long duration, founded upon a relatively small reservoir of musical materials, are discussed in relation to the music of Morton Feldman. Chapter 8 is a presentation of *The Wanderer*, the final piece of my doctorate. This chapter is a synthesis of the various techniques and concepts that were explored in the composition of this folio of works. Chapter 9 summarises the various issues raised by the use of audio-scores: its potential, its impact on the composer, the performer and the listener, etc. Chapter 10 outlines the different approaches to notation with which I experimented during my first year at IRCAM (2014-2015). This chapter briefly outlines future projects and improvements of audio-scores that I hope to achieve during my second year

at IRCAM in 2015-2016. Finally, it draws general conclusions on the current state of my research.

1 NOTATION

Introduction

‘In the beginning was the word...’
(Gospel of John, 1:1, King James Version)

Many cultural archetypes resonate in one way or another with the simple idea that the words we use to name or describe things have a crucial impact on their essence. This idea is present in various realms of study in the humanities, including philology, linguistics, literary criticism, semiotics, semiology and semantics. It is also expressed by diverse thinkers, who seem to agree on the importance of words and language, in spite of their different philosophical positions. For instance Marshall McLuhan writes that ‘the medium is the message’ (McLuhan, 1964), Jacques Lacan’s argues that ‘the unconscious is structured like a language’ (Lacan & Fink, 2007), Ferdinand de Saussure contends that ‘without language, thought is a vague uncharted nebula ’ (Harris & Harris, 1987), and finally, Martin Heidegger attempts to ‘unconceal’ or elucidate ontological questions through the interpretations of Hölderlin-and Greek poetry (Heidegger & Hertz, 1982).

The strength hidden within words is well expressed today in a statement by Nicholas Cook: ‘Language constructs reality rather than merely reflecting it’ (Cook, 2000), which I will return to in Chapter 9.2.1 below in this commentary. Cook’s statement reminds us that the word ποίησις (*poiesis*), the root of our modern poetry, comes from an active verb, ποιέω, an action, meaning ‘to make’.

If, as Beethoven claimed, the composer is a *Tondichter*, or a sound poet, he does not operate with words, but with musical symbols. Nevertheless, these very general considerations can only encourage the composer to constantly question the function of notation, in search for the most appropriate and meaningful ways in which to engage with performers and audience.

1.1 Notation and composition-centred practices

1.1.1 The influence of notation on composition in its historical context

In Western Art Music, composition is associated with musical notation in such an intimate way that it is impossible to dissociate the function of the latter from its music-historical context. In France in the 14th century, for example, a treatise attributed to Philippe de Vitry, *Ars Nova Notandi* (1322), exposed new techniques of rhythmic notation. This notational system lent its name (*Ars Nova*), and shaped the genre, style, and structure of the music of an entire era.

Later in Italy, the *Seconda pratica*, or *Stile moderno*, most commonly associated with Monteverdi, also reflects a profound modification within the notational system, with the decline of separate parts, the emergence of full scores and the generalisation of bar lines. According to the entry for 'bar line' in the *Harvard Dictionary of Music*: 'In ensemble (vocal) music the bar line was not introduced until the latter part of the 16th century, when the notation in single parts gave way to notation in score arrangement' (Randel, 2003, p. 82).

From the Baroque era until approximately 1945, notational conventions changed relatively little (with the exception of developments relating to dynamics). In this sense, notation was not a catalyst for the transformation of compositional practice during this period. The situation changed after World War II. For composers of the New York School in the 1950s, indeterminacy, and also possibly the influence of abstract expressionist painters, gave rise to a rigorous rethinking of standard notational practices. Composers of the European avant-garde also identified limitations in traditional notation, but as the composer and cellist Frank Cox points out, 'they in general accepted the notion of its functional transparency' (Cox, 2002, p. 74). In contrast with New Complexity composers, their main successors, who consider notation as an 'opaque' medium, charged with meaning or intention, composers of the European avant-garde regarded notation as 'transparent', sufficiently suitable to the meta-musical experiments of integral serialism; in this sense, according to Cox: 'the medium possessed no *density*' in its own right (Ibid. p. 74).

Nevertheless, some ten years later, the notion of the *Open Work* emerged in Europe, giving rise to works of structural indeterminacy, such as Stockhausen's

Klavierstück XI (1956), or Boulez's *Troisième Sonate* (1957). This context was also favourable to the emergence of original types of notation such as that of Berio's *Sequenza III* for voice (1966). André Boucourechliev and Silvano Bussotti were respectively great admirers of Earle Brown and John Cage, and the notion of the *Open Work* remained present throughout their careers. Both Boucourechliev and Bussotti used unconventional notation in which one or more compositional parameters is determined by the performer, thus validating multiple, contrasting interpretations instead of imposing a definitive text.

Since the 1970s, composers of the so-called 'New Complexity' school have considered notation as inherently linked to the broader musical project. For these composers, the role of the score as a medium, and the potential of notation to act in diverse ways as a stimulus, constitute key preoccupations. Although my music is not 'complex' in this sense, the issues pertaining to the relationship between composer and performer as raised by 'New Complexity' composers often resonate with my research. Their theoretical views and the solutions they developed in order to address perceived problems with the status quo are of great significance to my investigation into computer-aided interpretation and its relationship to musical notation, since their research focuses on the *medium* (the score) through which the composer and the performer can interact.

1.1.2 Meta-music, composition-centred abstract systems

European musical notation relies on purely abstract constructs. The concept of the note as a stable, sustained pitch, or the notation of time with bars, rhythm and tempo markings, are arbitrary and culturally-inherited representations of sound. It is within this imposed framework that the composer still operates today when he uses traditional notation.

In church music of the Renaissance, the notational system and the compositional rules only allowed for a finite number of possibilities of contrapuntal constructions. As a result, compositional practices came to resemble algebra or combinatorics, closely circumscribed by what the notational system allowed. Whether sung from the original notation, played by a viol consort, or even performed by an ensemble of marimbas reading from a score with modern clefs, in each instantiation of the work, the contrapuntal relationships remain comprehensible and most of the intentions of the work are communicated. In spite of the pictorial quality of Renaissance manuscripts,

notation at that time functioned as a systematic and unambiguous code. It facilitated an assessment of adherence to – or deviation from – the rules expounded in the treatises of the day.

Musical notation at that time was arguably consistent with the notion of the notational system as described by philosopher Nelson Goodman: 'a symbol system where each symbol corresponds to one item in the realm, and to each item in the realm only one symbol in the system' (Giovannelli, 2005, Chapter 3.2). In his book *Languages of Arts* (Goodman, 1976), the philosopher describes a theory of notation leading him to place music and painting at two opposite ends of a spectrum. Music is at one end, being *allographic*, i.e. allowing for notation, or different but equal instantiations of the work. Painting is at the other end, being *autographic*, a term which the philosopher defines as follows:

A work of art is *autographic* if and only if the distinction between original and forgery of it is significant, or better, if and only if even the most exact duplication of it does not thereby count as genuine.
(Goodman, 1976, p.113)

Therefore, music and *allographic* arts allow for multiple reproductions of the score, each of which may be said to be equally valid. Painting and *autographic* arts, in contrast, engages with the specific, singular item, which is historically connected to the artist who produced it.

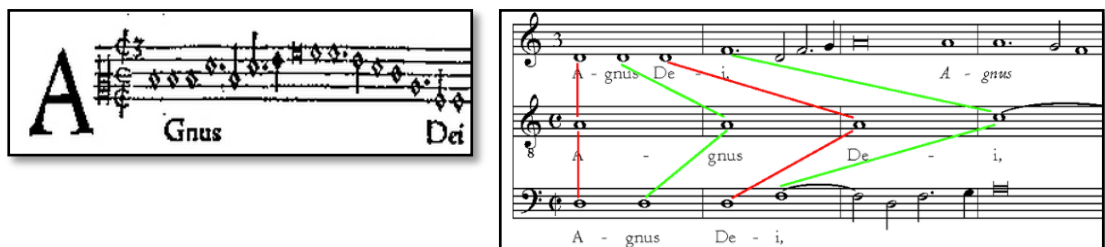
Because Goodman's classification is very schematic, his theories and views on notation have been the subject to criticism by a number of scholars.² Nevertheless the *allographic* concept exemplifies how musical notation is, in Goodman's view, the best example of an art form dealing with purely abstract material (i.e. symbolic signs) as opposed to painting or sculpture which engage with concrete objects. Notation, therefore, reflects an abstract compositional idea, whose distance towards its realisation in performance is evocative of a domain that might be called 'meta-music'. For example, in pieces such as Ockeghem's *Missa Prolationum*, or Webern's *Symphony Op. 21*, each sound

² For criticism of Goodman's theory, see, for example: A. Ralls, 'The Uniqueness and Reproducibility of a Work of Art: A Critique of Goodman's Theory,' *Philosophical Quarterly*, 22 (1972); J. Margolis, 'Numerical Identity and Reference in the Arts,' *British Journal of Aesthetics*, 10 (1970); A. Saville, 'Nelson Goodman's Languages of Art: A Study,' *British Journal of Aesthetics*, 11 (1971).

may be explained according to a set of axioms, in the manner of mathematical demonstrations. Regardless of whether or not the refinement of the notational/compositional construction is audible in these works, their strength arguably lies, in no small part, in an organisational coherence - one which was devised not according to sonic criteria, but rather through notation-based processes. Thus, these works enjoy a sort of autonomy vis-a-vis their concrete sonic existence.

Historical continuity can therefore be observed between the combinatorics found in Renaissance polyphony, serial music, and the work of some contemporary composers. These works manifest a sort of rigorous meta-musical coherence that is almost exclusively *notational*. It is precisely the syntactical divide, with the sonic result on one side, and coherence within the notational system on the other side, that allows for verification of acquiescence to a codified system of organisation of every single pitch. A parallel can be drawn here between a notational system and a fundamental aspect of mathematics: 'As far as the propositions of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality' (Einstein, 1921). The meta-musical coherence that we observe in the scores of Anton Webern surely derives, to some extent, from his in-depth study of late 15th century composer Heinrich Isaac. The context is, of course, very different in the case of Webern and that of Isaac or Josquin. Nonetheless, notation and compositional materials interact on the basis of a similar principle. For instance in a proportion canon by Josquin, where the singers all read from the same musical line at different speeds and in different clefs (Fig. 1-2), a note deviating from the rules of the canon is not 'notatable'.

Figure 1-2: 2nd 'Agnus Dei' from *Missa L'homme Armé Super Voces Musicales* by Josquin



Compositional rules and procedures appear as entirely subordinate to notation (i.e. the former may be considered a ramification of the latter).

Similarly, in Webern's music, the coherence found within the dodecaphonic processes reveals a subordination of the compositional rules to the notational system. According to Chris Dench, Webern represents the archetype of *Augenmusik* (eye music). For him the mismatch between the construction on paper and the aural result is evident, but does not diminish the quality of the music: 'Never mind the inescapable perceptual evidence that the lucidly notated point-after-point of Western Art Music is not matched by any such aural clarity' (Dench, 2002, p. 180).

This sort of mathematical coherence, found in the analyses of Webern's serial works, famously influenced Boulez and Stockhausen in the 1950s. This Webernian coherence was persuasive. For instance, when assessing a proven mathematical theory, all deemed capable of comprehension are expected to agree: there is not room to argue 'I understand what you say, but I don't agree'. Moreover, this coherence was in itself the object of aesthetic admiration. I am reminded here of a quote by Bertrand Russell: 'Mathematics, rightly viewed, possesses not only truth, but supreme beauty – a beauty cold and austere' (Russell, 1919, p. 60).

Whilst the notation of most tonal music may be viewed as a transcription of something which was first heard in the mind's ear, the rational constructs which we find in some Renaissance or serial music presupposes that tone-rows or canonical imitations were first calculated within the notational system, and then imagined as sounds. For a composer to prioritise a perceived beauty/logic/coherence within the compositional system over the sonic result would today be controversial. However, this danger was probably not as evident for composers of the avant-garde of the 1950s. In this sense, Feldman – who often took great pleasure in reporting that Boulez had said that he was less interested in how a piece sounds, rather than how it was made – was not only provocative, but also visionary. As often with Feldman, he supported his argument through analogies with the visual arts: 'No painter would talk that way. Phillip Guston once told that when he sees how a painting is made he becomes bored with it' (Johnson, 2001, p. 178).

1.1.3 On the role of intuition in my own practice

In spite of being a great admirer of the repertoires discussed above, such rational procedures are often foreign to me. In my own practice I prioritise an

entirely aural/intuitive generation (or discovery) of material, instead of establishing a set of generative rules. In this respect, I adhere to some extent to Debussy's doctrine 'Works of art make rules; rules do not make works of art' (Paynter, 1993, p. 590). It is therefore very rare in my scores to find, for instance, a number sequence or a series of intervals that would reveal how the material was produced. Moreover, following on from my hypothesis that compositional rules can often be conceived as subordinate to the notational system, the reliance on audio-files when I compose results in decisions made by ear rather than by any rational notation-based construct, and hence constitute a viable alternative to the creation of notational material *ex nihilo*. While manipulating material on a computer, I often devise situations where I avoid the possibility to be influenced by the visualisation of the pitches generated. For instance, in some of the *Five Pieces for Voices* (which I will discuss later in chapter 6.2), the microtonal intervals of each vocal line (or each track) could only be modified slowly and independently. With a system of representation that rendered visualisation of harmonic structure impractical, each pitch had to be moved individually, slightly higher or lower, in a manner which gave me the impression of being blind or in a dark room, only being able to trust my ears. In this case, transcription into notation after-the-fact revealed to me the types of pitch structures and principles I intuitively favored. Only at this stage would my music-analyst's mind begin to play a role in the process. Feldman, who famously refused to impose any compositional precepts upon himself, conceded in a conversation with Walter Zimmermann that the compositional process is nevertheless guided by what one may call *subconscious rules*: 'One cannot help but notice in the course of writing a piece that some underlying principle seems to be there' (Zimmermann, 1976, p.1). This idea of 'underlying principle' is evocative for me of notation as discovery, or as an unveiling. It is akin to a transient passage from the subconscious to consciousness, rather than a construction or generation through rational processes. Feldman expressed a similar idea in his 1984 Frankfurt lecture: 'I am not like Stockhausen [...] I'm not creating music, it's already there' (Feldman, 1985, p. 144).

In my own practice, often initiated with recorded improvisations or found-materials, the notion of transcription is essential. The unity of the work (or that which is 'already there' in Feldman's sense) reveals itself *a posteriori* through notation and detachment from the auditory material.

1.1.4 Notation as transcription

The first occasion in which a young composer engages with musical notation is likely connected to transcription in some way. Busoni's definition seems the most appropriate here: 'Notation, the writing down of musical composition is, above all, an inventive way to catch an improvisation so that it can be reproduced' (Kogan, 2010, p. 34). Notation, therefore, may be conceived as a transcription of a given performance. It is here a sort of crystallisation of a musical passage that would normally occur once, and then fade from memory. Its function is reminiscent of a tape recorder or a camera. Notation understood as transcription is univocal. Firstly, it aims for adherence to a *model*: different, successful transcriptions of the same musical fragment should ideally result in the same notated material. However, a distinction should be made when this transcription is to be interpreted by a human performer. The latter is, of course, a necessary figure in the restitution of a given musical passage. To him or her, the notated transcription allows for a virtually unlimited number of possible interpretative variances, and thus permits a distance between his/her version and the *model* which is being reproduced. In the same text, Busoni examines the importance of freedom of interpretation which the score must preserve for its interpreter: 'the performer must free himself from the rigidity of the signs [...]' (Kogan, 2010, p. 34). This position is, incidentally supported by Charles Rosen:

The most successful performances of contemporary works, as of the music of the past, are those that only give the illusion of remaining faithful to the text while they hide a genuine and deeply rooted freedom of interpretation. (Rosen, 1998, p. 73)

In my own compositional practice, notation is often concerned with this ambivalence between a) notation as *transcription*, which is supposed to resemble or represent a pre-existing musical object, turned towards its origins, and b) notation as a stimulus for the interpreter, or as a 'prompt for action'³, i.e. turned towards the work's future, or what it may possibly become.

1.2 Performance-centric notational practice

1.2.1 Limits of composition as transcription

³ The function of notation is understood as a 'prompt for action' in 'Interpretation and performance in Bryn Harrison's *être-temps*' (Clarke, Cook, Harrison & Thomas, 2005)

In a composition such as *Five Pieces for Voices*, the score essentially represents a transcription of material generated on a computer. Its rendering in notation was the result of diverse processes of quantization and measurements. This provides evidence of a *continuous/discrete* opposition, between the signified (the sonic intention, or the sonic result), which is *continuous*, and the signifier (the notation), which is *discrete*. This opposition is best exemplified in the notation of a *glissando* into the pitches by which it passes, or in the ‘encoding’ of a long duration into bars and beats). This *discrete* aspect of musical notation will therefore be discussed in Chapter 1.2.2, with reference to observations by Trevor Wishart on the notion of the *lattice*.

There is little need to state that today, computers offer possibilities to composers that had previously not existed. Yet the reliance on such tools reveals a potential constraint, in my work and possibly in the work of others: in the process of realizing the transcription of an electronic material, the recorded material being transcribed has a tendency to impose its influence like that of the ‘meta-musical’ systems described in Chapter 1.1.2. When, for the sake of faithfulness towards the model, notational inventiveness is negated, we once again find ourselves at the mercy of self-imposed limitations. This illuminates an overarching problem: ‘Meta-musical’ systems, as well as computer-generated sounds transcribed into conventional notation, are equally *composition centered*, in a manner inherited from the 19th century; they minimize the role of the performer. Once a twelve-tone row or a harmonic interpolation is completed, once a sound file is faithfully described, the score is not necessarily meaningful to the performer. How then might he or she assert his or her presence in the process? Some developments in the realm of tablature-based types of scores (Chapter 1.2.3), and the notion of ambiguity in rhythmic notation, in relation to *notation-as-prompt-for-action* (Chapter 1.3.3), will be presented as a potential solution to this issue.

1.2.2 Lattice/continuum

Goodman’s theory of notation is grounded on a finite differentiation between its constitutive symbols. It is precisely this finite or discrete aspect that Trevor Wishart finds most problematic in Western notation: ‘Notation (...) imposes a finite state logic upon the two domains [pitch and tempo]. The result is that music, at least as seen in the score, appears to take place on a two dimensional lattice’ (Wishart, 1996, p. 23).

Trevor Wishart, as well as being a pioneer in electronic music, is a solo-voice performer and improviser. His approach to sound while performing perfectly illustrates the types of gestures, or sonic morphologies for which notation is problematic. In his book, *On Sonic Art* (Wishart, 1996), he mentions the Japanese and Indian traditions as music to which glissando, portamento, vibrato and other continuous transformations of the sound are of central importance. These gestures, whilst commonplace in music of the Eastern tradition, are not well suited to Western notation. Wishart writes: 'An attempt to capture the essence of this music in conventional Western notation would clearly fail miserably' (Wishart, 1996, p. 27). Indeed our notational system is not adapted for such types of gestures and ornaments. As he remarks, music notation viewed as notes on a staff is best suited to a keyboard, where the sound can't be modified and keys can only be pressed up or down: 'The keyboard (...) represents the ultimate rationalisation of a lattice-based view of music' (ibid, p. 27). For Trevor Wishart the *lattice* poses two problems:

1. It 'forces 'musical sounds' onto this lattice', thereby transforming what is being notated according to the constraints imposed by the notational system. This is reminiscent of an interesting anecdote from Brian Ferneyhough. In an interview with Richard Toop he mentions a dream in which he had seen a score, and the frustration he felt upon waking up and realising that he was not able to reproduce it, 'because (...) the act of writing already dictates to you in a very strong and physical way what it wants to do, and not what the thing you are trying to recreate seems to be' (Ferneyhough, 1995, p. 262). Both composers speak of the notational system not as a transparent medium, but rather as a filter with its own behaviour.

2. According to Wishart 'the lattice only remains an approximate representation of what takes place in actual sound experience'. Again on this point Brian Ferneyhough would agree: in an interview with Philippe Alberà he says: 'I don't accept that a musical object can ever be defined precisely by any form of notational convention whatever. Even the most exhaustive notation only offers a semblance of precision' (Ferneyhough, 1995, p. 319). However, while Wishart sees this approximation as a limitation of notational conventions, the impossible match between notation and its acoustic image is source of stimulation for Ferneyhough, prompting him to seek ever more detail in his notation.

1.2.3 Tablature

Trevor Wishart's concept of *lattice* is an apt illustration of what many composers, particularly those who make regular use of extended techniques, find limiting with conventional notation. Today, the main alternative to traditional '*lattice-based*' notation is tablature, or prescriptive notation, in the sense defined by Mieko Kanno: 'Prescriptive notation specifies the means of execution rather than the resultant configurations of pitch and rhythm' (Kanno, 2007, p.1). The distinction between prescriptive and descriptive notation was already discussed in the fifties, as can attest the following statement by Charles Seeger:

'Prescriptive and descriptive uses of music writing, which is to say, between a blue-print of how a specific piece of music shall be made to sound and a report of how a specific performance of it actually did sound (...)' (Seeger, 1958, p. 1).

What brings closer Seeger and Kanno's conceptions is the idea that prescriptive notation is charged with a certain intention, whereas descriptive notation is more neutral, like a transcription from one code to the other. However, Seeger and Kanno use this distinction in very different ways: Seeger considered traditional (common) music notation as prescriptive, and encouraged to use the technologies of the day (oscillograms) in order to *describe* music in a more objective way, and to consider musicology as a descriptive science. Kanno, on the other hand, considers most conventional music notation as descriptive (i.e. describing the resultant configurations of pitch and rhythm), and examines 'how prescriptive notation unlocks creativity in areas unknown to conventional practice' (Kanno, 2007, p.1). Kanno's definition of prescriptive notation is therefore more appropriate here in order to discuss the tablature-based types of notations which interest many contemporary composers today.

Chinese traditional Guqin has used, for at least 1500 years, a system of tablature notation which prescribes tuning, finger positions and stroke techniques but not the resulting pitches. Tablature was also commonly used for lute writing in Renaissance and Baroque eras. The recent emergence of a new array of extended instrumental techniques has inevitably renewed interest in this approach. *Pression* (1969), for solo Cello, by Helmut Lachenmann is one landmark example of the reappropriation of largely obsolete principles. In the score, the clef is famously replaced by a schematic representation of the body of

the cello, so that the staff becomes a graphic indicator of *where* to perform *which* action upon the instrument. The concept of *Musique concrète instrumentale*, central to the German composer's aesthetics, possesses an undeniable affinity with the type of prescriptive notation discussed above: 'The sound events are chosen and organized so that the manner in which they are generated is at least as important as the resultant acoustic qualities themselves' (Lachenmann, 2008, p.1).

Composer Aaron Cassidy has dedicated a significant portion of his career to the development of tablature-based notations. Most of his scores since *The Crutch of Memory* (2004) have abandoned traditional clefs in favour of multi-layered tablatures. In this work, three separate staves control different playing technique parameters independently for a solo string player: 'the movement up and down the fingerboard, the spacing width of the fingers, the contact between fingers and strings, as well as the actions of the bow and right hand' (Cassidy, 2004, p.1). The resulting notation gives rise to what the composer describes as 'decoupling', i.e. a de-correlating of the component movements of an instrumental gesture. Precursors to Cassidy may be found in works by Brian Ferneyhough, notably his *Time and Motion Study II* (1973-76) for cello (where left and right hand are notated on different staves, each with its own, autonomous rhythmic structure), or *Unity Capsule* (1980) for solo flute (where voice and instrument are notated on different staves, despite being predominantly treated homorhythmically).

In the case of Cassidy, tablature notation gives rise to a situation where resulting pitches are largely unforeseeable; therefore, the notation does not provide instructions for performance of a strictly pre-defined, definitive text, but rather functions as a tool which interrogates the performer's *modus operandi*. Although highly conceptualised, the notation here seeks to communicate in a very direct, somatic way with the performer: he or she is required to find his/her own responses to the challenges imposed by the score. In other words, the performer is explicitly required to take part in the emergence of the work through a direct dialogue with the notation, rather than through an attempt to recreate a fixed entity; this correlates in my view with Umberto Eco's notion of *work of art*:

A work of art, therefore, is a complete and *closed* form in its uniqueness as a balanced organic whole, while at the same time constituting an open product on account of its susceptibility to

countless different interpretations which do not impinge on its inadulterable specificity. (Ecco, 1984, p. 49)

1.2.4 'Transparent notation' versus performance, text versus script

In general, the demanding types of notation described thus far involve working with a small group of specialised, new music performers. A composer writing in a more classical language, and for large ensemble or orchestra, will often be inclined to use common music notation, which, today more than ever, is largely standardised. *Behind Bars*, a very useful guide to notation by Elaine Gould (2011), shows how in most situations, a given approach to notation will be clearer than another, and therefore understood faster and by a wider community. The mastery of such conventions undeniably facilitates a fast and effective transmission of musical information from composer to performer; however, at the same time, one may argue that the works of composers who use them resist innovation in this area, anchoring the musical language within the notational practices of the 19th century. The performer will often see this clarity as a positive thing: he/she is provided with information which describes concretely the pitches and rhythms which are to be performed, but such 'transparent notation', since it does not resist sight-reading, may imply the idea that the work already exists within itself, and that it does not necessarily require a deep engagement from the performer in order to be conveyed. In other words the performer is implicitly adhering to the – presumably obsolete – ideal of an autonomous text, a conception that minimised the importance of *performance* in favour of the realisation of the score.

Nicholas Cook has discussed this issue: 'The text-based orientation of traditional musicology and theory hampers thinking about music as a performance art' (Cook, 2001, p.1). Talking about the score-centric or composition-centric representation of music that is again largely inherited from 19th century traditions, he suggests: 'This gave rise to the idea that meaning is inherent in the text, so that performing it becomes an act of reproduction, something essentially peripheral to musical culture' (Cook, 2005, p.2). Text-based or composer-orientated views tend to minimise the fact that what an audience hears in a musical performance is often less concerned with the composer/score interaction rather than with what happens between the performer and the score. Such considerations lead Nicholas Cook to introduce the notion of script, which allows for more flexibility:

Whereas to think of a Mozart quartet as a 'text' is to construe it as a half-sonic, half-ideal object reproduced in performance, to think of it as a 'script' is to see it as choreographing a series of real-time, social interactions between players. (Cook, 2001, Chapter 3: music as performance)

This notion of script displaces the emphasis, from the text/score towards its performance: 'The shift from seeing performance as the reproduction of texts to seeing it a cultural practice prompted by scripts results in the dissolving of any stable distinction between work and performance' (Ibid.).

This idea has gained considerable traction over recent years in the realm of musical performance studies, insofar as the term 'interpretation' seems today to connote an outmoded notion of performance.

For Pablo De Assis for instance, interpretation is only *one* stage in a three-step process: execution/interpretation/experimentation, where the last stage (the experimental one) is essential:

Taking Gilles Deleuze's invitation not to interpret but to 'experiment' with the materials of our domain, this research project aims to develop a different and original model for musical performance – a model that takes into account older modes of performance (execution, *Vortrag*, interpretation, performance and others) but which is crucially based upon 'experimentation'.

(De Assis, 2013, p. 100)

These views on scores and their performance may be associated with a wider paradigm-shift which occurred in the 1990s in the humanities and social sciences, which is commonly referred to as the *performative turn* (Conquergood, 1989), itself often associated with the young discipline of performance studies. This *performative turn* occurred when the focus of study shifted from the text, or fixed-representation, towards an event which unfolds in time, a performance. It is founded upon the assumption that *all* human actions are performed and as such considers human behaviour in general as a public presentation of the self. The famous words of William Shakespeare constitute a good formulation of this statement:

All the world's a stage,
And all the men and women merely players.
They have their exits and their entrances,
And one man in his time plays many parts,
His acts being seven ages.
(Shakespeare, [1599] 2004, act II scene VII)

Writing principally for voices has led me to reflect deeply upon the potential theatrical aspects of music. Audio-scores were always conceived in my compositional research as *performance-centered* (as opposed to *composition-centred*), as a means of facilitating the performers' task, or liberating them from the anxiety which difficult material may cause.

1.2.5 The status of notation after the decline of the *Urtext* paradigm

Brian Ferneyhough and Helmut Lachenmann exercise a significant influence over many young composers today, and a consequent, growing community of musicians seems to be more stimulated by, than wary of, the demanding notation which their musical lexicons require.

The notion of *resistance* is inextricably linked to the above-cited composers. Whether it be political or aesthetic, both composers have expressed through their music the difficulties, even perhaps oppressions which are faced by modern man. In an article entitled 'Resistant Strains of Postmodernism, the music of Helmut Lachenmann and Brian Ferneyhough', Ross Feller explains: 'Each sought to reinject vitality back into the idea of closed-form composition through integrating excessive, unstable, and chaotic structure' (Feller, 2001, p. 249).

According to Claus-Steffen Mahnkopf, some composers associated with Darmstadt and/or New Complexity might be categorised as a musical 'Second Modernity', or 'deconstructive turn', insofar as they refuse to recognise themselves as postmodern (principally in the sense that postmodernism accepts heterogeneous material).

Though complexism is probably not the only manifestation of second modernity, it can be used to illustrate its essential attributes. As far as the material is concerned, progress has a decisive role once again: microtonality, complex rhythms, nested formal constructions,

poly-works, live electronics, computer assisted composition, the whole spectrum of pitch and noise, hybrid playing techniques. As for the style, its aim is an autonomous, personal language that is cohesive within itself rather than combining foreign styles as collages (Mahnkopf, 2008, p. 14).

Second Modernity, as Mahnkopf explains, expresses solidarity with the historical avant-garde and the classical Modernity, and is not therefore exclusively turned towards the future: 'The second modernity does not define itself merely negatively as a rejection of postmodernism, however, but also positively, by expressing solidarity with the tenets of classical modernism and the avant-garde' (ibid. p. 9). The notion of resistance, for Second Modernity composers, represents to some extent a line of defence of the notation-based Western Art Music practice, the latter being challenged by new forms of music making in which notation is either non-existent or nothing more than utilitarian. The score is then, evidently, of central importance for New Complexity composers; in fact, it is at the heart of the identity of their collective effort. The revalorisation of the score might therefore be understood as an attempt to restore the outmoded notions of *Werktreue* (authenticity) or *Urtext* (as authoritative, definitive), but an examination of these models in regard to the concept of the *rhizome* will show that this is not the case.

The *Werktreue*, or faithfulness to text-support, supposes that the work has one 'true meaning', leading to the inevitable assumption that this work allows only for one, true (read: 'correct') interpretation. Although this concept is primarily associated with the Germanic tradition, it was still very influential throughout the 20th century, and perhaps found its most extreme defenders in Igor Stravinsky and Arnold Schoenberg. Indeed, Stravinsky declared: 'I have often said that my music is to be "read", to be "executed," but not to be "interpreted." I will say it still because I see in it nothing that requires interpretation.' (Stravinsky & Craft, 1967, p. 139). Schoenberg equally neglected performers, at least in his European years: 'Before his emigration he had stressed the importance of a performer's fidelity to the score and opposed interpretative deviations from it.' (Feisst, 2011, p. 157).

Ferneyhough's piano piece, *Lemma Icon Epigram* (1982), is headed by a quotation from Baudelaire: '*Tout est hiéroglyphe*'. It seems to me that the

analogy with hieroglyphics corresponds effectively with the poetic intentions of composers of the New Complexity. The notation is evidently extremely detailed and precise, but the overabundance of information in the score makes it paradoxically more ambiguous than deterministic, potentially stimulating the interpretation of the performer in multiple different ways, hence reminiscent of Deleuzian concept of rhizome. In *A Thousand Plateaus*, the rhizome is opposed to an arborescent, vertical conception of knowledge – itself reminiscent of *Urtext* and *Werktreue* paradigms – in which a trunk, root or origin exercises a dominant role:

As a model for culture, the rhizome resists the organizational structure of the root-tree system which charts causality along chronological lines and looks for the originary source of “things” and looks towards the pinnacle or conclusion of those “things”.
(Deleuze & Guattari, 1980)

Consequently, the complex network of symbols contained in a score by Brian Ferneyhough (or by composers of the Second Modernity) calls for multiple *rhizomatic* interpretations rather than for the faithful (*Werktreue*) restitution of a definitive text (*Urtext*).

Conclusion: The decline of notions of *Urtext* or *Werktreue* in the 21st century encourages to consider from a new perspective the creative process which is taking place whilst the performer is deciphering a musical text: instead of conceiving this process as an intent to realise the composer’s original idea, it is now understood as a means to prompt innovative situations of performance. Tablature-based, complex, graphic notation, as well as audio-scores all propose new approaches to musical notation which incline to take into account the performance-centrism discussed above.

1.3 Aspects of the function of notation

1.3.1 In my own work

1.3.1.1 Performance-centrism

My own practice-based research on notation and audio-scores engages with the performance-centric concerns discussed above: although the use of audio-scores, when used with notation, can lead to the realisation of a stable text, the

accuracy that this system allows has revealed to be subsidiary in comparison to how the *performative* experience is transformed by the use of this technique (when, for instance, musicians are placed around the audience).

1.3.1.2 *Transparent notation, unambiguous code*

Audio-scores (and more recently *screen-scores*) are not conceived in my compositional research as an *alternative to*, but as an *extension of* notation, which explains why I consider my research as a form of *extended notation*.⁴ Most of my works often use very conventional notation in order to facilitate the performer's task, since the latter always requires the clearest possible correspondence between what is written on the page and what is given to his/her ear. This intricate mirror-like identity between score and audio-scores makes possible a fruitful dialogue between the two media. Notation functions therefore here as an unambiguous, *allographic* code, informing the performer in the clearest possible way, and on the basis of which he/she is free to elaborate.

1.3.1.3 *Beyond accuracy*

This *allographic* model, however, cannot be applied to my piece *Etude De Synchronisation* (Chapter 5.1, 2011), where the use of unconventional playing techniques induced in some passages a certain distance between the aural and visual information given to the performer, and this non-coincidence made me aware of an interesting phenomenon: the more notation distances itself from conventional practice, the more its function moves away from representation (in which every sign has its codified meaning) towards resemblance (in which signs lack precisely decodable meanings, and function more as pictorial analogies).

Transition: In unconventional systems of notation, in order to remain comprehensible for the performer, the notation must set its rules and conventions of representation, but I contend that it should also seek to exploit the immediate impact of its graphic quality, as in a visual art-form, thus stimulating the performer in a more direct or pre-rational way.

1.3.2 **Notation: resemblance versus representation**

Nelson Goodman (as discussed in Chapter 1.1.2, p. 8), places musical notation and painting at opposite ends of a spectrum (the first being *allographic* and the

⁴ The term *extended notation* refers to Christian Dimpker, author of *Extended Notation: The Depiction of the Unconventional* (Dimpker, 2013), who proposes a systematic approach to the notation of extended instrumental techniques.

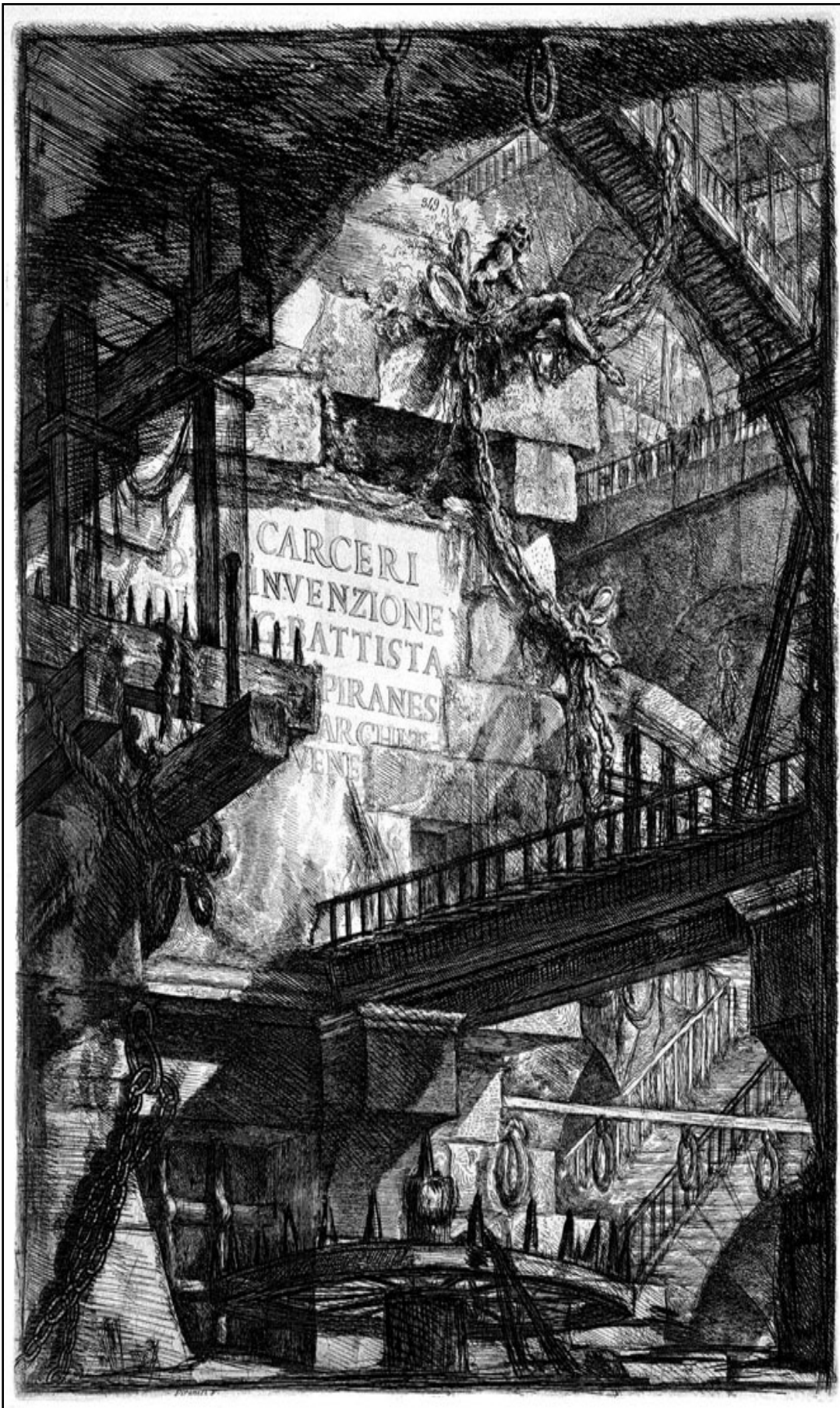
second *autographic*); the philosopher is also famous for showing that one thing need not resemble another in order for that other to represent it; in other words, representation and resemblance are more autonomous than they might initially seem. What is then the relationship between the notational system and the pictorial aspect of the score? In *Languages of Art*, Goodman gives the example of the Beethoven's Fifth Symphony, which remains the same piece be it performed from a modern edition or from a facsimile of the original manuscript. The identity of the score for Goodman relies in an exact one to one correspondence between notational symbols and their signification:

If we allow the least deviation, all assurance of work-preservation and score-preservation is lost; for by a series of one-note errors of omission, addition and modification, we can go all the way from Beethoven's *Fifth Symphony* to *Three Blind Mice* (Goodman, 1976, p. 187)

Musical notation as an allographic art (as understood by the philosopher), is on one hand very strict in terms of what the symbol may represent, but on the other hand it considers each version or edition of the score as equally valid.

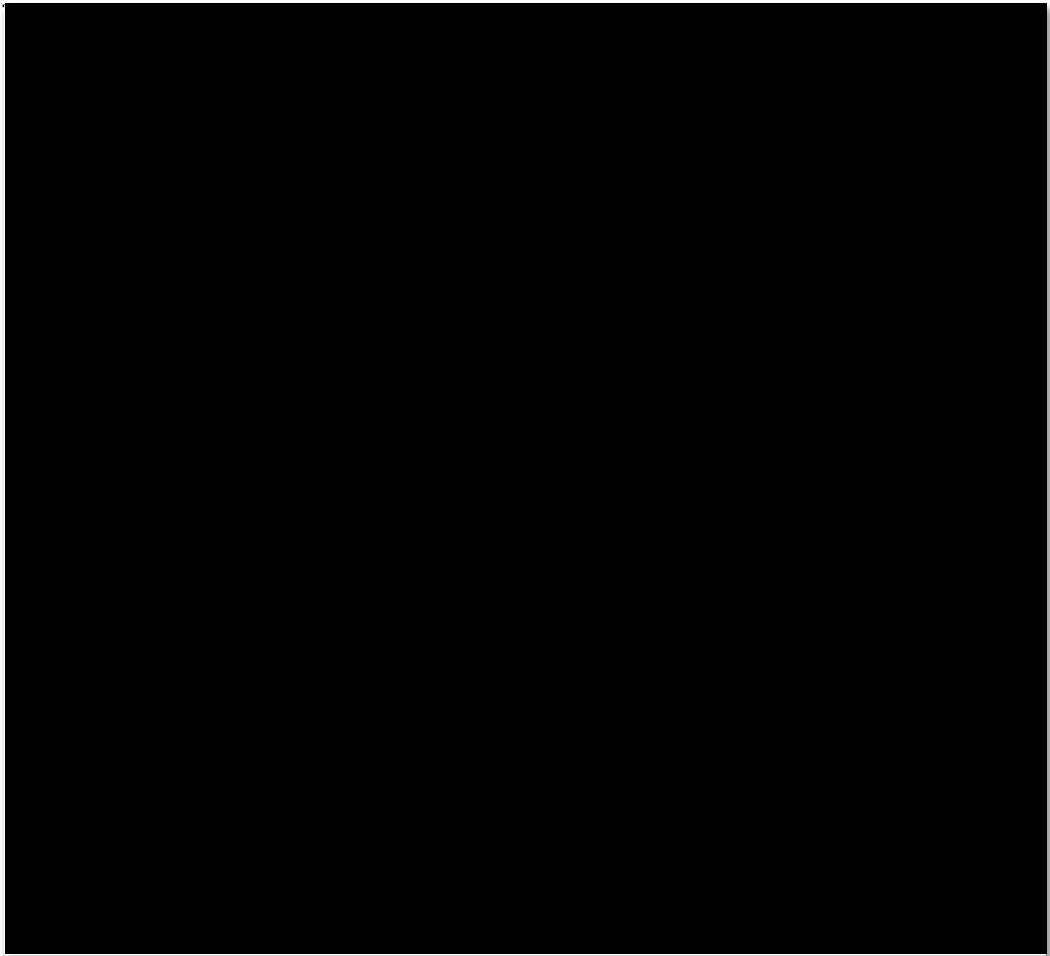
Such statements seem today more difficult to defend in contemporary classical music, where notational conventions are not as well established, and where performance is far less historically informed. If we think of Brian Ferneyhough, the *symbolic* and the *visual* aspects of his notation both tend towards the same type of meaning or expression. Ferneyhough's scores from the 1980s are, at a glance, extremely dense, i.e., an inordinately high percentage of the page is blackened with notational information. From 1982 to 1987, he composed *Carceri d'Invenzione*, a cycle whose title refers to an etching by Piranesi which depicts macabre, gloomy prisons. Could we not then argue that this visual darkness is equally intended to be communicated to the performer, and by extension, might be considered to be part of the aesthetic project of the composer?

Figure 3: *Carceri D'Invenzione* by Piranesi



Similarly, John Cage and composers of the New York School were so closely involved with painters that they seemed to have felt that the potential of the score to serve a second role, i.e. that of a visual artwork in its own right, could not be ignored. Earle Brown's *December 1952* is a famous example of a sort of crossover-work in that regard: its score resembles the work of a painter.

Figure 4: *December 1952*, by Earle Brown



John Cage, in his *Concert for Piano and Orchestra* (1958), explored a wide variety of graphic notations, such as, in the solo piano part, the dot-and-line notation, which he was investigating during that period. The comments expressed by Nelson Goodman on this particular score constitute an explicit case of divergent views on what notation is or should be. The philosopher criticised Cage's notation, finding it disconcerting for the performer. For Goodman, this work was 'not notational, for without some stipulation of minimal significant units of angle and distance, syntactic differentiation is wanting' (Anderson, 2013, p. 136). What Goodman finds most problematic here is the impossibility to separate and identify different symbols, just as we traditionally

isolate individual notes on a staff. 'Under the proposed system there are no disjoint and differentiated characters or compliance-classes, no notation, no language, no score' (Goodman, 1976, p. 188).

With the benefit of hindsight, it is difficult here to defend the philosopher's point of view: Cage's *Concert for Piano and Orchestra* and other works which used similar notational systems had a great impact upon American composers in subsequent generations, as well as on European composers such as Sylvano Bussotti or André Boucourechliev, who carried on using non-standard notations in the realisation of *open works* throughout their careers. At the time Goodman made this controversial statement, John Cage had already returned to more conventional notation (as in *Etudes Australes*, for piano [1974–75] *Freeman Etudes*, for violin [1977–80, 1989–90], or *Etudes Boreales*, for cello and/or piano [1978]), and had also begun working in purely visual media away from any translation into sound, for example in his printmaking activities.

Goodman showed that representation and resemblance are not necessarily correlated; if we adhere to his position opposing allographic and autographic arts, we must accept that the information conveyed in the score ought not to be nuanced by its visual aspect. Therefore, in rejecting Goodman's notion, we acknowledge that the score represents more than a mere vehicle for pitches, dynamics and durations, (as exemplified with the case of Brian Ferneyhough): indeed the manner in which information is visually apprehended by the performer is itself, perhaps more than ever before, a potential vector of meaning.

1.3.3 Rhythmic notation and meaningful ambiguity

The notation of rhythm in music with no sense of pulse is often ambiguous. As Morton Feldman said to a student in a masterclass in Johannesburg: 'The minute we leave repetition patterns, the minute we leave Stravinsky, we're in trouble' (Feldman, 1983, p. 2). Without a repetitive pattern, and in solo performance particularly, the composer is left with almost infinite possibilities of notating the same rhythm, all of which will convey a different feel to the performer, even though, paradoxically, the audience may not be aware of such nuances. In conversation with Walter Zimmermann, Feldman explained: 'When you hear it, you have no idea rhythmically how complicated that is on paper. It's floating. On paper it looks as though it were rhythm. It's not. It's duration' (DeLio, 2000, p. 105).

This rather evident but nonetheless essential characteristic of the notation of rhythm is not specific to new music; the end of the following example extract from Schumann's *Der Dichter Spricht* (*Kinderszenen*, XXI), illustrates the problem within the context of a 19th-century work:

Figure 5: Extract from Schumann's 'Der Dichter spricht' (*Kinderszenen*, XXI, op. 15 n°13, 1838)



The rests in the last few bars destabilise the meter, which the pianist will inevitably perceive differently to his or her audience. Rhythmic notation willingly contains ambiguity in meaning/intention: each player will interpret these rests slightly differently.

This very simple example shows how unexpected information in rhythmic notation is a potential vector of expression. The notion of surprise or misunderstanding here reminds of a passage by John L. Casti, quoted by Chris Dench:

Surprise is what happens when common sense fails... the word surprise represents the difference between expectations and reality... Systems displaying surprising (i.e., unpredictable) behaviours are more or less synonymous with those we regard as being in some way "complex" (Dench, 2002, p.181).

The notation of time is at the core of the performer's understanding of the score, and yet its representation is highly equivocal. To give a simple example, whilst a notated middle C will, in all but exceptional cases, be interpreted by composer,

performer, and audience in roughly the same manner, a rhythmic figure of comparable simplicity may be notated in a virtually infinite number of ways, which are then themselves open to different varying interpretations by the performer and subsequently, the audience.

As noticed by Morton Feldman in page 26 of the present thesis (DeLio, 2000, p. 105), in many cases the audience does not perceive the subtlety of rhythms written on the page, yet rhythm is undoubtedly one of the primary aspects of notation. The function of rhythmic notation might be understood then as an almost confidential dialogue between composer and performer, often suggesting ways of *understanding* the music, rather than ways of playing it.

The representation of time always takes a great deal of attention in my compositional practice. With a given sequence of durations, even in slow music, placing beats and bars, or positioning the attacks against the downbeat, constitute for me one of the most essential vectors of articulation and meaning. In my view, bars and metre articulate music in a very different way than slurs and accents. The metric structure of a piece conveys the performer a sense of architecture or coherence whilst it often remains potentially enigmatic for the audience (when there is no conductor). It is undeniable that choices in the notation of rhythm influence the performer deeply, but it remains difficult, in non-pulsed music particularly, to explain precisely *how*. Since the performer's response is unpredictable, we may conclude that these notational choices *suggest* or *prompt*, rather than *prescribe* or *describe*; the notation, to borrow a term from Xenakis, functions as a *symbolic excitation* (Xenakis & Kanach, [1970] 2001, p.124).

The passage below, extract from my *Piano Quintet* (2013), bars 75-78, illustrates how, in the process of transcribing a rhythmic sequence, a small difference in the choice of meter may have a crucial impact on the musical result. This passage is based on the superimposition of different periodic pulses. Violin 2 was chosen as a reference. Consequently Violin 2 marks the down beats, Violin 1 is perceived slower than the meter, and Cello goes slightly quicker.

Had I chosen Cello as reference, its attack would be placed on the downbeat at the beginning of each bar, in a slightly faster tempo, the same temporal

proportions would look totally different on the page, and would be understood differently by the performers who play it.

Figure 6: *Piano Quintet*, score extract (1)

[illegible]

Such attention to rhythmic notation during the transcription process (which meter to assign to a particular passage, how to cut a continuous flow into bars and beats, etc.) is, for me, evocative of how verses are divided in a poem, or by extension, how material and form may influence one another. As a child, I remember being quite dubious about the insistence of my father, a poet, upon very simple forms on the page, as if the visual aspect were more important than meaning. Now I view these systematic forms, and the rhythms which they suggest, as some of the greatest qualities of his poetry.

They lie heaped beyond the horizon
The poems I have not written, verses
 I have not yet devised
 To set words afloat

Unto an untroubled surface of time
Where the years will not touch them,
 whether by just neglect
 or the attentive ear,

Which is why I would wish you still
To continue in spite of our vehemence
 and wasting of time
 which has no limit.

(Bell, 1989, p. 9)

2 MORTON FELDMAN, BRIAN FERNEYHOUGH: Two significant influences

The originality of the present research lies in the fact that audio technology is used at every stage of the emergence of the work (composition, notation, and performance); yet my craft is only rarely concerned with acoustics, sound-design, or live-electronics. In this sense I feel indebted to composers such as Feldman, Ferneyhough, or Lachenmann, who famously did not use electronics extensively. Feldman and Ferneyhough in particular have been of tremendous importance for my development as a composer. Whilst some of my latest pieces share a clear affinity with the sound world of Morton Feldman, the relationship with the work of Ferneyhough in my work is more conceptual: the problematization of the relationship between composer and performer through the medium of the *score* (or the audio-score) has often drawn my attention to situations encountered by the British composer and his successors in the New Complexity movement.

2.1 A comparative study

Morton Feldman and Brian Ferneyhough's music and attitudes towards composition and notation are, in some ways, almost diametrically opposed. Taking the dialectic opposition between Schoenberg and Stravinsky discussed by T.W. Adorno in his *'Philosophy of New Music'* (1949) as a model, the intention here is to highlight some ways in which notation and the emergence of the material interact with each other in the work of these two composers, and also to examine their respective approaches in regards to the relationship between material and duration.

I first met Brian Ferneyhough at the age of 23 in Royaumont (France), which certainly influenced me very much in the following years. During my first years at the Paris Conservatoire studying under Emmanuel Nuyès, New Complexity was amongst the most oft-discussed topics. My encounter with the music of Morton Feldman came much later, in London, around the time I undertook the present research; his influence is, nevertheless, clearly perceptible in some of my recent music.

Feldman and Ferneyhough engage with two very different traditions, so it is not often that one finds them being discussed together in the same paper. Nevertheless Erik Ulman mentions his interest in the two composers in an article published in *Perspectives of New Music*, where he expresses his ambivalence towards the term 'New Complexity', in spite of that fact that, for him, any interesting music is complex in one way or another:

This is what I mean by "complexity": a music that privileges ambiguity and subtlety, nourishing many paths of perception and interpretation. By this definition, not only is the music of Ferneyhough complex, but also the webs of nuance in Feldman (Ulman, 1994, p. 203).

Bryn Harrison also brings the two composers closer:

Two composers who, I feel, have taken an interesting systematic approach to rhythmic organisation are Morton Feldman and Brian Ferneyhough. Both Feldman in his essay "Crippled Symmetry" (in Feldman, 1985) and Ferneyhough, (in Ferneyhough, 1995), describe how a bar might be perceived not as a unit of emphasis, but as a space of a certain size in which musical material can be "contained" through the use of complex ratios. (Clarke et al., 2005, p. 35)

The notation of musical time is, in my view, the most essential feature of the scores of the two composers. Although they treat this parameter in vastly different ways, the rhythmic notation of both composers has given rise, among performers, composers and music-theorists alike, to a polemic: at one end, vitriolic criticism for their degree of complexity, and at the other, laudatory commendation for their inventiveness.

2.2 Feldman and Ferneyhough, two antitheses sharing common values inherited from the post-war avant-garde

Before pointing out the fundamental differences in their respective approaches, I will briefly address some of their commonalities. Although on a superficial level, in terms of density of notation, or rate of change in the music, Ferneyhough and Feldman are antithetical to one another, both composers share a few common characteristics:

1. Their work is exclusively self-referential, and functions as a self-contained entity. In this sense they belong more to Modernity than Postmodernism.
2. Both composers benefit from being able to distance themselves from the Western classical tradition:

What was really interesting about the Abstract Expressionists was the singularly *non*-polemical environment they created (...). It is crucial to understand that Abstract Expressionism was not fighting the traditional historical position (...). This is what gives it that uniquely American tone; it did not inherit the polemical continuity of European art. (Feldman, 1985, p. 102)

What Feldman writes above about the Abstract Expressionists of the New York School is equally valid for his own output as a composer. Similarly, in an interview with Richard Toop, Brian Ferneyhough expresses the desire to maintain a distance from the ways in which Wolfgang Rihm and Helmut Lachenmann engage with history:

They both have similar views of what we might call 'History' with a capital 'H'. Each of them refers - Rihm positively, Lachenmann negatively - to a posited totality of history. One draws his musical nourishment from it; the other generates semantic significance by constantly negating it in every moment of a work. But of course this "totality of history" is itself a fiction. (Ferneyhough, 1995, p. 284)

3. Both composers avoid an explicitly teleological or directional unfolding of time. In contrast to musics driven by linear processes (most commonly associated with composers such as Ligeti, Grisey, Murail, or Reich), Feldman and Ferneyhough are typically more in line with Stockhausen's concept of *moment-form* (as developed during the composition of *Kontakte* [1958-60], then explored again in *Momente* [1962-69]). In this regard, the two composers discussed in this chapter share in their music the treatment of time as a *mosaic of moments*.

2.3 Relationships between material, duration and form

This non-teleological aspect of their music manifests itself through a blurring of the large-scale structure; form cannot be perceived as a linear and logical

succession of sections or movements. In the case of Ferneyhough, the discourse is always shifting from one thing to the next: sections are too short (or, rather, too contrasted on a medium-to-small duration-scale) to allow the listener to perceive a clear formal development. In contrast, in the late works of Feldman, the scale is extended beyond the standard limits of the perception of form. For instance, in his piece *Piano and String Quartet* (1985), a breathing-like alternating gesture (a notion which will be further discussed in Chapter 7.3.1) emerges in the second half of the piece. However, given that the work is almost ninety minutes long, the binary nature of the form is not perceptible (at least certainly not in any traditional sense). In both cases, albeit at vastly different scales, the listening experience is not guided by equation with traditional forms.

What makes the two composers so drastically different here is also paradoxically what connects them: the rate of change in Ferneyhough's music is excessively high, while in Feldman's it is sometimes almost null. In both cases the rate of change is, nonetheless, fairly stable, and contributes to a 'disorientation of memory'⁵, which I have often sought to reproduce in my own work. For instance in my *Percussion Quartet* (Chapter 4.2), the implacable frenzy of fragmentary repetitions is in my view evocative of Ferneyhough's music, although the musical syntax is quite different. Reference to Morton Feldman's formal procedures is arguably more explicit in the pieces presented in Chapter 7, where slow repetitive materials are extended over long periods of time. In both cases, the absence of narrative or drama in my own music aims for a treatment of memory and musical time in which I recognise the two mentioned composers very much.

2.3.1 Feldman and the notion of scale

Feldman's use of repetition is not inherited from traditional rondos, dance forms, or any repetitive forms of Western Art Music. Rather, it evokes the repetitions of visual art (such as the Oriental rugs which fascinated him in his later years), Beckett, or even (in respect of its temporal extremity) Satie's *Vexations*, a piano piece which requires 840 identical repetitions of the same chord sequence. Feldman's music, therefore, resists conventional analysis. As Dora A. Hanninen suggests, it necessitates the invention of new tools and methods in order to be properly understood:

⁵ These terms are borrowed from the article '*Crippled Symmetry*' (in Feldman & O'Hara, 2000, p.137).

I encourage analysts to rethink the role of repetition in music analysis, such that repetition is no longer (only) a goal, but becomes a point of departure. (Hanninen, 1999, p. 1)

In order to analyse Feldman's late works, Hanninen introduces two new concepts: *population* and *scale*, applied respectively to his radical uses of fragmentary orchestration and duration. A population is understood as a set of segments in the orchestral piece *Coptic Light* (Feldman, 1986). The segments themselves are smaller entities of, for instance, two notes in a single part. 'Populations are more than collections of segments; they are individuals with emergent properties'. Among these properties may be distinguished 'range of variation' and 'distribution'. According to the author:

Analysts might reconsider part-whole relationships in music analysis, and use the idea of 'populations' (with their attendant features of range of variation and distribution) to develop a non-reductive (...) approach to scale. (Hanninen, 1999, p. 1)

Analysis, for Hanninen, is more concerned with interpretation than definition. Her 'non-reductive approach to scale' seeks to expand rather than condense the musical experience, thus revealing a contrast with Schenkerian analysis, which aims for reducing the material to its simplest forms, and in which notions of *Ursatz* (fundamental structure) or *Urfinie* (fundamental line) are of central importance. The notion of *scale* discussed by the musicologist should be understood in Feldman's own terms:

Up to one hour you think about form, but after an hour and a half it's scale. Form is easy – just the division of things into parts. But scale is another matter. (Feldman [1970], 1994)

The concepts or tools Dora A. Hanninen developed exclusively for this music provide new insights on the orchestration found in *Coptic Light*. Also, taking repetition as a point of departure, they help understanding the extreme durations (or *scale*) Feldman explored almost systematically in his late works. Finally, this new terminology illustrates how traditional methods of analysis are ill-suited for such innovative relations between material, duration and form.

2.3.2 Ferneyhough's perpetual short-term articulation

Ferneyhough is a great lover of Renaissance and Baroque music. The articulation of his music, its ornamentation, and also its rhetorical quality, derive a great deal from the Baroque tradition. According to Nikolaus Harnoncourt, 'music prior to 1800 speaks, while subsequent music paints' (Harnoncourt, 1988). Indeed, the analogy with articulated language appears to correspond better to Ferneyhough's aesthetics than that of 19th-century painting or their contemporary large-scale symphonic structures.

His orchestral work *La Terre est un Homme* (1979) is reminiscent of late 15th century Franco-Flemish polyphony, and of Tallis' *Spem in Alium* (c. 1570), because of the extreme density of its counterpoint. In this piece, despite the presence of contrasting materials, the score is of such density that the listener perceives one continuous and global stream. Ferneyhough's chamber and solo works, on the other hand, are perceived as constantly changing material. These pieces are reminiscent of word painting in Renaissance madrigals, where musical texture may change abruptly upon the utterance of a word of significance. In both situations, a musical passage is neither perceived to be a consequence of, nor in contrast to, what was heard before, in the narrative sense. Rather, the music immerses the listener in a perpetually unstable world of sound.

2.3.3 Conclusion

Thinking of the notion of *rate of change* in relation to Morton Feldman and Brian Ferneyhough almost inevitably places most of my recent works stylistically closer to the one of the New-York composer: the polyrhythmic processes used in my *Percussion Quartet* (2011), *Three Painted Walls and a marbled ground* (2013), or the *Piano Quintet* (2013) (to which I will come back to in Chapter 4.1.3, Chapter 4.2.2, and Chapter 7.3.3), are responsible for a slow, even, and continuous rate of change in my own music, and remind in this sense of some of Feldman's repetitive passages.

Reflecting on the notions of material, form and duration in Feldman and Ferneyhough's works has helped me defining interesting structural relationships in my own music. More specifically, the notion of scale, as developed by Morton Feldman and critically examined by Dora A. Haninnen, is here most apropos: indeed the above-mentioned passages extract from my own music present

almost identical materials on vastly different scales (or temporal dimensions). For instance, *Three Painted Walls and a Marbled Ground* only lasts less than four minutes, and yet this short piece is based on polyrhythmic structures resembling the ones used in the *Piano Quintet*, which is over half an hour. Thus, the same compositional technique allows for the generation of contrasting musical characters whilst maintaining stylistic coherence.

2.4 Generated/found material

The use of complex systems of notation and multi-layered parametric processes contributes to the organic quality of Brian Ferneyhough's notation. Each single figure is generated by similar systematic processes. As a result, these figures appear to 'genetically' resemble each other. Ferneyhough's notation is in this sense strongly evocative of the oft-observed paradigm of the *organic unity*, primarily associated with the German classical tradition. Morton Feldman, on the other hand, is often seen today as the archetype of what Yves Knockaert calls *systemlessness* in the music of the 20th century (Knockaert, 2004, p.53). This is in part because of Feldman's reaction against the formalism of integral serialism. His notation does not arise from any pre-compositional generation of material. Instead, it deals with found objects. In a lecture in Darmstadt, the composer said:

Everything is a found object. Even something that I do invent is a found object. You're dealing with found objects. You're all amateur Duchamp and you don't know it. And in realising that you must lose your vested interest in ideas. (Feldman, 1984, p. 5)

Ferneyhough's materials appear to be generated *ex nihilo*. Feldman's point of departure, on the other hand, is concerned with found objects, pre-existing materials or isolated musical atoms (such as, for instance, the resonance of a single chord on the piano), which he contemplates. As basic and rudimentary as these entities may be, Feldman's found objects instigate an introspection into our perception of the basic constitutive sounds of Western Art Music. In this sense they differ from Duchamp's *readymade*, whose found objects are categorically extraneous to the tools and materials typically used by an artist.

2.5 Compositional systems and free choice

Feldman and Ferneyhough have very different views on the idea of the pre-compositional plan, or compositional system. Whilst Feldman – considered as an outsider by composers involved with integral serialism – strongly rejected ideas of formalisation, the generation of material in Ferneyhough's music is largely reliant on superimposed, multi-parametric systems. It is interesting here to consider the dialectic relationship between order and disorder, in regards to the contrasting compositional strategies of the two composers: Ferneyhough's systematic approach paradoxically does *not* give rise to a perceived order, but rather, disturbs it. In contrast, Feldman's intuitive methods of organisation engender symmetries and repetitions. Thus, a compositional system (in the sense of Boulez or Ferneyhough) should not be understood merely as a process undertaken to achieve coherence, but also, and perhaps more essentially, as something that liberates from memory-conditioned choices of the composer. The function of a compositional system is, in this sense, related to chance music procedures, which equally aim for the liberation from free taste or memory. Accordingly, in the above-mentioned article entitled *Systemlessness in Music* (Knockaert, 2004, p.53), Yves Knockaert contends that *I Ching* is a system, because it is an alternative to free choice, intuitive decision, or taste. The chance procedures used by John Cage, or others to be found in aleatoric music should therefore not be associated with systemlessness.

2.5.1 Ferneyhough's approach

In a private lesson given at IRCAM in February 2015, Brian Ferneyhough, after hearing a piece of mine, commented: 'it is good to do what your ears tell you, but your ears always want to do the same thing'. Writing intuitively can of course be limiting if it is never combined with any rational or extra-musical stimulation. For Boulez, this approach is equivalent to writing from memory, which he distrusts: 'I very much enjoy purely technical researches, because they don't interact with memory' (Boulez, 2010, Chapter 6 *Genèse et accident*, my translation).

Similarly, in an interview with François Meïmoun, Boulez tells us: 'Composition should not destroy memory, nevertheless it should discover something that memory has not recorded [enregistré] yet' (Meïmoun, 2010, my translation, p. 44). These statements about memory correlate with the assumption that notation, for Boulez or Ferneyhough, *precedes* listening. The action of writing is

not linked with transcription of something heard in the mind, or at the piano, which would be closer to Feldman's approach. Instead, notation itself is the medium of creative research, and in this sense relates to a statement by John Cage: 'You see I don't hear music when I write it. I write it in order to hear something I haven't yet heard' (Kostelanetz, 2002, p. 67).

Ferneyhough is often associated with parametric thinking, which he inherited from the integral Serialists. The composer often devises rhythmic and pitch materials independently, as exemplified in the following example.

2.5.1.1 Rhythmic material

Mikhail Malt discussed in detail his experience assisting Ferneyhough with the *Patchwork* software (Malt, 2000, p.61-106) during the composition of his *String Trio* (1994-1995). *Patchwork*, the precursor to *Open Music*, is a computer-aided composition program. Ferneyhough got very interested in the capabilities of *Patchwork* to generate nested-rhythms (with the *Combine* library of objects, which Mikhail Malt programmed especially for the elaboration of his *String Trio*). A rhythmic structure in *Open Music* or *Patchwork* is represented as a 'list' of elements framed between parentheses, as in any LISP-based process (LISP being one of the oldest programming languages). A nested-rhythm is therefore represented as a 'list of lists', and the similarity between the two arborescent representations afforded the composer quasi-infinite possibilities of generating complex rhythms.

Mikhail Malt remarked that Ferneyhough's rhythmic compositional techniques were already generated through such arborescent structures (Chapter 4, p. 74: '*La pensée rythmique de Ferneyhough et la représentation interne de Patchwork*'). This explains the composer's great interest in the development of the *Combine* library. He also observed that some of the operations that Brian Ferneyhough applied to lists (e.g., permutations, retrograde etc.) gave unpredictable results in the domain of rhythm-trees. Some of these methods of generation could therefore essentially be considered aleatoric (Chapter 7.2, p. 91: '*Les procédés utilisés dans le trio à cordes/variations aléatoires entre deux moules rythmiques*'). Once the material was generated, the composer was free to modify it intuitively. Nevertheless, it is an evidence to observe that the pre-compositional foundation of the rhythmic organisation of Ferneyhough's *String*

trio – or similar structuring of intervallic series and harmonic material – finds no equivalent in Feldman’s work.

2.5.1.2 Pitch Material

In February 2015 at IRCAM, Ferneyhough exposed some of his methods of pitch-material generation. These methods revealed a striking resemblance with Boulez’s chord-multiplication technique. The main difference between the two composer’s techniques was that Boulez’s system is in semitones while Ferneyhough’s is in quartertones (24-tone equal temperament). It struck me that the initial choice of temperament (12 or 24-TET) and its associated pitch notational system may perceptually have more impact on the overall harmonic result than the actual technique of generation itself. Such techniques of generation give some sort of genetic similarity between chords, but the main goal remains to permanently renew the pitch content.

2.5.2 Feldman’s approach

Such formalist pre-compositional procedures were incompatible with Feldman’s *modus operandi*. He composed in ink. Notation and the act of composing was for him, above all, a matter of concentration. Decision for Feldman was intuitive. It involved a free choice, and was dictated by the ear rather than by abstract constructs: ‘Ideas are given, concepts are given, everything is given. How do you orchestrate it? That’s not given... We must make that decision. And orchestration is notation’ (Feldman, 1985, p. 176).

Feldman would work according to the *classical* (or rather, as proposed below in Chapter 2.6, *pre-Schoenbergian*) paradigm of composition – namely, to first hear the sound in one’s mind, then to transcribe it.⁶

The article ‘Crippled Symmetry’ (in Feldman & O’Hara, 2000), describes Feldman’s empirical way of working, but reveals at the same time a conscious and self-reflective approach to musical time. The composer is undoubtedly guided by his intuition in the first place: ‘One chord might be repeated three times, another, seven or eight - depending on how long I felt it should go on’ (Feldman, 1981, p. 93).

⁶ This division is perhaps slightly simplistic if for instance we think of late Beethoven’s sketches or Renaissance polyphony, nevertheless the nature and function of musical notation were profoundly modified with the emergence of Schoenberg’s twelve-tone technique.

But this intuitive choice is also informed and refined by a conscious reflection on scale, memory, and forgetfulness:

I have reconstructed the entire section: rearranging its earlier progression and changing the number of times a particular chord was repeated. This way of working was a conscious attempt at formalizing a disorientation of memory (Feldman, 1981, p. 93).

2.6 Conclusions

While Ferneyhough's position towards notation evokes voluntarism, the *listener* attitude adopted by Feldman encourages interpreting his use of notation as almost *passive*: 'When I work I'm a listener, I'm not a composer' (Coolidge, 1988, p.1).

Notation, for Ferneyhough, is involved with the generation of a new material. For Feldman, it is concerned with the discovery or unveiling of a pre-existing found object.

I view Ferneyhough's notation as not being directly involved with sound, but with semantics, meaning, and energy: the sound itself is a cipher for something else. What primarily distances me from Ferneyhough's approach is the fact that notation in his work precedes the aural image. In this sense my attitude towards sound and intuition relate more to Feldman, whose acquiescence to memory and experience represent a paradigm of composition which I have frequently aspired to emulate in my own music, and which I will come back to in chapter 7.1.2 of this commentary.

The difference between the two composers could be eloquently summarized by these words from Jasper Johns, if we may substitute composition for painting, and hearing for seeing.

'Sometimes I see it and then paint it. Other times I paint it and then see it. Both are impure situations and I prefer neither' (Pearl, 2014, p. 341).

This ambivalence between cause and effect, regarding notation and its sonic image, sums up an oscillation that every composer faces at one time or another. Between rational stimulations, inventive systematic approaches exemplified by Ferneyhough, and Feldman's *listener* attitude, or, to put it in more general terms,

between notation and its sonic image, which one comes first to the mind of a composer? Whilst the invention of a musical theme during 18th or 19th centuries could conceivably emerge out of spontaneous singing, the mind's ear or improvisation, the serial composition methods devised by Schoenberg gave notation a new function: its role became to generate material out of a rational process, rather than being subordinated to an acoustic model. In my view, still today, both conceptions are equally valid, and the identity of each and every composer is defined, in no small part, by his or her position upon this spectrum.

In Chapter 1.2.3, I discussed the opposition between prescriptive and descriptive notation, and how this opposition can lead to diverse conclusions. Although today prescriptive notation is most commonly associated with the notational experiments of Helmut Lachenmann or Aaron Cassidy, the above cited quotation by Jasper Johns may lead to a third interpretation of the prescriptive/descriptive dialectical relationship: prescriptive notation would *precede* the sonic image, while descriptive notation would come after, in the manner of a transcription. According to this last definition, Brian Ferneyhough's approach to notation would be prescriptive, while Morton Feldman's would be descriptive.

As mentioned earlier, Feldman is concerned with the notion of *found object*. The New-York composer, therefore, treats his material with a certain distance, as if it was not exactly his own. This attitude towards material can be understood as characteristic of Postmodernism. In this sense, descriptive notation (transcription, for example) is evocative of that same mechanism of detachment, since it implies a passage from *non-own* towards *own*, through notation.

Finally, as will be demonstrated throughout this commentary, descriptive notation shares an affinity with my own approach, since audio-scores often imply the transcription of audio material into a score.

3 AUDIO-SCORES: A HISTORICAL SURVEY

3.1 Development of the score

An audio-score encourages the performer to learn by ear, as in the oral tradition. However, it relates more to the written classical tradition in the sense that it is highly predetermined. As in acousmatic music, this practice is interested in generating or developing musical material via an electronic medium. Where it differs is that the presence of a tape in the final product is subsidiary. The interest is focused on stimulating a response from the performer, asking them to recreate what is transmitted to them via this electronic means. Again, these auditory signals are conceived as a medium, i.e. as a score, allowing the realisation of material which otherwise would be laborious to play by notational means only (such as microtones or spatial separation). Below are a few examples of pieces where the performance has been judged as very difficult to achieve, or even unrealisable, in order to show that difficulty in contemporary music can sometimes relate more to the degree of complexity of the notation rather than to the physical virtuosity asked of the performer.

3.2 When notation pushes the limits of what is realisable

In the late 14th century, the post-Machaut generation of composers attempted a mixture of French and Italian rhythmic notation, leading to what we now refer to as the *Ars Subtilior*.⁷ This term is attributed to Ursula Günter, 'citing a number of uses of the word *Subtilitas* by fourteenth and 15th-century theoretical writers of that time to describe complicated rhythmic subdivisions, colorations, proportions, and syncopations characteristic of the style' (Cross, 2000, p. 228).

In the middle of the 16th century, the composer and theorist Nicola Vicentino, thought that the music of his time could be explained in terms of a combination of three Ancient Greek modes: the diatonic, chromatic, and enharmonic genera, the last of which was microtonal. According to him, the tuning of the music of Cipriano de Rore, Orlande de Lassus and others was very difficult to master, and likely impossible to play on instruments without having a system for adjusting the pitch of chromatic intervals in some way. In order to justify his ideas, he

⁷ Most of the pieces of the *Ars Subtilior* can be found in Codex Chantilly (Chantilly, Musée Condé MS 564), (Hanson, 1981).

developed a keyboard with 31 notes per octave, the *Archicembalo*. With this instrument was able to play the music written in his treatises, from which he taught his singers the correct pitches of his madrigals.

Similar examples of challenge in performance can be found in the 20th century:

- In *New Musical Resources*, Henry Cowell (Cowell, 1930, p. 142) developed a complex rhythmic notational system, where the shape of the note heads represents the prolation (for example quintuplets are notated with rectangular note heads) in order to illustrate his idea of physical identity between rhythm and harmony. This same idea of 'rhythm-harmony', developed in the score *Quartet Romantic* (Cowell, 1915-1917), led him to very complex rhythmic superimpositions (Cowell, 1930, p. 145). For example, in one passage, while the first flute plays 24 notes of equal durations, the second flute will play 15, the first violin 9, and the second violin 6 (Nicholls, 1990, p. 145).
- Perhaps more than any composer in the 20th century, Elliot Carter has pushed to their limit the techniques of polytempo (*Double Concerto*, *String Quartets*) and tempo modulations (*8 Pieces for Timpani*⁸, *Variations for Orchestra*⁹). With relatively conventional notation, he managed to develop genuinely new rhythmic ideas.
- *Nuits* (1968), for voices a cappella, by Iannis Xenakis, opens with complex microtonal melismas that would be nearly impossible to pitch exactly; thus they must tolerate approximation. Similarly, his piano piece *Evryali* contains passages which are physically impossible. For this reason, a distance should often be taken into account between what the composer means, and what the performer can or should do.
- Again, the so-called New Complexity School, exemplified by Brian Ferneyhough, is now well known for pushing precision in notation to its very limit.

⁸ (Carter, [1966] 1986a)

⁹ (Carter, [1955] 1986b)

Unfortunately, in these kinds of speculative works, notation has, at times, presented unyielding difficulties in (sight-)reading, performance and perception, when performers were not familiar with such complex or demanding notation. Indeed the end of the Double Concerto of Elliott Carter (Carter, 1959-1961), in spite of generous rehearsal time, was on the verge of collapse at its premiere. Similarly, Cowell's *Quartet Romantic* remained unplayable for six decades after its composition, until it was first recorded in 1978 by players listening through headphones to a computer click track that provided their tempo, prepared by Emmanuel Ghent.

3.3 Conceiving a click track: Berlioz, Carl Stalling, Emmanuel Ghent

Because of his experiments with distancing different orchestral groups, Berlioz was likely the first composer to think about coordinating musicians via electrical means. As he writes in 1855 in his orchestration treatise:

Best of all would be to have several sub-conductors with several electric metronomes beating the main beats of the bar in front of them. That is how I directed the concerts in the Palais de l'Industrie in 1855 (MacDonald, 2007, p. 358).

This electric metronome, set up by Bruno Verbrugghe, allowed the main conductor to send his pulse as a visual cue to the distanced sub-conductors, by pressing a copper key with his left arm. Berlioz frequently used this invention to conduct off-stage choirs, or to synchronise distanced conductors.

The invention of the click track in the 1930s is usually credited to Max Steiner,¹⁰ (although other sources have attributed it to Scott Bradley or Carl Stalling). It was used to synchronise the orchestra to silent movies. The click track was sufficiently useful as a synchronisation tool that it became part of standard recording technology, whether for films, radio or music. The click track was most commonly one of the tracks on a multi-track tape recorder.

In the domain of contemporary music the first and most explicit research in this domain can be found in an article by Emmanuel Ghent: *Programmed Signals to*

¹⁰ Max Steiner (1888 - 1971) studied composition with Gustav Mahler. As a film composer, his scores were renowned for following the moving pictures with great accuracy.

Performers, a New Compositional Resource (Ghent 1967), where the author proposed a system derived from the click track technique used in silent movies in the 1920s. With a machine that he called The Coordinome,¹¹ he could send auditory signals pre-recorded on a magnetic tape individually to each performer - that is to say in multiple channels. Ghent's preoccupations were mainly rhythmic: 'With the decline of periodic pulse as a structural matrix for music came unprecedented difficulties in performance' (Ghent, 1967, p. 97). In his piece *Dithyrambos* (Ghent, 1985 [1967], p. 98), the Coordinome allowed him a four-part counterpoint, wherein each instrument was provided with an independent tempo.

3.4 Different Types of Auditory Signals

The following is a discussion of key works in relation to six basic categories, which are:

- Synchronisation with video
- Synchronisation with tape
- Synchronisation between performers
- Spatial separation
- Performing without a score
- Microtonal intonation
- Generation of material through the spontaneous response of the performer

3.4.1 Synchronisation with video

It was mentioned in chapter 3.3 that the click track was invented to synchronise musicians to a silent movie. The click track helped live performers play along with an inflexible visual sequence. This practice is still quite common today. For example:

- Thomas Adès: *In Seven Days* (Adès, 2008). In this piece, the precise synchronisation between the music and the image gives fascinating results, but

¹¹ The Rhythmicon, the first rhythmic machine ever built, invented by L. Theremin, and commissioned by H. Cowell in 1930, may have influenced the invention of the Coordinome.

the composer himself conducted the orchestra and felt that following the click was quite restrictive.¹²

3.4.2 Synchronisation with fixed-media

One of the most common uses of the click track remains in synchronisation with tape. This technique is often necessary because, again, a tape is less flexible than any human accompanist. For example, the blend between voices and electronics in Joanna Bailie's *Harmonizing* (2011-12), for voices and tape¹³ sounds is very effective, but, as in the Adès piece, the conductor¹⁴ may not feel fully involved as the pulse does not come from him, and headphones prevent him from listening to the singers.

3.4.3 Synchronisation between performers

Providing each performer (or each group of performers) with an independent tempo is probably the idea that most attracted composers to use this device in order to help the realisation of their work:

- Elliott Carter: *String Quartet n°3* (1971). This piece was performed with a click track by the Composers String Quartet, and without by the Juilliard String Quartet.

- Benedict Mason: *Animals and the Origins of the Dance* (1992). Eleven click tracks are used simultaneously in order to enable the wind players to perform their own tempi, whilst the strings, percussion and synthesizers stay with the conductor who is on one further click track.

- Brian Ferneyhough: *Mort Subite* (1990), for flute piccolo, piano, clarinet and vibraphone. The temporal structure of this piece is based on the superimposition of two different speeds: five quavers against four. This is notated with the simultaneous presence of the numbers 8 and 10 as denominators in the time signature. Its realisation requires two different click tracks, one for piccolo and piano, and the other for clarinet and vibraphone.

¹² Related in private conversation with Richard Baker, 2011.

¹³ As well as synchronising the performers with the tape by giving the conductor a click track, sine tones heard in the tape are the same notes as those sung by performers. Thus that they can theoretically tune to them. However since the tape is quite far from where the singers are standing, it cannot be considered an audio-cue in the sense that will be developed later in this thesis.

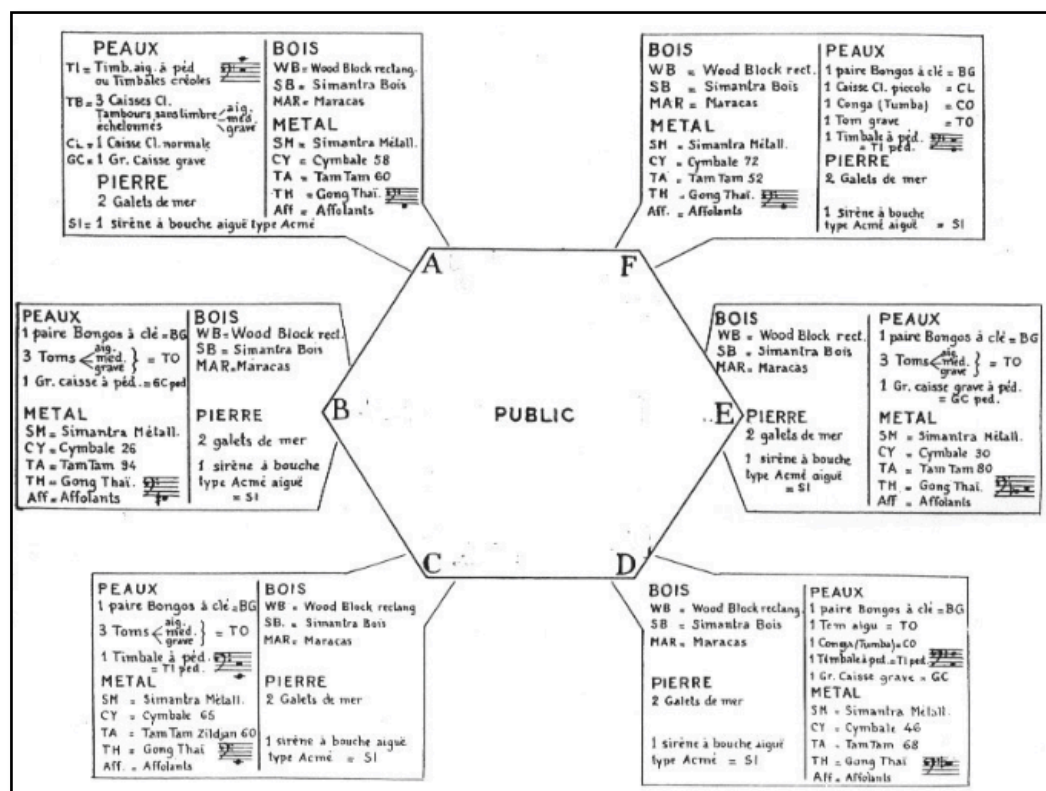
¹⁴ James Weeks, conducting the ensemble Exaudi.

3.4.4 Spatial separation

The idea of performers surrounding the audience has increasingly interested musicians since the second half of the 20th century. Audio cues are then often necessary if performers are very far from each other.

- Iannis Xenakis: *Persephassa* (1969). This piece, which demands a spatial separation of six percussionists, is usually performed with a click track nowadays.

Figure 7: *Persephassa* (1969), by Iannis Xenakis
(with the kind permission of Salabert, the publisher)



3.4.5 Performing without a score

Performing without a score is quite rare in contemporary classical music. Although many musical experiment in the real of contemporary theatre or improvisation could contradict this statement, the tradition carried on by German *Neue Musik* still considers the score as an essential tool, in rehearsal as well as in performance. The search for new concert forms may encourage us to consider a musical execution as a theatrical performance, or an installation, thus

considering the score as potentially isolating the performer from his audience. This aspect is one of Mason's principal concerns in his series of 'Music for European Concert Halls'.

- Benedict Mason *felt|ebb|thus|brink|here|array|telling* (2004) 48 performers are coordinated by acoustic signals (divided into twelve parts) giving temporal information (click tracks), pitches and other musical instructions. The work was premiered by The Ensemble Modern. The composer writes in the liner notes of the recording:

Presentation is all, and such an installation of performers in proximity and intimacy with the audience must not be hindered by paper... That is why the piece has to be done from memory and the clicks; words and samples can provide important reminders and aide memoires for the musicians. (Mason, 2004, p. 14)

3.4.6 Microtonality

Singers, compared to instrumentalists, are able to respond to their ear in a more immediate way. This might be one of the reasons why composers make greater use of audio cues for tuning in vocal music.

- Rytis Mazulis: *Ajapajapam* (2002), for 12 voices, string quartet and electronics.

In this piece, all the performers are given audio cues. It is based on a thirty-five minute glissando over a perfect fifth. The piece is based on polyphonic imperceptibly slow glissandi, and gives a harmonic effect of pitch modulation process, which operates on a very large scale. The Lithuanian composer carried on using audio-guides in many other works, notably in: *Cum essem parvulus* (2001), *Form is Emptiness* (2006), *Non in Commotione* (2008), *Canon Fluxus* (2008), *Puja* (2009), *Schisma* (2009), *Telescope* (2011). The audio-guides in these works are often used in order to create textures that change extremely slowly. The gradual changes are almost imperceptible in his music, and strike by their implacable regularity over long durations, creating a unique minimal aesthetic.

Figure 8: *Ajapajapam* (2002), by Rytis Mazulis
(Reproduced by kind permission of the composer)

The musical score for *Ajapajapam* (2002) by Rytis Mazulis is presented below. It consists of 18 staves, each representing a different part of the ensemble. The parts are labeled on the left, and the starting frequency in Hz is indicated above each staff. The A 3, B 3, and Ve parts include glissando markings and specific frequency shifts for each measure.

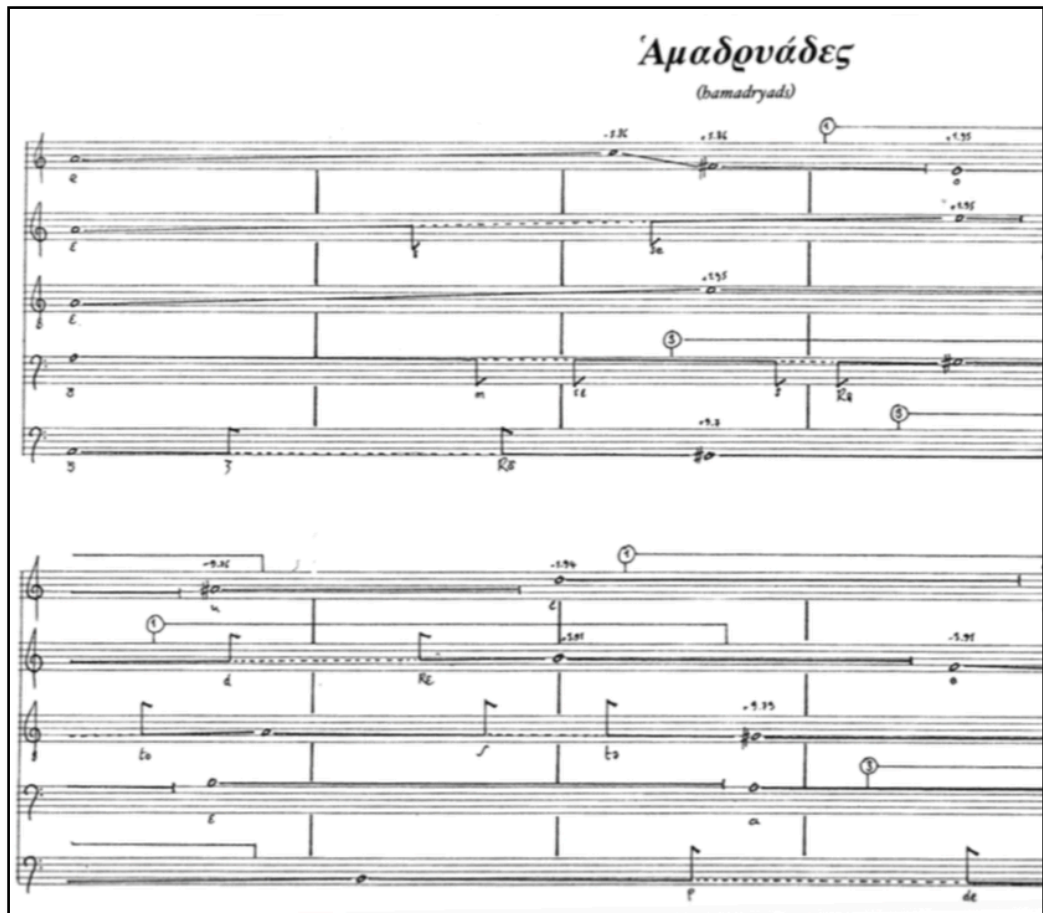
Part	Frequency (Hz)	Measure 1	Measure 2	Measure 3	Measure 4	Measure 5	Measure 6
S 1	59,663865	2	3	4	5	6	
S 2	59,831938	2	3	4	5	6	
S 3	60,0	2	3	4	5	6	
A 1	60,168067	2	3	4	5	6	
A 2	60,336138	2	3	4	5	6	
A 3	60,504205	gliss.	2 -3	3 -7	4 -10	5 -13	6 -17
T 1	59,663865	2	3	4	5	6	
T 2	59,831938	2	3	4	5	6	
T 3	60,0	2	3	4	5	6	
B 1	60,168067	2	3	4	5	6	
B 2	60,336138	2	3	4	5	6	
B 3	60,504205	gliss.	2 -3	3 -7	4 -10	5 -13	6 -17
Vln 1	60,0	2	3	4	5	6	
Vln 2	60,168067	2	3	4	5	6	
Vla	60,336138	2	3	4	5	6	
Ve	60,504205	gliss.	2 -3	3 -7	4 -10	5 -13	6 -17

The Vln 1 part is marked *pp sempre*.

- Martin Iddon: *Hamadryads* (2010), for 5 voices and glass harmonica.

Figure 9: *Hamadryads* (2010), by Martin Iddon

(Reproduced by kind permission of the composer)



At the beginning of the performance, each singer triggers an iPod. The composer writes in the score (Iddon, 2010, p. 1): ‘The singers are each provided with an earpiece, playing a pre-recorded sequence of sine tones. These give the singers guide tones for the pitches they are to sing’. The example of the iPod seems quite appropriate to realise what is facilitated by this method: first, the performers do not need to be connected to a computer by a wire; also, it gives the performer the possibility to rehearse alone in conditions that are very similar to the concert situation, simply playing along with the guide track.

3.4.7 Material generated through spontaneous responses of the performer

There have been various works in which the spontaneous responses of a singer to an auditory signal are in themselves central to the composition. In these cases, the auditory signals are more a stimulus than a cue. Their role is not to

help the realisation of the score any more, but, instead, to replace the score, or to add a layer of information.

- Pia Palme: *Cantu Foliato* (2012) Singers respond to pre-recorded voices heard through headphones, and are not provided with a score, although Palme composed the piece with the help of notation. In that piece, the auditory signals are conceived as an 'audio-score'. James Weeks reports from a workshop of this piece with the ensemble EXAUDI: 'There was a fragility and sense of discovery to the sound, and also a sense of direct expressivity and freedom, that simply could not have occurred had they been reading from scores' (Weeks, 2011, p. 2).

Figure 10: *Cantu Foliato* (2012), by Pia Palme

(Reproduced by kind permission of the composer)

- Aaron Cassidy: *I, purples, spat blood, laugh of beautiful lips* (2007)

In this piece, the singer has to pitch to a live generated sine tone glissando (a Max patch), sent through an earpiece and different in each performance. This pitch material must then spontaneously match the complex information of the score, learnt beforehand. The composer tells us after the score extract available on his website: 'the score indicates all metrical, rhythmic and textual data, as well as all information about articulation, dynamics, performance techniques, ornamentation, etc.' (Cassidy, 2007, p. 1). As a result, the same passage of the

score will sound completely different if it coincides with an auditory signal asking for the performer to sing in a low or high register. This concept reveals an interesting distance toward the medium (the earpiece), in the sense that what is sent through the earpiece is not exactly what the composer wants to hear (otherwise it would not be randomized), but rather something he proposes to the performer in order to get a particular kind of response, and again functions as a stimulus.

Figure 11: *I, purples, spat blood, laugh of beautiful lips* (2012), by Aaron Cassidy

(Reproduced by kind permission of the composer)

The musical score is for a voice part. It begins with a tempo marking of 84. The score is divided into measures with various dynamic markings: *fff*, *mp*, *f*, *mp*, *ff*, *mp*, *ff*, *mp*, *f*, *mp*, and *ff*. There are also ratios: 5:6, 5:4, 3:2, and 11:8. The lyrics are: "A - n - y - where n - - (n) - ear b - l - - a - - n - k" and "A n - (n) - oir, E b-l - - l - - anc". The score includes a "voice" label and a "Voyelles" label. The lyrics are written in a stylized font.

In order to separate the two different approaches I developed respectively during the first and the second year of my doctorate, I will use the distinction between synthesized and recorded sounds. The idea of this separation was inspired by a historical reference. In the realm of electronic music, IRCAM and GRM¹⁵ were two rival institutions throughout the end of 20th century in Paris. IRCAM abandoned magnetic tapes in the eighties in favour of computers, and became a pioneer in sound synthesis and processing, while GRM kept using recorded tapes, in the Schaefferian tradition. This opposition between IRCAM and GRM, between synthesis and recording, can also evoke wider oppositions, such as artificial/natural, or machine/human. The pieces presented in the fourth chapter 'Rhythmical Investigation' were mainly composed using MIDI¹⁶ controlled sounds. Each note was generated on the computer, hence the feeling of synthesis, or artificial sounds (despite the fact that the outcome is still

¹⁵ *Groupe de Recherches Musicales*, founded by Pierre Schaeffer in 1958.

¹⁶ Musical Interface for Digital Instruments.

instrumental music). On the other hand, the fifth chapter, 'Recorded Material' borrowed extracts of human performances as an initial material, in order to stimulate the player's interpretation.

4 RHYTHMIC INVESTIGATIONS

The pieces discussed in this commentary are presented in chronological order. However, *Three Painted Walls and a Marble Ground* (2014), written during the final stages of my doctorate, is presented first. This is because, within a few bars, its rhythmical components, and its installation aspects condense some of the properties offered by audio-scores.

4.1 *Three Painted Walls and a Marble Ground* (2014)

(DVD1 track 1, <http://jonathanbell.eu/three-painted-walls-and-a-marbled-ground/>)

This very short piece for two clarinets and two strings recalls the rhythmic preoccupations that initially guided me towards the use of audio-scores. It has a site-specific (or *in situ*) component that is of interest to me. Three instrumentalists are positioned at a distance in the space, one on each side of the room, while the fourth player (Clarinet 1) is almost hidden from the audience, and plays in the room next door. The *in situ* aspect as well as the rhythmic precision achieved by the players in this work provide a good sense of the potential of such a singular set up. The piece was composed for a student workshop at The Guildhall School of Music and Drama. Each composition student was asked to write a short piece inspired by works of the Turkish visual artist Canan Tolon for a concert in the Parasol Unit Gallery, where the paintings were exhibited.

4.1.1 Relation to painting, drawing upon extra-musical sources

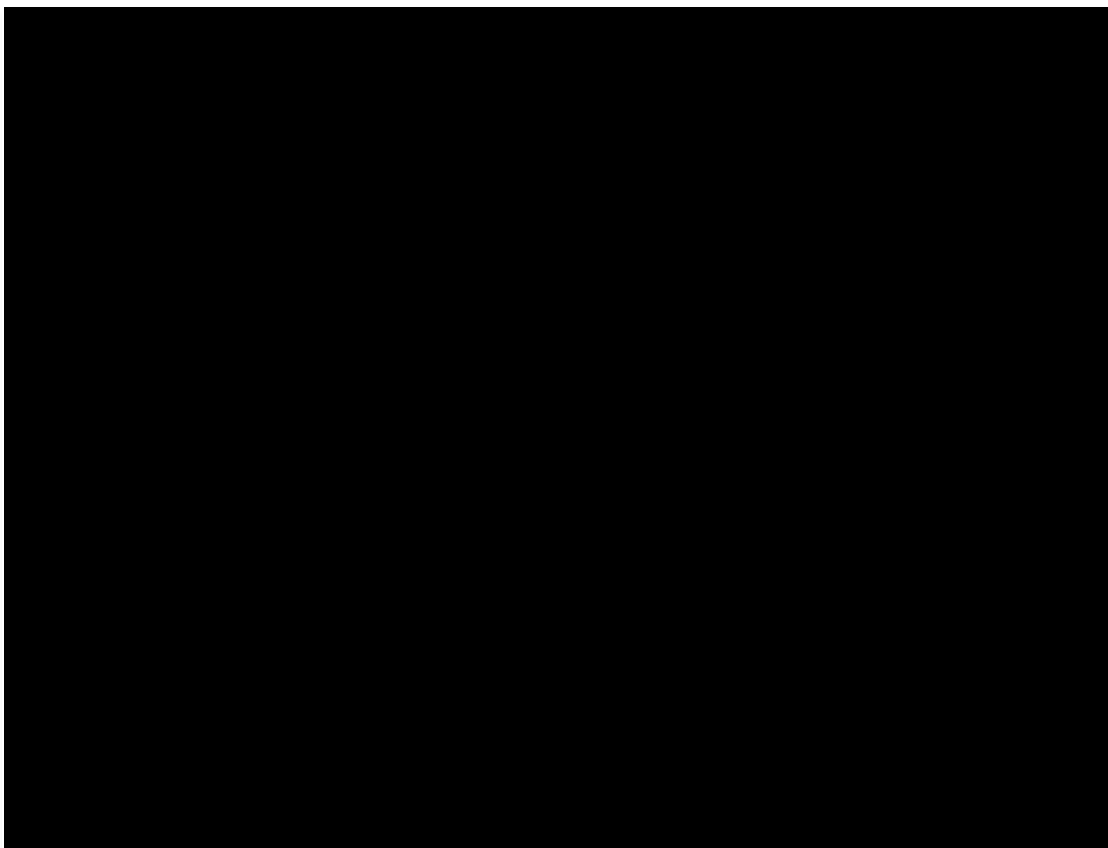
The work I chose, '*Time After Time*' (2012), was an installation made of three painted walls (hence the title of my piece), whose immersive aspect was of great interest to me. In an interview with Sharad Kant Patel during the composition process, Tolon explains: 'The paintings, of course, are two-dimensional, but because there is going to be three of them in the space, you will be feeling like as if you are inside the paintings' (Patel, 2013, p.1).

While watching '*Time After Time*', the eye is caught by the three surrounding paintings. I wanted the audience to be immersed in the listening experience in a similar way. I decided to create an analogy between those three walls and three

instrumentalists playing rhythmic figures, who would surround the audience during the performance.

The analogy is made explicit due to the fact the material exposed by the visual artist on the three walls is of same nature, and the three instruments visible by the audience (Clarinet 2, Violin and Cello) play very similar figures (staccato, rhythmic motives). The resulting three-part echo (or *hoquetus*) is intended to mirror the reflection of the three walls against each other.

Figure 12: *Time After Time* (2012), by Canan Tolon, Parasol Unit, London 2014.

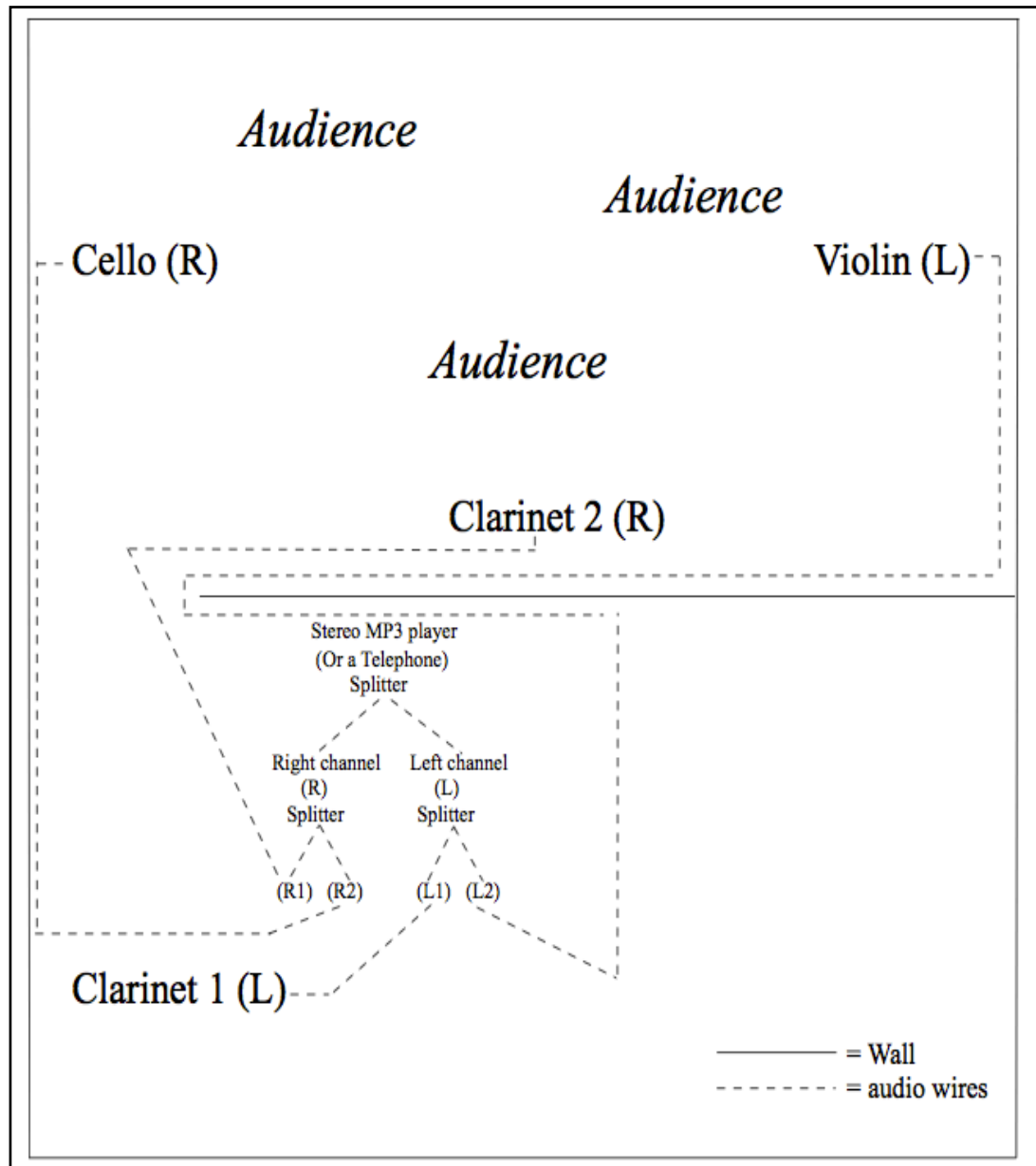


Although it was not, strictly speaking, part of Canan Tolon's installation, the three walls were grounded on marble in the Parasol Unit exhibition. This contrasting absent element was translated in my composition by the second clarinet, whom the audience could not see, and whose more continuous gesture contributes to the edifice of the piece.

4.1.2 Placement in the performance space and technical requirements

A stereo mp3 file (the audio-score) was used to coordinate the performers distanced in the space. The sound file provided the musicians with a click track, in addition to what was notated in their part. The following graph represents the placement of the performers. It shows which instruments are heard in the left or right channel of the stereo sound file:

Figure 13: Placement of instrumentalists in the performance-space



4.1.3 Rhythmic *hoquetus* inherited from medieval music.

The two fragments below, extracted from *Chantilly Codex* (Hanson, 1981), suggest that some composers of the *Ars Subtilior* might have been interested in minute time difference between parts. Indeed in the first extract, each arrow represents, in 6/8, an interval of time of a demisemiquaver (in today's terms).

Figure 14: Extracts from *Chantilly Codex*, Editions de L'Oiseau Lyre, Vol. 18-19 (Hanson, 1981)

"O Bonne Douce Franse", rondeau-refrain, *Anonymous*, bar 2

"En Albion de Fluns", Ballade, *Anonymous*, Bar 7

The second example (on the right) shows a succession of first inversion chords leading to a cadence, very common in medieval polyphony. The interesting feature rhythmically, characteristic of the *Ars Subtilior*, is that the notes of the chords are not heard simultaneously, but rather, as a fast arpeggio, with a semiquaver time difference between voices.

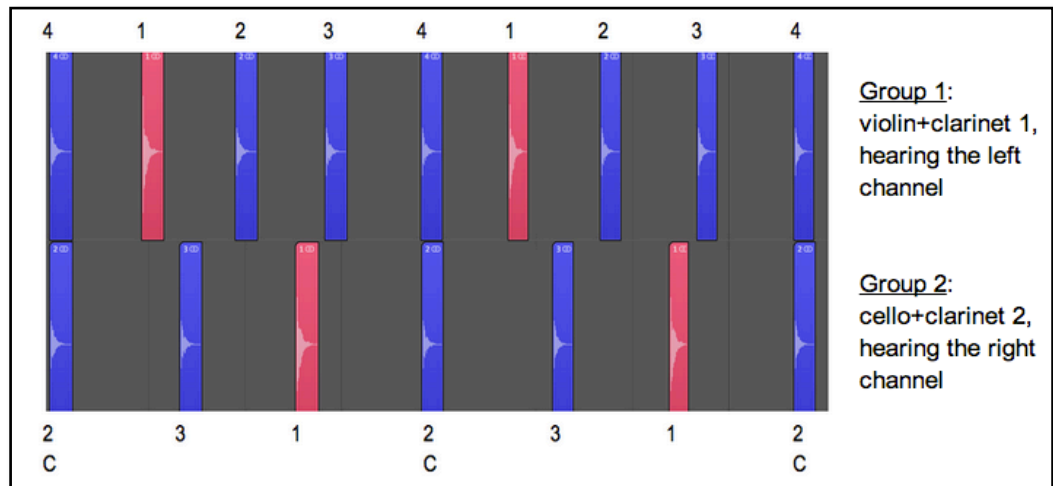
Figure 15: *Three Painted Walls and a Marbled Ground*, score extract

The main idea was to transpose the fast echoing games between parts borrowed from the *Ars Subtilior* to another context, as in this passage from bars 19-20 of my piece. The distance between performers creates an interesting stereophonic effect for the audience, which stands in the middle of the performers.

4.1.4 Rhythmic fundamentals

The diagram below represents the two channels of the audio-score with their respective click tracks. This temporal grid preceded the composition.

Figure 16: *Three Painted Walls and a Marbled Ground*, visualisation of the stereophonic click track in Logic.



The sign 'C' indicates the convergence points between the two different groups. Throughout the piece the tempo relation between the two equals either the ratio 3:4 (as above), or 4:5, as in the opening of the piece.

The pink impulses indicate the downbeats. The duration between two downbeats is the same in each group. However, rhythmic fluidity in the piece was achieved by dissociating convergence points and downbeats, so that they do not occur simultaneously. This 'phase difference' is at least as efficient as the more ordinary superimposition of speeds.

The performers may all play at the same time if required. For instance in the graph above, on the convergence points (C), the four players will play at the same moment if the first group plays on the fourth beat, and the second group plays on the second beat.

4.1.5 Score and parts

The coexistence of two different time layers (with one click track each) requires a different rhythmic notation in each group. This difference between score and parts will be discussed in greater detail in Chapter 4.2.4. For the moment, I will show the full score of the beginning of the piece, stacked between the part of

Group 1 (above) and the part of Group 2 (below). The opening of the piece is based on a loop divided in 15 quavers in the first group. For this reason, Group 1 is measured $\frac{4}{8} + \frac{4}{8} + \frac{4}{8} + \frac{3}{8}$ (as $4 + 4 + 4 + 3 = 15$).

Figure 17: *Three Painted Walls and a Marbled Ground*, rhythmic notation in Group 1, Group 2, and full score.

The image displays a musical score for the piece "Three Painted Walls and a Marbled Ground". It is organized into three main sections: Group 1, Full score, and Group 2.

- Group 1:** This section shows the initial rhythmic notation for two instruments: Clarinet in B $\flat$ and Violin. The Violin part features a complex rhythm of quavers, while the Clarinet part is mostly rests.
- Full score:** This section provides a more detailed view of the music. It includes parts for Clarinet in B $\flat$, Violin, and Cello. The Violin and Cello parts are marked "Pizzicato, all the way though". The Violin part includes a "5" with a slur, indicating a quintuplet. The Cello part also includes a "5" with a slur. The Clarinet part is mostly rests.
- Group 2:** This section shows the rhythmic notation for two instruments: Clarinet in B $\flat$ and Cello. The Cello part features a complex rhythm of quavers, while the Clarinet part is mostly rests.

The score is written in 3/8 time. The Group 1 section is divided into 15 quavers, and the Group 2 section is divided into 12 quavers.

The loop is divided into 12 quavers in Group 2, so it is divided in 4 bars of $\frac{3}{8}$, (as $3 \times 4 = 12$).

In this passage, the rhythmic ratio between the two click tracks is 4 against 5, which corresponds to the proportion of 12 against 15 quavers, as mentioned earlier.

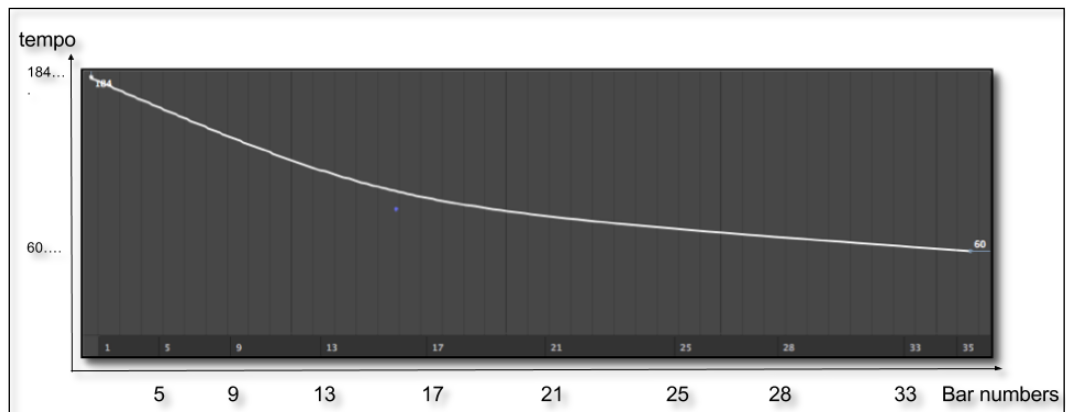
I have chosen to notate the full score in $\frac{3}{8}$, according to the bars and beats of the second group. This means that the rhythmic notation of cello and clarinet is identical in the scores and parts, but the rhythm of the first group is re-notated in the full score from the perspective of this $\frac{3}{8}$ meter. As a result the rhythm of the first group is simple in the part, but quite complex in the full score.

4.1.6 Tempo fluctuations

The second interesting temporal feature of this short piece concerns the constant *accelerandos* and *ritardandos*. These tempo fluctuations, combined with the implicit polyrhythmic structure, allow for a progressive transformation of rhythmic motives.

The graph below displays the tempo curve of the first 35 bars of the piece, with bar numbers displayed on the x-axis. It is based on a continuous *ritardando*. The shape of the curve indicates that the slope (*ritardando*) is steep in the beginning, and more stationary towards the end. In 35 bars, the tempo moves from 184 to 60.

Figure 18: *Three Painted Walls and a Marbled Ground*, tempo curve.



This curve represents the tempo as is it perceived from an audience (or composer) point of view. In order to make it easier for the performer to sense the speed, the tempo is doubled when it becomes too slow. Consequently, the cello and clarinet II see the indication 'double speed' in bar 28, while in fact an overall *ritardando* is still happening until bar 35.

4.1.7 Loops and their development

The first 24 bars of the piece are based on a very systematic process. A loop is clearly identifiable from the start, with the E flat pizzicato repeated in the cello part. With each iteration, the duration of the loop¹⁷ augments and new components appear. There are added components¹⁸ in each repetition, as if one were discovering new details or ornaments while zooming in on an object.

¹⁷ The 'loop duration' is indicated below the score extract, in dotted lines.

¹⁸ The 'number of components' is indicated in Roman numerals.

Figure 19: *Three Painted Walls and a Marbled Ground*, score extract, number of components

The image shows a musical score extract for four instruments: Clarinet I, Violin, Clarinet II, and Cello. The score is organized into 9 bars, numbered 1 through 9 at the top. Clarinet I and II have mostly rests. The Violin part features trills in bars 1, 3, 5, 7, and 9, with fingerings II, III, II, III, and V indicated. The Cello part has notes in bars 1, 4, 5, and 8, with fingerings I, IV, I, and IV indicated. Below the Cello staff, two durations are marked: '4.5 seconds' spanning bars 1 to 4, and '5.5 seconds' spanning bars 5 to 9.

In mathematics, the inverse of frequency is period ($F=1/T$). This is why if the tempo (frequency) diminishes, the duration (period) augments. Every four bars, the loop gets approximately 1.5 seconds longer, and between one and three new notes (or components) appear. This is summarised in the table below:

Figure 20: *Three Painted Walls and a Marbled Ground*, table, number of components.

Bar numbers	1-5	5-9	9-13	13-17	17-21
Number of components	IV	V	VII	X	XII
Loop duration (in seconds)	4	5.5	7	8.8	10

The piece is discussed in this chapter through the angle of its rhythmic mechanism because this was my principal focus during the composition. However, on the day of the performance, members of the audience principally commented on the offstage clarinet sound, making me realise that the clarinet glissandi on trills strongly impacted one's perception of the piece. The combination of glissando and trill on a clarinet gave a fragile, unstable sound. The significant reverberation in the art gallery embellished the effect, as would normally be the case for a harmonic tremolo on strings, for example. Furthermore, the first clarinettist was located very far away, in the room next door, which contributed to its unusual sonority.

4.1.8 *Three Painted Walls and a Marbled Ground* and the *Piano Quintet*: similar material presented on different scales

The piece presented above is very short, and exposes material which is very similar to the *Piano Quintet*. However, it is about eight times shorter than the latter. How can the same principle function in such different contexts? Both pieces, (as well as some passages in my *Percussion Quartet*), rely on a technique I have often used throughout my production - namely three or four voices in slow *hoquetus*, treated as gradually evolving loops, and involving players separated in the room. What interests me most with this type of polyrhythmic structures is that it is somehow 'pre-musical'; it could be presented with any type of sound, but also a visual impulse. Also, in my view, the predictability of such repetitive patterns creates dance-like circular movements, or geometrical trajectories that are strongly evocative of our spacetime representation of the world.

The fact that it is essentially based on the transformation of a rhythmic cell is what makes such material recognisable at very different scales, and in different musical contexts. The infinite loops which I will discuss later in the *Piano Quintet* can, therefore, be understood as a temporal augmentations of the *hoquetus* of *Three Painted Walls and a Marbled Ground*. In both cases, the material is perceived as a gradual process, changing continuously, in the sense developed by Steve Reich in his *Music as a Gradual Process* (Reich, 1968). This also relates to the aesthetics of the French Spectralist composers. Julian Anderson explains that in the 1970's Gérard Grisey and Tristan Murail used consonant spectra as 'points of rest [...] away from which progressive deviations are carefully measured' (Anderson, 1993).

In the case of *Three Painted Walls and a Marble Ground*, where I was asked for a short piece, the overall tempo is fast (although it is constantly changing). The attacks are clear (*pizzicati* for the strings, *staccato* for the clarinet), and the time difference between two attacks is always short. In the *Piano Quintet* on the contrary, the tempo is very slow and stable, so the time difference between each sound made held tones preferable to *pizzicati* in that case. The gradual changes are not occasioned by *tempo accelerandi* or *ritardandi*, like in *Three Painted Walls and a Marble ground*, but rather by superimposed slightly different speeds, such as will be exemplified in Chapter 4.2.2 with the *Percussion Quartet*.

4.1.9 Formal structure

Three Painted Walls and a Marble ground is based on an extremely limited pitch material:

- The cello plays only four pitches throughout (E₂, D₃, E₃, A₃).
- The violin plays eight pitches (G₃, A₃, B₃, E₄, F₄, C₅, A₄-E₅).
- The second clarinet plays 8 pitches (D₃, D₃[#], E₃, F₃, F₃[#], G₃, A₃, A₃[#]).
- The offstage clarinet plays four different figures based on the same pitch structure each time.
 - *Repeated note* (on F₃, as in bar 17)
 - *Held notes* (a multiphonic lowered down a semi-tone, as in bars 18-20)
 - *Tremolo* (a figure based on E₃, in bars 36-38 and 74-79)
 - *Bisbigliando-gliss.* (a combination of finger trills and embouchure glissandi, as in bar 42)

Although the discourse is rather continuous, three moments are considered as major articulations of piece. These moments are indicated in the score by the timings 1'30, 2'16 and 3'33).

At 1'30, the *sforzandissimo* articulation introduces new material in the offstage clarinet, suggesting a separation between 'section A' and 'section B'.

Figure 21: *Three Painted Walls and a Marbled Ground*, rhythmic figure of 'Section C'



Section C:

As the piece evolves, the feeling of segmentation is less perceptible since the listener starts hearing more globally after the first minutes. However, a rhythmic figure appears between the violin and cello just after 2'16 (bar 47), and its repetition every two bars makes the presence of a third section very clear between 2'16 and 3'32.

Section D:

The coda, at 3'33', is made explicit by the return of the tremolo figure in the offstage clarinet. In the staccato writing of the three instruments in *hoquetus*, each pitch emerges and disappears independently. The table below shows the distribution of these pitches throughout the temporal structure:

Figure 22: *Three Painted Walls and a Marbled Ground*, table, formal structure

(NB: a cross positioned at the left of the square indicates that the pitch is only played at the opening of the section)

Instrument	Pitches/gesture	A 0'00 – 1'29	B 1'30 – 2'15	C 2'16 – 3'33	D 3'33 – 4'00
Off-stage Clarinet	<i>Repeated note</i>	X	X		
	<i>Held notes</i>	X			
	<i>Tremolo</i>		X		X
	<i>Bisbigliando-gliss.</i>		X	X	
Violin	A#4-E5	X	X	X	X
	C#5	X	X	X	
	F4			X	
	E4		X	X	X
	B ₃	X			
	A3	X			
	G3	X	X		
2nd Clarinet	A#3			X	
	A3	X		X	
	G3	X			
	F#3	X	X		
	F3		X	X	
	E3			X	X
	D#3	X		X	X
	D3		X		
Cello	A3	X	X	X	X
	E ₃	X	X	X	
	D3			X	X
	E ₂	X		X	

This table highlights in the first place that A3 (in the cello part) and A#4-E5 (in the violin part) are present throughout the work. They strongly contribute to the sonic identity of the piece.

The distribution of crosses along the grid gives evidence of a match between the 'moments' or 'articulations' and an actual change in the pitch material. The piece can therefore be conceived as divided into four parts.

Summary on the formal structure: This short piece aims for a continuous transformation of the rhythmic material. Nevertheless, the analysis shows a clear segmentation of the form in four parts, in the writing of the offstage clarinet, but also in the distribution of pitches in the three staccato instruments.

4.1.10 General Conclusion

The use of audio-scores in this short piece allowed for greater rhythmic precision, as well as a significant physical distance between players in the performance space, whilst utilising a very light technological setup (a smartphone with cables and adaptors).

4.2 Percussion Quartet (2010/2011)

(DVD1 track 2)

This piece was written during the first year of my doctorate. At this stage, the main goal for me was to improve the technical results of performance in terms of synchronisation, as I was initially investigating the use of click tracks. I was therefore trying to compose music that would be impossible to perform without the help of a set of earpieces. The opening of Conlon Nancarrow's *Piano Study No. 37* for example, and more generally the 'impossible brilliance'¹⁹ of his music were an exemplar of sorts, inspiring the idea to compose a piece that could only be realised by mechanical means (or a computer). The goal was achieved in the sense that the audio cues undoubtedly facilitated the learning of the piece, and it probably could not have been realised any other way. The articulations between gestures sounded very accurate, percussionists responded very fast to each other, and most of their accents corresponded to sudden cuts or change of speaker in the tape. However, I now think that the piece presented a sort of

¹⁹ This expression is borrowed from the title of the Southbank Centre's 2012 event: 'Impossible Brilliance: the music of Conlon Nancarrow'.

restlessness that should have been counterbalanced with other types of materials.

One of the main advantages of providing the performers with audio cues is the reliance on the multichannel technique. Each performer is sent information corresponding to his/her individual part, making instructions very clear and saving rehearsal time. This same idea of polyphonic audio cues leads to another useful way of informing the performer. When one voice is silent, the phrase that comes next is always provided in the performer's separate part and audio-score (as a cue). This allows a comfortable anticipation of what comes next. In the following piece, synthesised signals, controlled via MIDI, were mainly used to provide information to the performers, not to be heard by the audience (piano sounds excepted).

I consider this piece as an exhaustive rhythm study, because its material is very limited. The whole work relies on a single idea, which is to achieve spectacular coordination between performers and electronics, while avoiding a sense of periodic pulse for the listener. The piece was performed and recorded live, with a satisfying interpretation. However the MIDI version is submitted here, synchronised with the video of the live performance, instead of the performers' live audio recording.²⁰ The MIDI version is much clearer for analysis because in the live recording, the spatialisation and the sonority of each performer are less contrasted. The visual component was quite important. The eye could catch the rapid circulation of the sound between the four musicians, but this aspect cannot be clearly perceived in the live audio recording.

4.2.1 A game between the four performers and four-channel tape

In the study score, Percussion 1 (left rear) and Percussion 2 (right rear) are at the top of the page. They sound further away in the recording. Percussion 3 (left front) and Percussion 4 (right front), at the bottom of the page, sound closer. The single line under each percussion stave represents a channel of electronics, which sounds at the same place as where the performer stands. Since the four channels of electronics are very separated, the piece can be conceived as an eight-part counterpoint (represented by the eight staves).

²⁰ However, the live recording is submitted in the musical examples (CD 2, Track 11), with the same timing as in the MIDI version, so the two versions can be compared easily at any point in the piece.

Figure 23: *Percussion Quartet*, score extract

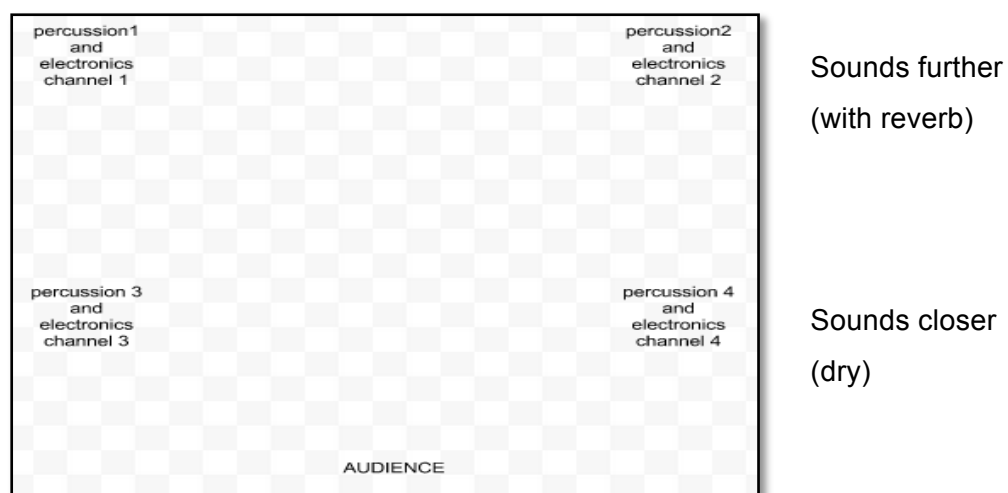
Left-Rear (LR) Percussion1
Electronics (LR)

Right-Rear (RR) Percussion2
Electr. (RR)

Left-Front (LF) Percussion3
Electr. (LF)

Right-Front (RF) Percussion4
Electr. (RF)

Figure 24: *Percussion Quartet*, placement of the performers in the space



One of the general main ideas of the piece was simply to create a sense of sharp reactivity between the four percussionists and the four speakers in each

corner of the room. If we hear the passage represented above, without electronics (CD 2, track 1), this intention of fast dialogues between instruments is very clear. The electronics were composed after the percussion parts, as a means to underline the responses of the live performers, as can be heard in this second example (CD 2, track 2).

4.2.2 Superimposed tempi

The rhythms generated by the superimposition of regular pulses with slightly different ratios have always fascinated me, as a sort of natural phenomenon; it is well known in contemporary music, as for example in the work of Conlon Nancarrow. Kyle Gann shows us that the opening of Study No.37 is a series of twelve canons (Gann, 1995, p. 193), where each voice has one of the respective speeds (these numbers represent tempo markings):

150 / $160\frac{5}{7}$ / $168\frac{3}{4}$ / 180 / $187\frac{1}{2}$ / 200 / 210 / 225 / 240 / 250 / $262\frac{1}{2}$ / $281\frac{1}{4}$

The very first gesture of my percussion quartet presents similar concerns with layered tempi, and other 'polytempo imitations' appear later in the piece. To use a similar ratio notation as Gann's, the click tracks of percussion 1, 2 and 3 have the following speeds at the beginning of the piece:

123 / $134\frac{1}{3}$ / $145\frac{1}{2}$ (which can approximately be reduced to the ratios 11/12/13)

Figure 25: *Percussion Quartet*, score extract, beginning of the piece

Perc. 1
♩ = 145.5

Perc. 2
♩ = $134\frac{1}{3}$

Perc. 3
♩ = 123



This extract can be heard without the tape in CD 2 Track 3. This material is repeated twice, later in the piece, at the rehearsal letters P (page 17) and R

(page 19-20). The study score (e.g. the extract above) uses proportional notation, so the distance between left and right is precisely proportional to time. This was realised with the help of A3 tracing paper on a large screen, zooming on the sequencer software. The parts were written in Finale, so with a different approach, non-proportional, but obviously more suitable for practical realisation, as the use of a click track implied conventional measured notation. In this same passage (the beginning of the piece), each percussionist has to hit a log drum on the downbeat²¹ every two bars in his separate part, as exemplified in the first bars of the separate part of Percussion 3.

Figure 26: *Percussion Quartet*, separate part extract, percussion III, beginning of the piece

The figure displays two musical staves. The top staff, labeled 'Perc. 3', is in 4/4 time with a key signature of one sharp (F#). It contains several measures of music, including a triplet of eighth notes. The bottom staff, labeled 'Click track', shows a series of downbeats represented by vertical lines, corresponding to the first beat of every two bars in the Perc. 3 part.

4.2.3 Infinite *ritardando*

The end of the Percussion Quartet (from 12'16" in the recording, page 32 in the score) is driven by the idea of an infinite *ritardando*. In the study score, the lines under the instrumental parts represent each of the 4 click tracks (they do not represent the tape as in the beginning of the piece). The click tracks get constantly slower, but subdivide frequently (double speed), in order to keep the *ritardando* continuous. Fast rhythmic figures appear as a sort of foreground, and are then repeated slower. A visual analogy would be to travel looking backwards. When the eye comes back to an element, it has become smaller (i.e. slower). This final section aims to release the tension carried throughout the piece.

4.2.4 Score and parts

A complex, fast and precise coordination between performers was achieved by writing in separate parts – reducing the whole gesture to a sum of elementary fragments – each one being specified and cued in an autonomous click track. At this point, it might be relevant to look at the same passage of the score (displayed in figure 23), in order to compare this to what the performers read in their parts (below). Only the first stave represents what the performer plays, the

²¹ Throughout the piece, the main concern was to make accents and downbeats converge in each part, to attain better precision (see for examples 'J', page 10, and 'Q', page 18 where each click track is written in the study score).

two smaller staves represent what the performer hears in the guide track, which cues what comes next:

Figure 27: *Percussion Quartet*, separate part extract, percussion III, beginning of the piece



The audio cue for the first percussionist at this particular passage can be heard on CD 2 track 4.

Below are given the parts of percussion 2, 3 and 4:

Figure 28: *Percussion Quartet*: separate parts corresponding to the full score in figure 23

Observing the separate parts, to show what performers actually see and hear when playing the piece should help the reader understand a central question which arose while I was writing this piece: what is the role of the performer? Does he feel reduced to a mere executant?

4.2.5 Conclusion

The players found the cueing system ingenious, and recognized that it could only help the accuracy of execution. Despite this, the piece remained very difficult. Provided with audio cues imitating what he is going to play in the following bar, the performer can feel hindered because he is not asked to recreate rhythmic figures himself from notation, but merely to repeat what he just heard. Above all,

this piece raised the question of balance between freedom and control that the composer should allow the performer. Rhythms in this piece are very precisely determined, almost 'imposed' on the performer, so that the realisation with audio cues allows far more accuracy than with traditional means. But one of the most important notions of notation-based composition was missing: the idea that the music does not really exist until the performer plays it.

5 RECORDED MATERIAL

Although they were only sent to the performer and not heard by the audience, MIDI generated sequences had a mechanical aspect that I wanted to avoid. This is why I started using recorded sounds during the second year of my doctorate. Writing pitches on a score, or manipulating MIDI notes, allowed more control over the material, and was close to the ideal of a work created *ex nihilo*. In contrast, because the sample of a recording is already music itself, with its own historical references, and its own musical characteristics, working with borrowed material was for me the occasion to experience an entirely different way of composing.

5.1 *Etude de Synchronisation* (2011)

(CD1, track 1, available at: <http://jonathanbell.eu/etude-de-synchronisation>)

This piece was commissioned by the Zafraan Ensemble; it was premiered in KonzertHaus Berlin in October 2011, and had its French premiere in October 2012 in Strasbourg. I had to decide on a title at a very early stage during the composition process. It appeared to me afterwards that what I found musically consistent in the piece was more about sound, instrumentation, timbre or contrast between different musical characters, rather than actual *time coordination*, which was more the concern of the percussion quartet. The title nevertheless influenced the performers to play in synchronisation to the tape, so they permanently had to stay aware of what was coming out of the speakers. Since this was one of the principal ideas of the piece, the title was kept.

5.1.1 Spatial separation

The separation of the ten given musicians into four chamber groups within the space came very early in the composition process. The groups were not divided by families as in the orchestra. Instead each group of two or three musicians contained a string player, and had an equal role. Although this piece is not reminiscent of early music at all, I had to write polychoral works in the style of Roland de Lassus (2007), and Giovanni Gabrielli (2008) as part of my *écriture* training. The antiphonal aspect of this music influenced the initial project of this piece. The placement on stage and the dialogue between groups determined which instrument would play, almost like in a choreography. This is why, in my

view, it relates more to the *cori spezzati*, the separated choirs of the Venetian style, rather than to an orchestration. Unconventional placement of performers also relates evidently to the 20th century tradition, notably Stockhausen's *Gruppen* (Stockhausen, 1957) or *Carré* (ibid., 1960). My former teacher Emmanuel Nuñez, who had incidentally studied with Stockhausen in the 1960s in Köln, experimented extensively with the unconventional placement of performers, and thus influenced me in this direction.

5.1.2 Audio cues delivered by loudspeakers

The most singular aspect of the composition of this piece relies on its use of recorded samples. On four speakers I edited, processed and projected extracts of recordings of solo instrumental performances found on the web.²² Each speaker was close to the corresponding group of instruments on stage (a duo or trio of instrumentalists + one loudspeaker in each corner of the room). The parts were written as four groups (of two or three instruments), so that each performer could see on the page and hear through his corresponding speaker what was happening in his group. What came out of the speaker, more than an accompaniment tape, was, again, a set of polyphonic auditory signals to performers. Speakers project sound in a very specific direction, so the placement of the four speakers in rehearsal, and in the concert hall, allowed each group of performers to hear their part individually in the tape. During the concert, from an audience point of view, the tape was much quieter than the live instruments, although a very particular blend could still be perceived. Apart from few obvious quotations,²³ the samples were barely heard by the audience, and therefore not perceived as quotations in the final work. Their essential function was to stimulate the interpretation of the performer. The latter had to find his path between what was written on the page, what came out of the speakers, and what corresponded best to his own technique, taste and style. The coordination of the whole ensemble was made possible by a fifth channel (in addition to the four channels of electronics), which provided a click track to the conductor.

²² The third part of my bibliography, *References of borrowed audio material*, provides a list of each source with their respective URL and detailed timings.

²³ The most recognisable quotations include: Schoenberg's opening of *Pierrot Lunaire*, (bar 184 in my *Etude*), Berio's *Sequenza IXb*, (bars 16-32), and Richard Baker's *Aria Infuriata* (bars 108, 139, 209).

5.1.3 How the form of the piece emerged

Gradually, the piece emerged by assembling these samples together. I first obtained a great variety of short chamber music episodes, contrasting in character, instrumentation, and dynamics. I then juxtaposed these episodes to one another, in a manner reminiscent of Stravinsky, but also evocative of the *cori spezzati* discussed above, because of the spatial separation of the different groups. Two of these passages used larger forces, and revealed the potential to be extended linearly as a crescendo using the majority of the instruments. These two sections later became: 1/ the introduction (bars 1-39, on a rhythmic ostinato); 2/ the major crescendo or articulation of the piece (bars 209-236, on a melodic ostinato, first announced more briefly bars 108-124). Apart from these two clearly identifiable moments, and the ethereal ending (in high register, pianissimo) the piece unfolds as a journey passing by different landscapes, but without necessarily a sense of direction or evolution.

5.1.4 Borrowed material

It quickly appeared to me that this piece asks significant questions. With borrowed material, an ethical question arose: am I allowed to make use of commercial recordings found on the Internet? Such an opinion is evidently questionable, since any recording, even if accessible on *YouTube*, should still be considered as protected. Although I did not feel entirely comfortable with this process, while collecting material it occurred to me that the principal positive aspect of web technologies is that they give free access to culture. I found this interesting in light of the fact that contemporary classical music has often been considered as reserved to an elite. The scholar Ronan Deazley²⁴ pushes similar arguments even further: 'The presence of a copyright regime need not necessarily impede the production of new derivative cultural goods' (Deazley, 2006). Such views may of course be highly controversial. Charles Ives famously incorporated existing music into his own compositions. This might explain why he adopts a singular attitude toward the access to his scores:

Everybody who wants a copy is to have one! If anyone wants to copy or reprint these pieces, that's fine! This music is not to make money but to be known and heard. Why should I interfere with its

²⁴ Ronan Deazley is a British legal scholar and author of 'Rethinking copyright: History, Theory, Language' (2006).

life by hanging on to some sort of personal legal right in it?
(Cowell & Cowell, 1955, pp. 121-122)

Composing from pre-existing material can evoke the famous ‘collage’ by Berio in the 3rd movement of his *Sinfonia* (Berio [1968], 2011), but it differs here in the sense that my use of samples was mainly concerned with a sort of naïve transcription made by ear of found materials, collected initially as a repertoire of sounds. In Berio’s work, a complex network of textual quotes, and a reflection on the ideas of symphonism and quotes seem to have been the starting point for the composition. His work is based on quotations of the third movement of Mahler’s Symphony No.2 (which itself includes references to Jewish folk music, and is based on the setting of ‘Des Antonius von Padua Fischpredigt’ from ‘Des Knaben Wunderhorn’, which Mahler composed almost concurrently). This reference game likely also echoes Charles Ives’ Symphony No.2, where quotation techniques were first used in his music on a grand scale.

5.1.6 Samples and their reception by the performer

I quickly realised that these samples had a very strong and precise effect on the performer. Contrary to MIDI generated signals, samples themselves inspired a real interpretation. While editing these samples, I often felt that I owed more to the recorded performer than to the score that was being interpreted, because of the short length of the chosen fragments. Firstly, these samples provided explicit information about instrumental technique – for example a specific jet-whistle, or particular type of trill on a bass clarinet. For me, capturing these sounds or effects (e. g. Garth Knox playing tremolo harmonics on viola) was reminiscent of recording an ornament in a piece of early music. The recordings were able to suggest ideas of interpretation: an ornament – although it can be precisely notated – is usually more the concern of the individual performer, while the composer generally has more exclusive control over the large scale structure.

The use of recordings of extended instrumental techniques also presented an interpretation of the score which the performer could easily identify and reproduce, or be inspired by, with relatively simple notation. In contrast, ‘Musique concrète instrumentale’²⁵ usually requires complex notation and a great level of

²⁵ Lachenmann has referred to his compositions as ‘*Musique Concrète Instrumentale*’, as a reference to Pierre Schaeffer’s *Musique Concrète* (Schaeffer, 1977).

expertise from both the performer and composer in order to reach the variety of timbres it aims for.

5.1.7 Fragmentation/Montage

The extract below illustrates that fragmentation makes the sources (score, composer and performer) hardly recognisable, so they are not perceived as quotations (CD 2, Track 5). The three windows of bass clarinet aim to show that, although they all came from the same source, the excerpts of the bass clarinet solo (detailed in Chapter 3 of the bibliography: *references to borrowed audio material*, p. 200) were themselves fragmented, shuffled and reorganised, so they differ very much from the original.

Figure 29: *Etude de Synchronisation*, score extract with references

The image displays a musical score extract for the piece *Etude de Synchronisation*. The score is written for a large ensemble, including Flute (Fl.), Violin (Vln.), Piano (Pno.), Percussion (Perc.), Viola (Vc.), Bass Clarinet (Bb. Cl.), Violoncello (Vcl.), Double Bass (D.B.), and Harp (Hp.). The score is divided into three systems, each with a set of staves for different instruments. The first system (L.R.) includes Fl., Vln., and Pno. The second system (R.R.) includes Perc., Vc., and Bb. Cl. The third system (L.F.) includes Vcl., D.B., and Hp. The score is marked with various dynamics (f, p, mf, ff) and includes several references to other works, such as Gyorgy Kurtag's *Piano pieces opus 8*, Arnold Schoenberg's *Klavier Stucke op.11 n°3*, Luciano Berio's *Sequenza IV*, Brian Ferneyhough's *Time and Motion Study I*, and Luciano Berio's *Sequenza IXb*. A note indicates that the cymbal ostinato comes from an ethnic music fragment whose provenance was lost. The score is marked with a tempo change to 'Faster' and includes a rehearsal mark '1'00'.

5.1.8 Conclusions

Because it owes so much to the recording of the performers, and can pose problems regarding copyright, I do not envisage using this particular technique again. On the other hand, I believe that this way of writing music has pedagogical value. Using a similar way of working, a group of musicians having had little contact with new music could learn much about extended techniques and their notation. Also for a young composer, the act of transcribing – which this method necessarily implies – reveals in an interesting way how notation rarely simply reflects its model, but instead underlines certain aspects it.

Finally, the online component of this piece raises questions surrounding the implications of today's free access to recordings. Walter Benjamin, in his article '*The Work of Art in the Age of Mechanical reproduction*' (Benjamin, 1936), and especially Paul Valéry, in '*The Conquest of Ubiquity*' (Valéry, 1928), were able to predict, nearly a century ago, this recent phenomenon²⁶: the omnipresence or instant access to any cultural content, and its various effects on the object that is being reproduced.

5.2 *Body Factory* (2011)

(DVD 1, track 3, available at: <http://jonathanbell.eu/body-factory>)

This piece was the result of a collaboration between dancers and musicians²⁷, performed four times in the Robin Howard Dance Theatre, at The Place, in November 2011, and twice in July 2012, for the London Contemporary Dance School (LCDS) student graduation. The young choreographer I worked with, Mansoor Ali, was at the time a second year LCDS student. He often found very original ways to direct his dancers. He provided them with constraints which also allowed for a certain individual freedom. The result was always very stimulating and evocative. In this work, the approach was completely different to the usual way I write music, since most of the material was developed during the rehearsal

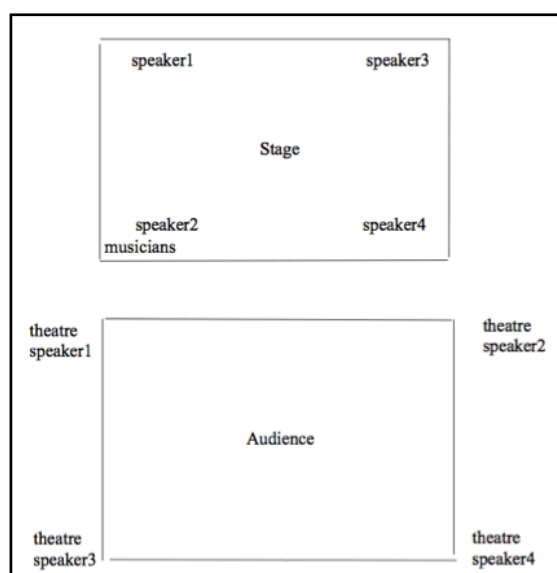
²⁶ The notion of 'Global Village' developed by Marshall McLuhan also relates to this idea (McLuhan and Powers, 1989).

²⁴ Mansoor and I collaborated on two other projects after *Body Factory*. He is also one of the two dancers involved with *Five Pieces for Voices and Electronics*.

²⁷ The artists involved in this project were: Emily Crouch, Rickard Fredborg, Bridget Lappin, Ellen Nous, Julie Schmidt Andreassen, Elliot Smith (dancers), Mansoor Ali (choreography), Alexia Pinguaud (singing), and myself (composition, percussion and electronics).

process with the choreographer and his dancers. I was sometimes quite surprised at with how the sequence of events and their duration was clear in the choreographer's mind. The negative aspect, musically, was that some decisions had to be made 'on the spot', in dialogue with the choreographer, and then became marks for the dancers, so could not be changed anymore. In that sense, the more conventional way of providing a set piece of music, to be choreographed afterwards, allows the musical material to develop itself with more sophistication (like in the five pieces for voices and electronics which I will discuss further). In rehearsals, four speakers surrounded the dancers, in order to establish correspondence between their movement on stage and trajectories of the sound.

Figure 30: *Body Factory*, placement of speakers and musicians in the performance-space



For the representation, in the theatre, the diffusion was made a little bit more complex (adding four extra sources), in order to make the sound movement effects more perceptible to the audience.

Each of the eight speakers depicted in this graphic was controlled independently.

Most of the vocal material in this piece was generated by selecting samples of recordings by Cathy Berberian, or samples of miscellaneous early music vocal repertoire.²⁸ The singer learned the piece aurally, imitating the samples I presented to her. As well as being a means of stimulating the interpretation of the performers, some of the samples used in this piece were heard directly by the dancers and the audience (Antonin Artaud, Cathy Berberian...). This constitutes a different approach than in the previous piece, *Etude de Synchronisation*, where the samples were 'filtered' by the performers, and barely heard by the audience.

²⁸ The list of borrowed material is detailed in: 'Bibliography/Chapter 3/Reference of Borrowed Material', p. 202.

5.3 Verbatim Theatre

While I worked as a rehearsal pianist for the London-based physical theatre company DV8, I noticed that the principal dancer, Hannes Langolf, wore headphones while rehearsing his role (dancing and delivering a spoken text at the same time). I had already heard about the headphone-verbatim technique before, but this opportune event made me aware of its increasing use in the domain of theatre practice. Lloyd Newson, who has led the company since its foundation in 1986, has adopted the technique in all of his recent productions, at least since *'To Be Straight With You'* (2008).

The headphone-verbatim form was introduced by British director Mark Wing-Davey, in his drama workshop *Without Paper* (2001), at the London Actor's Centre. *Recorded delivery* – a theatre genre devised by Alecky Blythe, who founded a theatre company of the same name – is a particular type of verbatim theatre in which actors wear headphones through which they hear their script, in rehearsal and also in performance. The actors recite the audio-script with absolute precision, recreating the exact speech patterns of original interviewees. The result is a hyper-natural form of documentary theatre that evokes the essence of the audio source with fidelity. As playwright Sir David Hare reported in an interview about verbatim for the National Theatre:

If you simply write from your imagination, then you write from your recollection of people's way of life, but if you go out and collect evidence about people's way of life, things are revealed to you which are completely extraordinary and which you don't see coming.²⁹

I think that this last observation can be applied to a musical domain, and is quite evocative of the two pieces presented in this chapter. More generally, this recent development of Verbatim Theatre over the last fifteen years, and the emergence of successful plays utilising this technique increases in my view the potential of using audio-scores for the creation of new forms of stage works or operas. In a commission from Île-de-France Festival, I used the recording of a spoken text

²⁹ Transcription from 'An introduction to verbatim theatre' published by the National Theatre, 16 January 2014 on YouTube, 1'10", Available at: <https://www.youtube.com/watch?v=ui3k1wT2yeM> [Accessed: 27 August 2015]

written by 15th-century poet François Villon as source material. This recording was fed into the ear of the performer, so that the singer recites the text as the piece unfolds (*De Joye Interdict*, 2014, in 'subsequent works', DVD 3, track 1, also available at: <http://jonathanbell.eu>). Such use of audio-score conveyed in my view an intense and unforeseen dramatic intensity, which I will investigate further in future compositions.

5.4 Conclusions

5.4.1 Found material

The works presented in this chapter have been an occasion for me to investigate the question of found material and its appropriation. The difficulties of authorship encountered when making use of materials that I had not generated myself have led me to conclude that such methods would not be viable in the long term, in spite of the great variety of sound worlds which they may give access to. Also, such ways of working are more suited to presenting a plethora of different materials rather than developing one single idea, which is why it could be argued that in a piece like *Etude de Synchronisation*, in spite of the variety of materials presented, the rate of change comes across as too regular after a while. These two self-criticisms, therefore, guided me towards more self-contained forms of composition in subsequent works. This singular approach has, nevertheless, been fundamental for my understanding of the process of composition. This experience, together with my former *écriture* studies, taught me a great deal about the difference between writing in a given style, using referenced material, and writing 'your own' music. This use of samples, as found material, also made me realise that com-posing (putting together) rarely means generating material *ex nihilo*, since the methods of generation themselves, the instruments, or the conventions within which concert pieces are presented are all culturally inherited. Finally composing with/from referenced materials touches on the paradoxes that composers always oscillate between: the necessity to refer to a tradition and *authority* in the act of composing.

5.4.2 Authorship

The notion of authorship, as we conceive it now, did not exist in the Middle Ages. For example Vincent de Beauvais writes in the prologue – *Libellus Apologeticus* – of his encyclopaedia *Speculum Majus* (the most comprehensive encyclopaedia of the Middle Ages): '*lpsorum igitur est auctoritate, nostrum autem sola*

*ordinatione*³⁰ (Zimmermann, 2001, p. 159). Thus, the encyclopaedist insists on the fact that his task was merely to compile and authenticate. Similarly Chaucer closes *The Canterbury Tales* with its retraction: '(...) namely of my translacions and enditynges of worldly vanitees, the whiche I revoke in my retracciouns' (Fisher, Allen & Chaucer, [ca. 1389] 2011).

Retractions, or palinodes, were very common in the Middle Ages, probably because to be an author (auctor: who increases), or the creator of a work, could be subject to censorship or inquisition. This is because authorship (or authority) properly belonged to God, and because most writings were collective.

The medieval notion of collective authorship is closer today to scientific research than artistic practice. The function of a scientific publication is to contribute to the knowledge of a given research field, which requires contextualisation and acknowledgment of works published in the field. Art, on the other hand, is concerned with aesthetics and taste, which cultivate implicit values – such as, for instance, self-expression, the uniqueness of the artist's craft, or the structural unity of the work – and incline us to judge autonomous works with greater respect in art than in science.

5.4.3 Postmodernism

While such direct or unmediated expression of the self was associated with heresy in the Middle Ages, the sceptical attitude that postmodern composers adopted towards their material gave rise to a similar distance towards what might be called *direct speech*³¹ (in favour of *reported speech*). Postmodernism, for Jonathan Kramer (1996), Umberto Eco (1989), or Jean-François Lyotard (1979), is less a style or a historical period rather than an *attitude*. Kramer explains that postmodern music 'shows disdain for the often unquestioned value of structural unity' and 'includes quotations of or references to music of many traditions and cultures' (Kramer, 1996, p. 1). Indeed, the third movement of Berio's *Sinfonia* quotes, references, reports, or documents external sources. In that regard such work resembles medieval motets or encyclopaedias, and contrasts with the idea of the artist's self-expression and of his own, unique, inner vision. Although this

³⁰ 'They are the authors, I am only the compilor' (my translation).

³¹ Brian Ferneyhough, during a private lesson at IRCAM, while discussing a harmonically consonant passage in my piece *De Joye Interdict*, made an observation expressing this distance explicitly: 'As long as it is not tonal, but "tonal"' (mimicking scare quotes with his fingers).

belief in *self-reflection* or *introspection* – which is not without suggesting a form of narcissism – is inherited from German Romanticism, it is still very influential in the artistic research of many composers today. Thus, discussing composers of the Second Modernity, Claus-Steffen Mahnkopf writes:

They are interested in the development of their personal style, their poetics and their life's work (...). As today's culture continues to be postmodern (...), the art of second modernity stands in opposition to this in its emphasis on seriousness and artistic truth. (Mahnkopf, 2008, p. 10)

Amongst the works presented in this chapter, the *Etude de Synchronisation* – which could also have been called *Etude de Transcription* – has been one of the most instructive. The initial project was not to compose a postmodern work, and yet reflecting on the piece afterwards revealed that it is quite characteristic of this style or attitude. Using such heterogeneous sources of material made me aware of fundamental concepts and problems such as authorship, found material, and transcription, which are of central importance for a composer today. Transcribing/notating fragments of borrowed material, in particular, showed me how the choices made during the notational process necessarily reflect the way I perceive them. These fragments became mine essentially by the act of transcribing. The function of notation in this particular work was therefore to transform and assimilate external ideas, thus contributing to the development of my personal style.

6 VOCAL WORKS PERFORMED WITH THE HELP OF AN EARPIECE

Microtonality is the area I am most interested in while writing vocal works. Auditory signals allow the singer great stability in intonation within the minute gradations of pitch which are required in order to compose outside equal temperament. The singers I have worked with find audio cues very useful in realising such intervals, which would otherwise be very difficult to pitch. On the other hand, in some cases instrumentalists find tablatures or fingerings more efficient. Tuning for plucked string instruments is evidently set before the performance, so an audio guide would not be useful for them in concert situation. Wind players experienced with microtonality rely highly on fingerings when playing microtones. Brass players also rely on similar artifices in order to gain accuracy while interpreting microtones. For example some horn players will use the seventh natural harmonic of their instrument in order to lower certain pitches. Finally, string players, in this sense, are closer to voices (and therefore can find audio-guides very useful) because their tuning principally relies on their ear.

Although the two pieces presented here were performed with a score most of the time, there is potential for utilisation of this tool as an aide-memoire in a larger scale vocal work. The text and musical material can be sent through earpieces and the music performed without a score.

6.1 *Lasciato Hai Morte* (2011)

(CD 1, track 2, available at: <http://jonathanbell.eu/lasciato-hai-morte>)

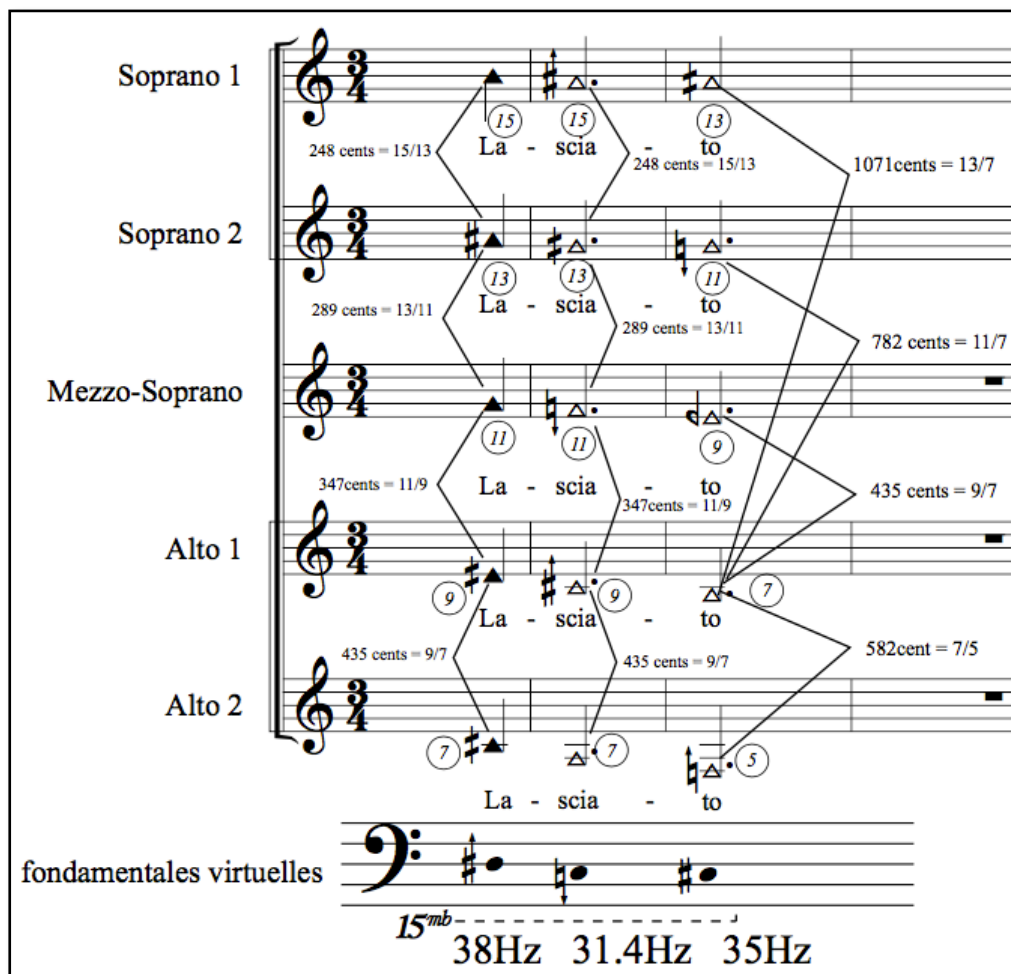
6.1.1 References

The vocal ensemble *De Caelis* commissioned this piece in June 2011. It contains obvious references to Italian madrigals: first in its use of five voices *a cappella*, with fragments of a Petrarchan sonnet as the text; secondly, in its construction, which consists of relatively short contrasting sections; finally, though less literal, another reference to this genre deals with experiments on pitch material. In the madrigals of Rore, Marenzio, Gesualdo, Vicentino or D'India, unusual chromatic and even microtonal relationships may be seen, so in this regard, there is a tradition of experimentation within the madrigal genre.

6.1.2 Microtonality

In this piece, two ways of approaching microtonality lead to different types of notation in the study score. Triangle note-heads correspond to notes calculated spectrally, and do not obey the rules of the equal temperament. Conventional note heads, on the other hand, correspond to quartertones (24 equal temperament).

Figure 31: *Lasciato Hai Morte*, spectral-harmony analysis



For example, the three opening chords of this piece are based on the odd partials of the harmonic spectrum. Each singer was sent a three-note sequence (on the word *Lasciato*), so that each note corresponds to one of the odd partials of each fundamental. The partial number is indicated in a circle in this extract, while the intervals are expressed in cents and in ratios. The virtual fundamentals are displayed at the bottom.

These fundamentals were chosen primarily for the contrapuntal relationships they occasioned. Just like in classical voice leading, the first condition was that intervals in each voice should be as small as possible, and of course each note had to match with the tessitura of the corresponding singer. The choice of fundamentals was, therefore, a consequence rather than the cause of the movement of the voices: first a general melodic contour was outlined within the tessitura of each voice, and then the fundamental that corresponded best was chosen.

The following audio example (CD 2, track 6) compares the theoretical model with two different performances. It demonstrates that, in each case, the realisation of the extract above is not very far from the model.

In this piece, another way of composing with microtones is to use conventional triads of equal temperament, where each voice resolves to the following chord using the small interval of a quartertone, in a manner reminiscent of the music written in Vicentino's treatise.

Figure 32: Nicola Vicentino, *Della Prattica Musicale, Libro terzo*, (1555)



In the examples above, a dot written above a note raises it by a fifth of a tone approximately, (31-division E.T.).

Figure 33: *Lasciato Hai Morte*, score extract

This example (above, CD 2 track 7) shows two triads where voices move in contrary motion of a quartertone (bars 127-130).

Figure 34: *Lasciato Hai Morte*, score extract (2).

Here the three voices move in parallel motion of 3 quarters of a tone (bar 30-31). In this passage, each voice has a different speed. They converge on the syllable 'ma'. Without an auditory assistance or a microtonal instrument, these passages would probably be perceived as normal tonal music, because of the use of major and minor triads. Other tonal references combined with micro-intervals play an important role in this piece, the last section is quite explicit in that regards:

Figure 35: *Lasciato Hai Morte*, score extract (3).

Figure 35 shows a musical score extract for the piece *Lasciato Hai Morte*. The extract is for measures 135 to 146. It features five staves: S1 (Soprano 1), S2 (Soprano 2), Mezzo (Mezzo-soprano), A1 (Alto 1), and A2 (Alto 2). The time signature is 8/46, and the tempo/mood is marked 'p' (piano). The lyrics for S1 are 'Do - glio mio sol ne sol ho - o da - do - ler - me'. S2 has the lyric 'o'. Mezzo has the lyrics 'Do - glio mi - o Do - glio mi - o'. A1 and A2 have the lyrics 'mi - o Do - glio mi - o Do - glio'. The score shows various musical notations including notes, rests, and dynamic markings.

In this example, the four lower voices alternate between two chords:

- a D minor triad (Dm7, with E being appoggiatura of D)
- an A_d minor triad (A_dm7, with B_d being appoggiatura of A_d)

6.1.3 Counterpoint in a modal environment

In some passages where voices are not homo-rhythmic, pitches are treated as a mode, giving important weight to the pitches lowered by a quartertone.

Figure 36: *Lasciato Hai Morte*, score extract (4).

Figure 36 shows a musical score extract for the piece *Lasciato Hai Morte*. The extract is for measures 20 to 40. It features five staves: S1 (Soprano 1), S2 (Soprano 2), Mezzo (Mezzo-soprano), A1 (Alto 1), and A2 (Alto 2). The time signature is 4/4, and the tempo/mood is marked 'p' (piano). The lyrics for S1 are 'co - no - bi li - o ch'a pian - ger qui ri - ma - si'. S2 has the lyrics 'ch'a pian - ger qui ri - ma - si'. Mezzo has the lyric 'a'. A1 has the lyrics 'spen-toil pri - mo va - lor l'hu-man le - gna - gio'. A2 has the lyric 'e'. The score shows various musical notations including notes, rests, and dynamic markings.

The passage above, for example, is based on Phrygian tetrachords, where the third degree was lowered a quartertone.

Figure 37: ‘Lowered Phrygian’



6.1.4 Examples of cueing in the performer's separate parts

Figure 38: *Lasciato Hai Morte*: soprano separate part extract



Cues are notated in smaller print and appear without text. Their role is to help identify what comes next. Here, the tempo relates to what the singer is about to sing, and can differ from what is actually sung by other performers at the same time.

Then, the performer sings along with the earpiece, so now the auditory signal is not perceived as a cue, but as a sort of instrumental support.

In this same passage, the three upper voices hear their cue while Alto 1 and 2 sing the previous section.

Figure 39: *Lasciato Hai Morte*: Score extract (5)

The image shows a musical score extract for five parts: S 1, S 2, Mezzo, A 1, and A 2. The parts are arranged vertically. S 1, S 2, and Mezzo have lyrics: 'ch'a pian - ger qui ri - ma'. A 1 has lyrics: 'mar de - vreb - be'. A 2 has lyrics: 'l'ae - re la ter - ra el mar de - vreb - be'. A circled '5'07"' is placed above the S 1 staff. The score includes various musical notations such as clefs, notes, rests, and dynamic markings like 'f'.

The best way to show how cueing functions in this piece is to read an extract of the part of Soprano 1 (page 30), while listening to the corresponding audio track sent to the ear of the performer (CD 2, track 8). As in the Percussion Quartet, bars and beats do not correspond in the score and parts. The conductor's score represents what the listener hears globally, while each performer's part is measured in order to make downbeats and musical accents converge. This allows more autonomy for each voice, and keeps each part rhythmically simple, and therefore quickly memorisable.

This idea of autonomy, so that each performer can potentially follow his part without having to rely on other singers can seem contradictory, if we think that ensembles aim for cohesion in rehearsals. However, the vocal pieces presented here aim to be performed with singers around the audience, in which case cohesion or the global sound is perceived in a different way. The goal here is to recreate for the listener the circulation of sound perceived by singers, for example, in an imitative passage from a madrigal performance. Paradoxically, if performers are distanced from each other, the audience can more clearly more hear contrapuntal responses between voices, although the singers' ability to hear one another is impeded.

Figure 40: *Lasciato Hai Morte*: soprano separate part extract (6)

Jonathan Bell

Soprano 1

mf *molto rit.*
las - cia - to sen - za so - leil mun - do

p 0.40
las - cia to hai mor te sen - za so - leil mun - do sen - za so - leil

mf
mun - do sen - za so - lei mon do

mf *Ritardando molto, un'al bar 38*
sen - za so - lei mon do os - cu - reo fred - do le - ggia dri - a - i - gnu - da

mf
le - bel - le - ze - in - fer - ne co - ro - bi - li - o cha pian - ger qui ri - ma si

6.2 Five Pieces for Voices and Electronics on Poems by Robert Bell (2012)

(CD 1, track 3-7, available at: <http://jonathanbell.eu/five-pieces>)

The *De Caelis* Ensemble premiered this piece on France Musique, on May 7, 2012. Again, voices are given their pitch individually. However, unlike in *Lasciato Hai Morte*, they are provided with recorded voices instead of piano sounds, so the performer's approach is more imitative.

These five pieces are an homage to my father. The work mainly utilises his poetry, except for the first piece, which employs a fragment of a poem extract from Omar Khayyam's *Rubbayat*.

6.2.1 'Menbimeieno'

The material used in this first piece is very minimal. The Persian text, '*Man Bi Mey-e Nâb Zistan Natvânam*', may be translated as 'Without pure wine there is no life for me'. The aim was to tune voices spectrally to the sounds of the tape (a flute whistle tone transposed two octaves lower, and processed with reverb and compression). The harmony of this first piece is built on a harmonic spectrum. The fundamental is situated around 91Hz, thus slightly below the lowest F# of the piano. The notes sung by the singer correspond to the harmonics 7 to 12.

Figure 41: *Five Pieces for Voices and Electronics*: Soprano part extract



The example available on CD 2 track 9 shows the three stages of elaboration of the material for the first piece. The first fragment presents a sample of a recorded voice (this is the fragment by Omar Khayyam), from which the words were extracted. The second fragment shows how this material was presented to the performers transformed. The third fragment reveals the final interpretation.

Although each voice repeats the same melody every twelve seconds, each part has a different tempo and time signature, so that musical accents of each

melody converge with downbeats. As in the *Percussion Quartet*, each performer perceives his/her own part on the downbeat and the other parts as a counterpoint, which ‘contradicts’ his/her time signature.

6.2.2 ‘Leaves, Dead Leaves’

The first page of the second piece of this cycle obeys a very simple rule: vertically and horizontally, the interval of three quarters of a tone is predominant. A1, the section between Bars 1-6 (A1 is displayed in dotted lines), is followed by a variation (A2), bars 7-11. The second time, D₄ of Alto 2 (bar 1) is sung by Soprano 2 (bar 7), and an F is added in Soprano 1.

Figure 42: *Leaves, dead leaves*: score extract

The image shows a musical score extract for the piece 'Leaves, dead leaves'. It consists of five staves labeled S1, S2, Mezzo, A1, and A2. The score is divided into two sections, A1 and A2, indicated by dashed lines. S1 and A1 have rests in section A1. S2, Mezzo, and A2 have lyrics: 'dead lea ves leaves dead leaves' and 'leaves' respectively. S2 and Mezzo have a '<>' symbol under 'leaves' in section A2. A2 has a '<>' symbol under 'leaves' in section A1.

From bar 79 onwards, this piece makes substantial use of *contrepoint brisé*, a technique borrowed from Renaissance counterpoint, which consists in delaying some voices in a homorhythmic passage (bars 79-82, displayed here, but also 90-95, 100-105).

Figure 43: *Five Pieces for Voices and Electronics*: Soprano part extract

(An example of the technique of *contrepont brisé*, characteristic of Renaissance style)

The alternation between this kind of loosened homorhythm, strict homorhythm (bars 75-78, 98-99) and imitative passages (bars 88-89, 95-96, 106-117) also constitutes an attempt to imitate Renaissance polyphony.

In bars 84-86 (below) and 99, two voices sing a slow shallow glissando in contrary motion, while a third voice stays on the same note. This material is perhaps one of the most problematic to execute without the help of an audio-score.

Figure 44: *Five Pieces for Voices and Electronics*: score extract (1)

In order to evaluate the precision acquired from the earpieces' assistance, the recording of the end of this piece (CD 2 track 10) was transcribed, and compared to the original model (before the transcription). Only the precision of intonation was considered here, not the rhythmical aspects. Luckily, the transcription matched the original most of the time. The major differences are framed in dotted lines. In these passages, the difference is rarely wider than a quartertone.

Figure 45: *Five Pieces for Voices and Electronics*: original notation

The image displays a musical score for the piece "Five Pieces for Voices and Electronics". It features five vocal staves labeled S1, S2, Mezzo, A1, and A2, along with a "Tape" staff. The music is written in 3/4 time. The lyrics are as follows:

S1: in this place of dis - sa - fee - tion to which I have to which I have
S2: in this place of dis - sa - fee - tion to which I have to which I have
Mezzo: in this place of dis - sa - fee - tion to which I have to which I have
A1: in this place of dis - sa - fee - tion to which I have to which I have
A2: in this place of dis - sa - fee - tion to which I have to which I have
Tape: in this place of dis - sa - fee - tion to which I have to which I have

The score includes musical notation with notes, rests, and dynamics. Some differences between the original notation and the transcription are highlighted by dotted lines, particularly in the vocal parts. The tape part is marked with a "p" (piano) dynamic.

Figure 46: *Five Pieces for Voices and Electronics*: transcription of the recording

The image displays a musical score for the piece "Five Pieces for Voices and Electronics". It features six staves, each representing a different vocal or electronic part. The parts are labeled on the left: S1, S2, Mezzo, A1, A2, and Tape. The notation is in treble clef with a key signature of one flat (B-flat). The lyrics are written below the notes, with some parts enclosed in dashed boxes to indicate specific phrases or repetitions. The score includes various musical notations such as notes, rests, and dynamic markings like *f* (forte) and *p* (piano). The lyrics include phrases like "in this place", "of dis-sa-fec-tion", "to which I have", and "be-come".

Ideally, to measure the improvements acquired through the use of earpieces, the transcription of a recorded performance without the help of auditory signals would have been helpful here.

6.2.3 'And I will'

The main unifying factor in the third piece is characterised by slow glissandi sung with slow vowel diphthongs. The three sections were composed separately, each one based on a fragment of a different poem. Due to their similarity, I decided to group the sections together³² afterwards. Because the extracts taken from the poems are so short (they consist of only a few isolated words in this piece), the poetry can only be considered source material. Here is what follows the first fragment '*And I will stay here in solitude*' in the poem:

And I will stay here in solitude
To delve into the foundation
Of the poem, for in the beginning
Was the word. I'm at the end
And the only way to proceed
Is in song (...)
(Bell, 1988, p. 2)

In order to demonstrate that the section between bars 133 and 145 is a variation of the opening (bars 118 to 132), the following describes what remains invariable in those two passages.

The words '*And I*' are treated as a two-voice counterpoint (bars 118-119, Alto 1 and 2 are in unison), then the word '*will*' is sung by the whole ensemble on slow glissandi. After one more entry on '*And I will*', the words '*stay here*' appear, without glissando, and finally the words '*in solitude*' are sung by one voice, in a descending melodic shape. An effort has been made in the variation to change the arrangement of voices; for instance, what was initially sung by the three lower voices is sung by the soprano the second time. The variation also presents different pitches, but the general shape remains very similar. In order to create an effect of amplification in the second presentation, the glissandi on the word '*will*' takes more time, and Sopranos go up to G. The second section, which uses

³² This manner of composing veers away from the idea of a pre-compositional plan; it is for me reminiscent of Beethoven's string quartet op. 131, where seven relatively short movements follow each other in a very singular way.

Its consonance is due to the perfect fourth F $\sharp$ -B and the major second G $\sharp$ -A $\sharp$. The absence of a semitone is a second factor of consonance, for three quarters of a tone can be acoustically considered as less dissonant than a semitone.³³ The ending, on the '*to purge my guilty ways*' plays with the detuning of the perfect fifth D $\sharp$ -A $\sharp$.

[illegible]

The fourth and fifth pieces use the same poem:

³³ Pythagoras found that ‘pleasant’ sounding musical intervals were produced when the frequencies of two vibrating entities formed simple integer ratios (e.g. 3:2 corresponds to the perfect fifth, 2:1 the octave), whereas complex ratios produced ‘harsh’- or ‘rough’-sounding tones (e.g. 16:15, dissonant minor second). Therefore, three quarters of a tone (e.g. 11:12 or 12:13) can be considered more consonant than a semitone, although it is obviously culturally less common.

Father and son
Desperately linked in play. For homo is ludens.

(Bell, 1989, p. 28)

The fourth piece overlaps spoken and sung words. The speed of elocution being much faster with spoken words, the singers only use the ending of the first strophe (into which...). The words are spoken by two different voices, symbolising father and son, and the spoken word 'desperately' converges with the sung word 'stones', on a chord based on perfect fourths and fifths, which recalls an effect of parallel or hidden consecutives, underlined by the absence of contrary motion.

The piece finishes on a sequence where the same set of pitches is repeated in a loop, in a manner reminiscent of the opening (*Membimeino*). This repetition (bars 191-197 displayed below) made the microtonal environment more obvious, and contrary to my expectation, I realised that the help of an earpiece can be more effective within such frozen harmonic landscapes rather than in passages where the pitch content is not stable. Framed by the octave and fifth D4-A5-D5, this whole passage is reminiscent of a D minor triad in root position, with the minor third and minor seventh (F and C) lowered a quartertone.

Figure 48: *Five Pieces for Voices and Electronics*: score extract (3)

The image shows a musical score extract for five voices and electronics. The staves are labeled S1, S2, Mezzo, A1, and A2. The music is in 3/4 time. The lyrics are: S1: ge - ther to - ge - ther to - ge -; S2: nes to - ge - ther; Mezzo: - ge - ther to - ge - ther to; A1: to - ge - ther to - ge; A2: to - ge - ther to - ge - ther. The score includes various musical notations such as notes, rests, and slurs.

6.2.5 'Who knows'

The last of the five pieces features a recording of a Persian plucked string instrument called the Târ.³⁴ Regarding microtonality, the Târ is interesting because its fret board contains quartertones. The challenge in this piece was to combine variety in the vocal writing with the slow modal development that classical Persian music requires. To maintain a sense of continuity I used the *Furud*, the last part of a traditional improvisation, which resolves the tension by briefly recalling the different modulations (*gushehs*). The following is a description of how pitches were chosen in that piece, in relation to the Târ recording:

Bars 202-206 (below): at the beginning of this piece, the tuning system is simply identical to the one of the recorded instrument. The extract chosen from the improvisation of the Târ player corresponds to his second modulation on D, which is an allusion to the mode Shur, a minor tetrachord with its second step flattened a quartertone. Thus, the voices and Târ share the same four pitches: D, low E, F, and G. The târ was tuned slightly flatter than A = 440 when I recorded it (between a quarter and an eighth of a tone); therefore the voices and Târ sound slightly flatter than what is written here.

Bars 207-209: when the Târ has modulated to G, the voices sing a spectral chord whose fundamental is the lower C_# on a piano keyboard.

Figure 49: *Five Pieces for Voices and Electronics*: table voice/note/partial

Voice	Note	Partial No
Soprano 1	A quarter sharp	13
Soprano 2	G quarter flat	11
Mezzo	C#	8
Alto 1	B low	7
Alto 2	G#	6

34 In an earlier piece of mine employing this instrument, I discovered another potential benefit of working with audio cues. In this previous work, I had pre-recorded samples of this improvisation, and used the same technique of audio-scores described in other works of this folio. However, this time with improvised material transcribed in a separate part. This allowed me to introduce fragments of târ improvisation very precisely in a long work for 10 musicians, without any difficulties in rehearsals. In other words, it was then possible, with the help of audio cues, to predetermine a written composition with material that came from an oral tradition. Although the târ player on this occasion was not a well-trained reader, the association of auditory signals and score made the visual input (his separate part) much easier to understand. The musical phrases were not difficult for him to memorise, but he relied on the paper in order to know how many counts he was given before each entrance.

Figure 50: *Five Pieces for Voices and Electronics:* Score extract (4)

Figure 50 shows a musical score extract for the piece "Five Pieces for Voices and Electronics". The score is for six parts: Soprano 1 (S 1), Soprano 2 (S 2), Mezzo, Alto 1 (A 1), Alto 2 (A 2), and Tape. The lyrics for the vocal parts are "in the skull - bones of the earth". The score is written in 2/4 time. The vocal parts are written at concert pitch. The Tape part features a complex electronic texture with various rhythmic patterns and pitch bends.

Here, the voices are written at concert pitch (not slightly flatter as in the beginning) however, the Târ sounding still slightly flat, the notes of soprano 1 and 2 should be very close to G and B flat of the Târ.

Bars 210-214: this section corresponds to the *Furud*, where different sections of mode are summarized. The whole passage is unified by an F harmonic spectrum, which uses the same loop technique and the same words as the first piece to create a cadential gesture.

Figure 51: *Five pieces for Voices and Electronics:* Score extract (5)

Figure 51 shows a musical score extract for the piece "Five pieces for Voices and Electronics". The score is for six parts: Soprano 1 (S 1), Soprano 2 (S 2), Mezzo, Alto 1 (A 1), Alto 2 (A 2), and Tape. The lyrics for the vocal parts are "bzi - stan net - voh - ne" and "men - bi - mei - e - no". The score is written in 2/4 time. The vocal parts are written at concert pitch. The Tape part features a complex electronic texture with various rhythmic patterns and pitch bends.

Bars 215-219: Soprano 1 and 2 oscillate around A, so they are essentially related to the Târ by an interval of a fifth, D being the centre of this passage, and also the most important note in the *ostinato*.

Figure 52: *Five Pieces for Voices and Electronics:* Score extract (6).

The image shows a musical score extract for five parts: S1, S2, Mezzo, A1, and Tape. The score is for bars 216-219. S1 and S2 have lyrics 'a - - - - è - -'. Mezzo has the word 'no' followed by a long horizontal line. A1 has a few notes. The Tape part shows a complex rhythmic pattern with triplets and sixteenth notes.

The audio-score sent to the singers in this passage is a sample of Cathy Berberian (transposed on A, displayed above), imitating a childish voice, where a short glissando precedes a change of phoneme.

Bars 221-227: A triple appoggiatura in the voices is resolved in contrary motion by slow glissando of a semitone, progressively reaching the pitches of the *ostinato*.³⁵

³⁵ In an earlier piece of mine involving the same instrumentalist, I discovered another advantage of working with audio cues. In this previous work, I had pre-recorded samples of this improvisation, and used the same technique of audio cues described in my other works, but this time with improvisations transcribed in a separate part. This allowed me to introduce fragments of the improvisation very precisely in a long work for 10 musicians, without any difficulties in rehearsals. In other words, it was then possible, with the help of audio cues, to predetermine a written composition with material that came from an oral tradition (improvised). Although the târ player on this occasion was not a well-trained reader, the association of auditory signals and score made the visual input (his separate part) much easier to understand. The musical phrases were not difficult for him to memorise, but he was relying on the paper in order to know how many counts in he was given before each entrance.

Figure 53: *Five Pieces for Voices and Electronics*: Score extract (7).

The image shows a musical score extract for three vocal parts (S1, S2, A2) and a Tape part. The vocal parts are in treble clef with a key signature of one flat (B-flat). The tempo/mood is marked *mf* (mezzo-forte). The score is numbered 220. The lyrics for the vocal parts are: "men - bi - mei-e - no _____ bzi _____ stan - net voh - ne". The Tape part is in treble clef and features a series of eighth notes, with a bracket indicating a group of 7 notes.

6.3 Conclusion

While writing these two pieces I was primarily concerned with harmony, or with the realisation of microtonal material. In hindsight, I think what the audio-scores conveyed to the singers was, in the case of *Five Pieces for Voices and Electronics*, an extremely even, slow, and quiet material, somehow compelling the singer to find an intimate, almost introverted character. In the case of *Lasciato Hai Morte*, on the other hand, the audio-score gave a reassuring base on which they could elaborate more freely.

After years of experience writing vocal music performed with the help of earpieces, it is still difficult for me to tell how these works would sound if they were sung conventionally, without audio-scores. Due to recent technological improvements (such as web applications described in Chapter 9.2.4.2), I am today even more enthusiastic than before about performing these works with such devices. Nevertheless, I would still be interested in the future to try and use earpieces as a learning aid, and then let the singers perform without such

assistance on the day of the performance. If the works presented in the present chapter were to be performed without audio-scores, their support materials (i.e. the score) would require, as with any work transmitted via standard notation alone, a more challenging – and thus perhaps more active – engagement from the performer. For example, the mutual listening among singers, which is required for an accurate execution of just intonation harmonies, would create stimulating *performative* situations, thus reactivating the function of the notation-as-prompt-for-action, which is at the heart of the performer-as-interpreter tradition.

7 MUSIC AND DANCE AT ST MARY OF THE ANGELS

7.1 Introduction

7.1.1 Installation for dance

The two pieces presented in this chapter were written for a specific space - St Mary of the Angels Church in Notting Hill. The performance involved the Archos Quartet, fellows at the Guildhall School of Music and Drama, collaborating with four dancers who graduated from London Contemporary Dance School.

Figure 54: St Mary of the Angels, the performance space



Both works were influenced by a residency I participated at *Royaumont* in France between 2013 and 2014, entitled '*L'espace propice à l'apparition du chorégraphique*'.³⁶ The pieces were composed having in mind a slow pace, relatively quiet and undifferentiated dynamics, in order to create in this resonant space an atmosphere, a particular environment with performers around the

³⁶ This can be translated as: 'The space favourable to the emergence of a choreography'.

audience. I wanted this music to be an immersive installation in which the dancers would be integrated organically. There were three sessions in the church with the dancers, during which I played the recording on CD. During the rehearsals, I deliberately let the dancers improvise without giving any instructions. My intention was to make the music and the chosen space more stimulating than restrictive. In another context this approach could have left the collaborating artist doubtful, but the dancers found this non-verbal approach accommodating.

The relationship between music and dance has profoundly changed in the 20th century. It has become freer, in part due to the Cage-Cunningham heritage. Contemporary dancers often require an important autonomy in relation to the music. This can be understood partly as a reaction against the domination which musical forms and beats imposed on classical ballet. For some contemporary choreographers and dancers, musical accentuation can be limiting, or even go against the organic nature of movement. It is therefore often the case that contemporary choreographers and dancers seek continuity or fluidity.

As a general observation regarding music and dance in the pieces presented in this chapter, I must confess that I wish the dance had been more calm and slow in, as the music was. In a subsequent project, my *Piano Quintet* and the *Five pieces for voices and electronics* were used for a dance piece by the French choreographer Hervé Robbe (cf. *Polyphonies*, DVD 3 track 2). On that occasion, the slowness and fluidity of the movement worked in synergy with the music.

7.1.2 Morton Feldman

The sound world I had in mind while writing these pieces was inspired by the late music of Morton Feldman. Two of his pieces in particular had a great influence on me: *Piano and String Quartet* (1985) and his last piece *Piano, Violin, Viola, Cello* (1987). The real encounter with the music and thought of this composer occurred only recently for me, while studying in the United Kingdom. I remember at university Horacio Vaggione, an Argentinean electronic music composer, warning us against that which pertained to 'stasis'. At the time, he was targeting a tendency found in spectral composers such as Tristan Murail or Gérard Grisey. Likewise, at the Paris Conservatoire, my first composition teacher, Emmanuel Nuñez, seemed to have a similar concern, often criticising a static or contemplative presentation of the material. He always encouraged more

contrasts, in dynamics, registers, tempi, instrumentation, distances in the space, giving fascinating results, though in clear opposition to minimalistic approaches. In my later years at the Paris Conservatoire, Stefano Gervasoni also warned me against the danger of 'being fascinated by the material', preferring a development where elements would be in constant evolution, notably with a proliferation of extended instrumental techniques. In this sense the music of Morton Feldman, its 'surface', its technique and even its ideology is quite different to the aesthetics of the teachers I mentioned above. This might be one of the reasons why my involvement with his music occurred relatively late.

7.1.3 Surface, stasis, transcendence

Morton Feldman commented once about young composers looking for 'recipes', in reference to serialism or chance music. Writing today in the manner of the New York composer could be one of these easy 'recipes' to follow. There is, of course, a danger in following such a singular route. This is partly because of the sense of abandon which Feldman's music may provoke, almost diametrically opposed to the demands required of the listener from the music of a composer like Helmut Lachenmann. Nevertheless, Feldman's approach remains unique, and I believe there is much to learn through assimilating some of his ideas, or aspects of his later style. In the article *Between Categories*, he discusses in detail the notion of *surface*:

My obsession with surface is the subject of my music (...) I prefer to think of my work as: between categories. Between Time and Space. Between painting and music. Between the music's construction, and its surface (Feldman, 1988, p. 5).

The opposition made by Feldman between construction and surface reflects in the first place a difference which could distinguish many American and European composers in the 1950s. At that time, American composers tended to focus on perception and sound rather than intellectual constructs favoured by the European avant-garde. For example when Boulez and Stockhausen established Webern's *Symphony opus 21* as a model, they analysed its canonic and serial construction, whilst Morton Feldman and John Cage perceived the piece as a listening experience, on its sonic level.

The notion of *surface* is also of central importance to understand Feldman's conception of time. In the same article, he quotes his friend Brian O'Doherty: A music that has a surface *constructs* with time. A music that doesn't have a surface *submits* to time and becomes a rhythmic progression (Ibid, p. 3). This observation leads Feldman to express his distance towards Stockhausen, who treats time as a compositional element, whereas, in his view: 'Time must simply be left alone [...] I am interested in getting time in its unstructured existence. That is, I am interested in how this wild beast lives in the jungle, not in the zoo (Ibid, p. 4). The notion of *surface*, more evidently, relates the sonic domain to a pictorial notion; it refers to the New York School, the abstract expressionism, and to the close relationship Feldman kept with these painters throughout his life. From a European perspective, this represents something very new, a rupture with European history.

The composer's way of discussing music is often pithy, laconic, sometimes provocative, but very stimulating for a composer. 'My desire was not to 'compose', but to project sounds into time, free from a compositional rhetoric that had no place here' (Feldman, 1985, p. 38). Rhetoric was notably used in the 16th and 17th century to compare music composition to the art of discourse; therefore, Feldman's affirmation suggests that his music should be listened to with a distance towards such criteria. His music, 'freed from rhetoric', should not be understood as a logical narrative, but rather as an installation work, or an abstract painting. This absence of metalinguistic discourse or narrative was clearly something I wanted to integrate to my own music. Similar ideas, about surface, stasis or absence of rhetorics undoubtedly had a significant impact on the duration of the pieces which will be presented in Chapters 7.2 and 7.3. My intention was to expand considerably the duration of a singular idea, in order to investigate a musical form where rhetoric or a logical succession of contrasting characters could not be applied. Feldman progressively abandoned elements of differentiation, such as accents or sforzandos, (which he relates to punctuation), to arrive in his later style to what he called *stasis*. 'I'm involved in stasis. It's frozen, at the same time it's vibrating' (Feldman, 1985, p. 165).

Some of the most radical examples of stasis can be found in Feldman's second string quartet, which can last over six hours, and in which some passages simply repeat one single chord. For me stasis in music primarily relates to an absence of contrast, continuity, quiet dynamics, and, to some extent, slowness. The

resulting stillness is evocative of meditation or prayer. 'I think we lost that religiosity about music, about sound itself' (Morton Feldman, in Coolidge, 1988)³⁷.

The pieces presented in this chapter don't have any religious meaning to me. Nevertheless playing contemplative music in a church inevitably evokes transcendence, and resonates with the idea of common origins between ritual and art, as described in Walter Benjamin's article *The Work of Art in the Age of Mechanical Reproduction*:

We know that the earliest art works originated in the service of a ritual – first the magical, then the religious kind. It is significant that the existence of the work of art is never entirely separated from its ritual function. In other words, the unique value of the "authentic" work of art has its basis in ritual, the location of its original use value. This ritualistic basis, however remote is still recognizable as secularised ritual even in the most profane forms of the cult of beauty (Benjamin, 1936, Chapter IV).

The evocations of ritual, stasis, surface and transcendence are of great importance for the *Wandelweiser* group, an international collective of composers and performers for whom John Cage is a central figure. For example Swiss composer Manfred Werder, a member of this group, composed the piece *found sentences* (Werder, 2008), whose score simply consists of a sentence taken from Hamilton Grant's book *'Philosophies of Nature after Schelling'*: Depths are not the transcendental, but rather the transcendental is the surface of the world, while both are physical (Grant, 2008, p. 205).

Annet Nemeth's realisation of it simply associates sparse field recordings with long sustained tones. The piece is extract from *Wandelweiser und so weiter* (2012), released on the label *Another Timbre*. Although the musical language of this group of composers is far more radical than mine, the pieces presented in this chapter feature a similar interest in the formal exploration of undifferentiated material extended over long durations. Through this investigation it became apparent that, in such conditions, the listener is unable to perceive a linear argument, as if he was reading a text without paragraphs or punctuation. As a

³⁷ See also: (Amirkhanian, 1986, No. 2, 16"50').

result, the listening experience stops focusing on rhetorics or narration, but instead evokes a situation where the listener contemplates the surface of a canvas.

7.2 *Flute, Guitar and Piano* (2013)

(DVD 1, Track 4, available at: <http://jonathanbell.eu/flute-guitar-and-piano>)

I started composing this piece writing very long and homogeneous passages for piano. I then tried to combine this piano part with guitar arpeggios that had been written separately. This rather unusual combination prompted me to add a flute, which, in my view, was quite a natural complement to the guitar. The choice of an electro-acoustic guitar was made in order to adjust the dynamics of the three instruments. A classical guitar with amplification would have also been suitable, although I found the sustained resonance of the electro-acoustic guitar preferable.

Within this folio of compositions, the present piece is perhaps the only one which could have been performed without audio-scores, because it does not contain micro intervals or difficult rhythms. However, the presence of earpieces made its realisation more secure, because of the short rehearsal time, and because of the unusual placement of the performers. As evidenced in the video, the instrumentalists were positioned at a considerable distance from each other, which invited the dancers to utilise the whole space.

The audio-scores were also necessary in order to synchronise the musicians with the tape. The electronics in this piece acted as a resonator, which was efficient in such a reverberant space, but required the performers to precisely stay in sync with the tape. The natural resonance of the live instruments and the electronics being very similar in terms of pitch content, the ambiguity that emerged between the two provided interesting results. In spite of the great distance between the acoustic and digital sources, the reverberant acoustic of the church allowed the sounds to blend together organically.

The tape was generated from a pre-recorded MIDI maquette version of the piano and guitar parts. Due to their percussive nature, these two instruments can, unlike the flute, be simulated in MIDI without the result sounding too artificial.

This recording was then processed through a Max³⁸ patch, whose most interesting feature is a spectral delay. This module re-synthesises the sound and repeats its different spectral components at different times. The outcome can be very diverse, sometimes behaving like a standard delay line, sometimes decomposing the morphology of the sound, prolonging the reverberation of a chord, or only components of it, like a filter. The resonance in the electronics of an element played by a performer on stage is most commonly found in live-electronic repertoire. However, here it was realised by a fixed tape, allowing for more control, and less risks in live performance.

In this piece, there was insufficient rehearsal time for the musicians. In such situations, the anxiety of the performer can become apparent, and this sense of insecurity can interfere with the musical statement or atmosphere the performer wishes to convey to the audience. The audio-score system therefore proved to be necessary to help the player keep in time with each other and with the tape.

One of my concerns before the performance was in regard to the disparity between a metronomic execution by the players and the floating quality the music is supposed to have. Because I wanted to allow for more flexibility in their interpretation, I sent each performer two different files: one with a click track at Crochet = 30 and a second one with Quaver = 60. I informed them that I preferred the first version, because a slower click track allows for more approximation; however, they unanimously chose the faster one (60), so this is what was used in the end.

The click track allowed for sudden echoes between flute and piano. In subsequent performances, I might consider not using a click at all. Instead, the performers would be provided with cues in the earpiece indicating the pitches they have to play, without bars and beats, in proportional notation. This way the performer could play with more freedom, without the need to count, repeating with a slight delay what is heard through the earpiece.

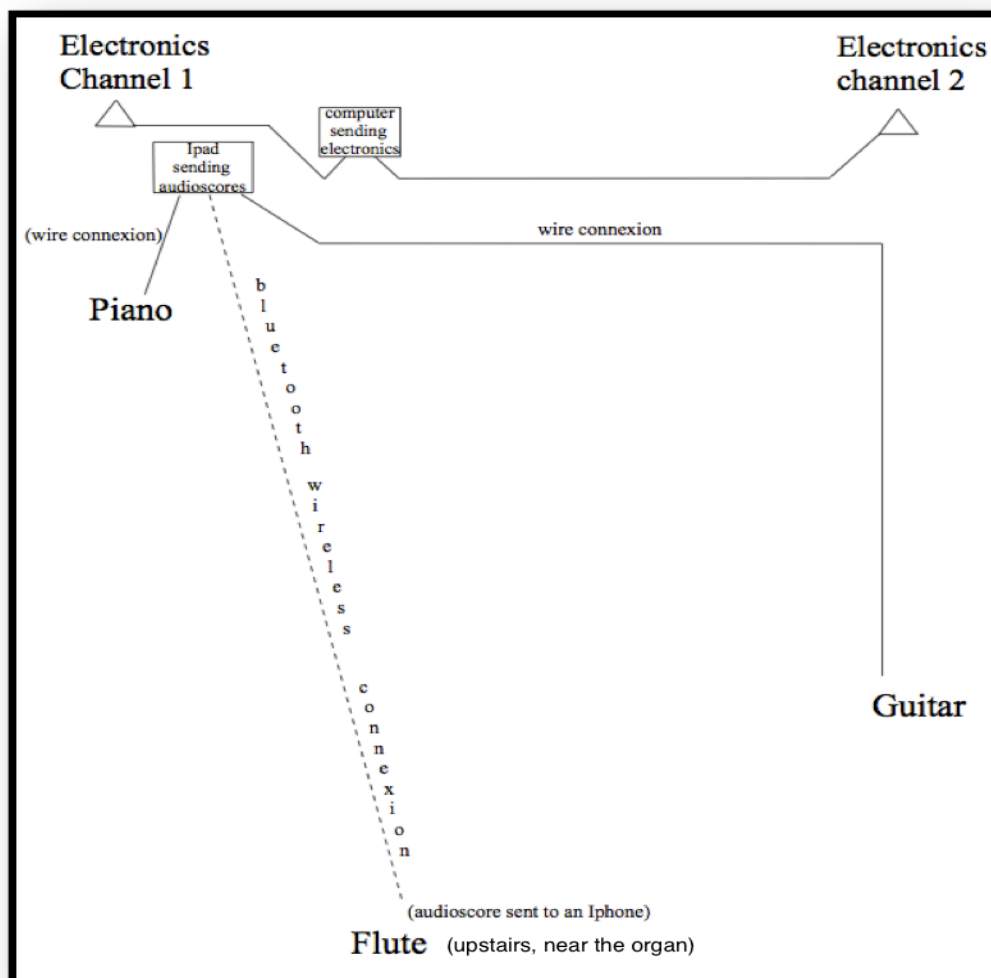
I was pleased with the overall result. My only criticism of this interpretation was that the character and energy could have been more intimate and fragile. The

³⁸ Max/MSP is a visual programming language for music and multimedia developed and maintained by San Francisco-based software company Cycling '74. It was originally developed at IRCAM by Miller Puckette.

musicians played the notes in correct time, but in my view it was a bit too loud, and the dancers were sometimes too active.

The diagram below shows the different wire and wireless connexions used in this piece. A computer plays the electronics, while an iPad sends the audio-scores to the three performers: through wires to piano and guitar, and through a wireless Bluetooth connexion to the flautist.

Figure 55: *Flute, Guitar and Piano*, technical setup



The computer and the iPad were manually triggered at the same time, at the beginning of the piece, allowing the whole ensemble to play in time until the end.

As briefly mentioned above, this piece was composed in a different way than others in this portfolio: the instrumental parts were written in layers. The idea was inspired by early historical models such as: improvisation on *cantus firmus*,

polytextual motet, and isorhythmic *tenor* against *duplum*. All of these medieval techniques assume the pre-existence of one voice before another. I started with a long, resonant, almost undifferentiated section of piano, nearly always in the high register. What interested me most with this material was the way fragments were repeated, and how subsequent passages could be enhanced if they just presented the same material differently. There was no conscious use of transposition or intervallic proliferation. The notes, cells or fragments were just repeated, with very little transformation. This repetition without transformation, although very fragmented, contributes to the feeling of stasis described earlier. It also contrasts with the idea of development, which is more directional. In the following extract, displaying only the piano part, each cell is framed with a different shape: a rectangle, a rectangle in dotted lines, a diamond shape, and an ellipse, in order to highlight how these fragmented iterations occur.

Figure 56: *Flute, Guitar and Piano*, repetitions in the piano part



Other repeated cells are found in this passage, like the perfect fourth D-G (bar 66 and 69), or the major ninth C-D (bar 78 and 81), but they are only repeated very locally.

The guitar part was also composed separately during the first stages, with its own harmonic rules, limited only by the possibilities of the instrument. As I was exclusively seeking resonating chords, the 'rule' was to find one note per string, using open strings as much as possible. The extract below is a presentation of the first bars of the guitar part. Although the guitarist played from the full score, only his part is displayed here to highlight its internal repetitions. The capital letters indicate the order in which the chords are presented.

Figure 57: *Flute, Guitar and Piano*, repetitions in the guitar part

The image displays a musical score for a guitar part, consisting of five staves of music. The notation is in treble clef with a key signature of one sharp (F#). The music is characterized by arpeggiated chords and specific rhythmic patterns. Capital letters (A, B, A', C, D, E, F, G, H, I) are placed above the staves to indicate the sequence of chords. Numerical figures (3, 2, 7, 5, 3) are placed above the notes to indicate fingerings or string counts. A box labeled '4 TIMES' indicates a repeated section. The staves are numbered 8, 11, 21, 30, and 40 at the beginning of each line.

The guitar part was composed by experimenting with the chords on the instrument. The tablature notation was maintained as it made reading easier for the player. I intended to develop a simple idiomatic feature, using relatively high positions on the fret board while striking the strings in a natural order (from thumb to the little finger). As a result, the arpeggio turns into a more complex melodic line.

Figure 58: *Flute, Guitar and Piano*, tablature extract

The image shows a musical score extract for a guitar part, labeled 'Gtr.' and 'Tab.'. The guitar part is written in treble clef with a key signature of one flat (B-flat) and a 4/4 time signature. The score starts at measure 47. The guitar part consists of a series of eighth and sixteenth notes, with some measures containing rests. The tablature part is written on a six-line staff, with fret numbers (0, 5, 6, 7) indicating finger positions. Arrows point from the guitar notes to the corresponding fret numbers in the tablature. The score is divided into measures by vertical bar lines, and some measures contain fingerings (e.g., 2, 5, 2, 3) above the notes.

When I started assembling the two instruments, the piano harmonies often had to be modified in order to respond to the guitar more naturally. It was only at this stage that I felt that a flute would enhance the piece considerably. The flute's part is often extracted from the piano material, which is why these two play in unison in some passages, despite the great distance separating them in the space.

Although the three performers worked sufficiently on their individual part, we managed to organise only one rehearsal with flute and guitar before the concert (I played the piano). On the day of the performance, the pianist was playing with the flautist and the guitarist for the very first time, which demonstrates both a weakness of the piece and a potential strength of audio-scores: for a player following his audio-score, there is little change between the performance situation and a reading with his audio-score at home, thus allowing for less rehearsal time. This touches on a paradox related to placing musicians apart in a room. In placing the audience in the centre of the space, with musicians around them, the listener gets a clearer idea or sensation of the dialogue between the musicians, which is one of the great aspects of chamber music. At the same time the further the performers are placed from one another, the more this dialogue is jeopardised as they cannot hear one another properly.

In spite of the problems that may arise in mutual listening, having performers extremely distanced from one another added a spectacular dimension to the piece, as can attest the video submitted in this folio. For the listener, an effective balance was found between the natural reverberation of the space (as a unifying factor of the global sonic image) and the disparity of the acoustic sources (instrumental and electronic sources all coming from different directions). The acoustic property of this set-up, in my view, strongly contributed to the *immersive* quality of the piece, which is possibly its most successful aspect.

7.3 Piano Quintet (2013)

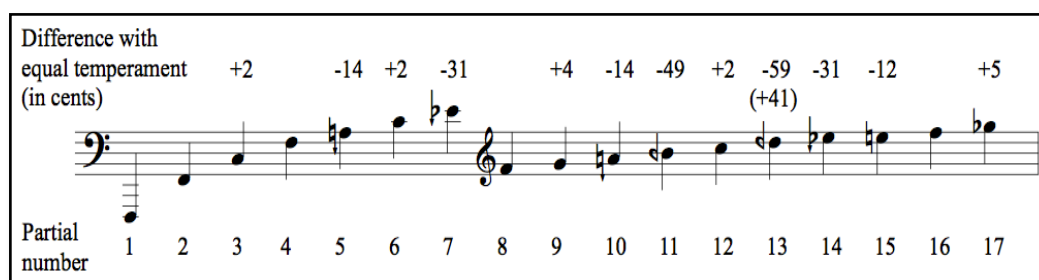
(CD 1, track 8, available at: <http://jonathanbell.eu/piano-and-string-quartet/>)

This piece is a spectral harmony study, as well as an attempt to push the extension in time of a limited material to its limit. The main advantages of using audio-scores for this performance was the ability to place performers at a considerable distance from one another, and to allow the string quartet to play accurately in just intonation.

7.3.1 Harmony

The piano's harmonic language is free and intuitive, while the string quartet almost exclusively uses the harmonic series of a low F.

Figure 59: the 17 first partials of the harmonic series of a low F



In order to obtain a greater variety of combinations, I allowed few transformations of this theoretical model. Partial N°11 (low B) and N°13 (low D), are often transposed an octave lower. These two partials present quartertones: N°11 is 49 cents lower than tempered B, perceived as exactly a quartertone. N°13 is 59 cents lower than D, slightly closer to D flat than D natural, but still differs clearly from the equal temperament. An octave lower, these two notes receive more weight, and contribute to the 'micro-tonal consonance' I was looking for. The idea of transposing some partials down an octave is inspired by Gerard Griseys's *Partiels* (1975), where similar types of transformations allow a gradual progression towards inharmonicity.

The partial number equals the multiple of the fundamental frequency (a low F). Lowering a note by an octave means dividing its frequency by two; this is why partials 11 or 13 heard in the register of middle C are notated with ratio 11/2 or 13/2 in the following example. This extract displays the string parts of the

beginning of the piece. Above each note, the corresponding partial number is indicated in a circle.

Figure 60: *Piano Quintet*, score extract (1)

The image shows a musical score extract for the first four measures of a piece. The score is for Violin I, Violin II, Viola, and Cello. The tempo is marked 'Adagio' with a quarter note equal to 40 beats per minute. The key signature has one sharp (F#). Above each note, a partial number is circled. In measures 1-4, the strings play a sustained chord with partials 6, 8, 11, and 13. The Viola part has additional partials 13/2, 7, 11/2, and 5 in measure 4.

In the first four bars, the octave between the violin and viola amplifies the 13th harmonic. It exemplifies the attempt to achieve microtonal consonant harmony. For me, the main difficulty of working with harmonic spectra is trying to prevent a dominant seventh chord impression. I found that avoiding the major third can help (A, 5th or 10th harmonic). This is why the note A rarely appears as a sustained note in this extract (although it is still present in bars 5, 6 and 8). The presence of this note in many cases makes the chord identifiable in terms of classical harmony. It becomes an 'accord classé'. With this same 'dominant seventh' concern in mind, I often grounded chords on a C (3rd harmonic) rather than on the fundamental (F) for example in bars 1-4 and 12-15 of the same extract.

Nearly the entire piece is grounded on a low F, though in a few sections, when the piano has a more prominent role, the string quartet freezes on a breathe-like gesture. The fundamental needs to change in these passages, in order to obtain a more contrasting chord, such as in the second and fourth bar of the extract below, where the fundamental of the strings' chord alternates between F sharp and F natural.

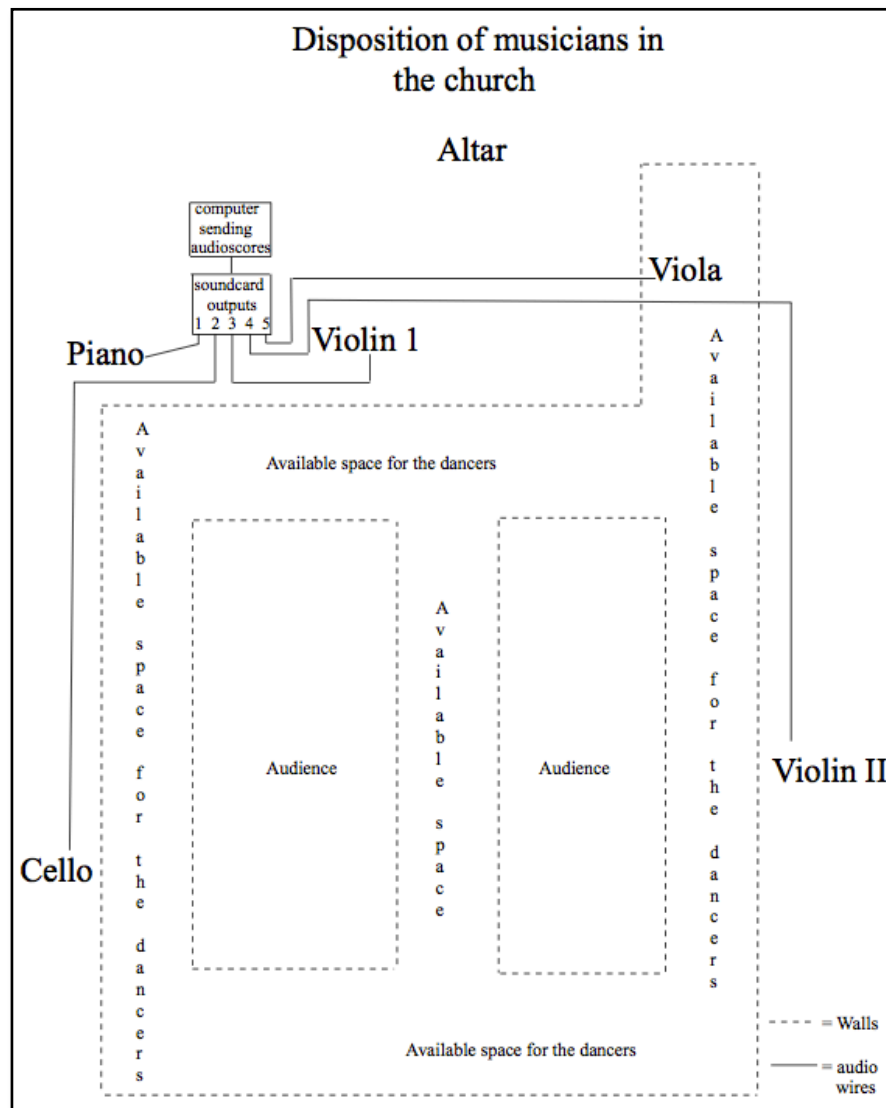
Figure 61: *Piano Quintet*, score extract (3)

Bars 33-37 are displayed above, though the alternating gesture goes on for twenty bars. In an interview with Charles Shere, (Shere, 1967) Feldman, while discussing one of his pieces for three pianos, associates this kind of repetitive alternation with the classical cadential gesture V-I-V-I. This gesture appears four times in the piece: bars 25-45, 128-146, 332-336, 422-427. It occupies a substantial span of time in its first two appearances (around 20 bars), but it is only briefly evoked when it returns towards the end, only as reminiscence.

Unlike in the Trio, we managed to have several rehearsals with the string quartet. I was able to hear an improvement in each rehearsal, especially in terms of stabilisation of intonation. During the first run-throughs, the string players constantly adjusted to the pitch sent to their ear, which resulted in very small glissandi throughout the piece. After the third rehearsal, the players had already memorised most of the finger positions of microtones, and consequently could find their pitch straightaway.

7.3.2 Placement of the performers and sonic spatialisation

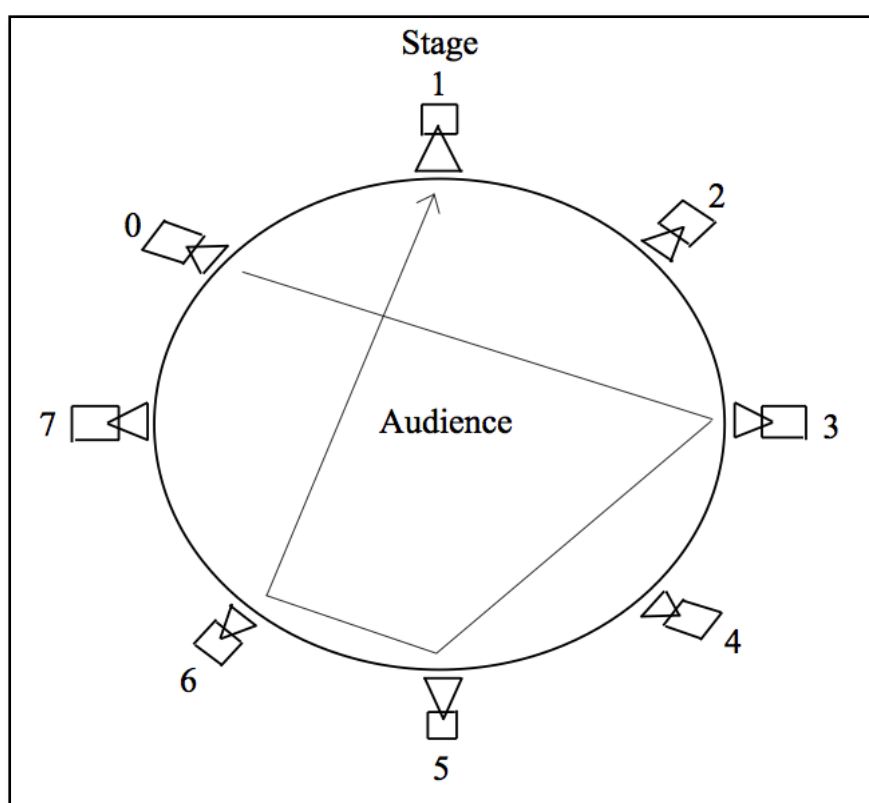
Figure 62: *Piano Quintet*, placement of the performers and technical setup



Again in this piece, the five performers are conducted by a computer. It sends individual pitches through a soundcard to each musician independently, with a common click track for all. The movement of sound in space is very important here. The following is an explanation of how I discovered this parameter in a musicological article, which will show how the diagrams employed in this paper have inspired a 'choreography of sound' used in the string quartet, though in a very different musical context. A book of collected writings about the Portuguese composer Emmanuel Nuñez (Szendy, 1998) was of central importance for my understanding of spatialisation during the first years of my composition studies.

This book contained an extensive analysis³⁹ of the piece *Lichtung I*, for ensemble and electronics (Nuñez, 1988-91), which displayed very detailed diagrams representing the itinerary of the sound processed in the electronics. Each of the eight loudspeakers was assigned a number. These itineraries, (or trajectories of the sound) were described as a suite of numbers, and were represented as arrows on a diagram.

Figure 63: An example of sound-trajectories in the electronics of music by E. Nuñez



The trajectory above represents a sound beginning on loudspeaker 0, travelling through different stations across the room and finishing on loudspeaker 1. During the realisation of the piece *Lichtung I*, it would have been described as the list (0 3 5 6 1) by the composer and his co-workers electronic music designers (RIM: *Réalisateurs en Informatique Musicale*) at IRCAM.

Although I never incorporated this level of complexity in my music, I was influenced by these notions of trajectory, and experimented with them on various occasions with both electronics and instruments. The following is a discussion of how the movement of sound occurs in my Piano Quintet. The performers

³⁹ Alain Boiteau: 'Toucher l'espace', in Emmanuel Nuñez, textes réunis par Peter Szendy (Szendy, 1998, p. 41-124).

primarily play one after the other rather than being homorhythmic. This allows the circulation, as exemplified in the three passages extracted from the string parts below:

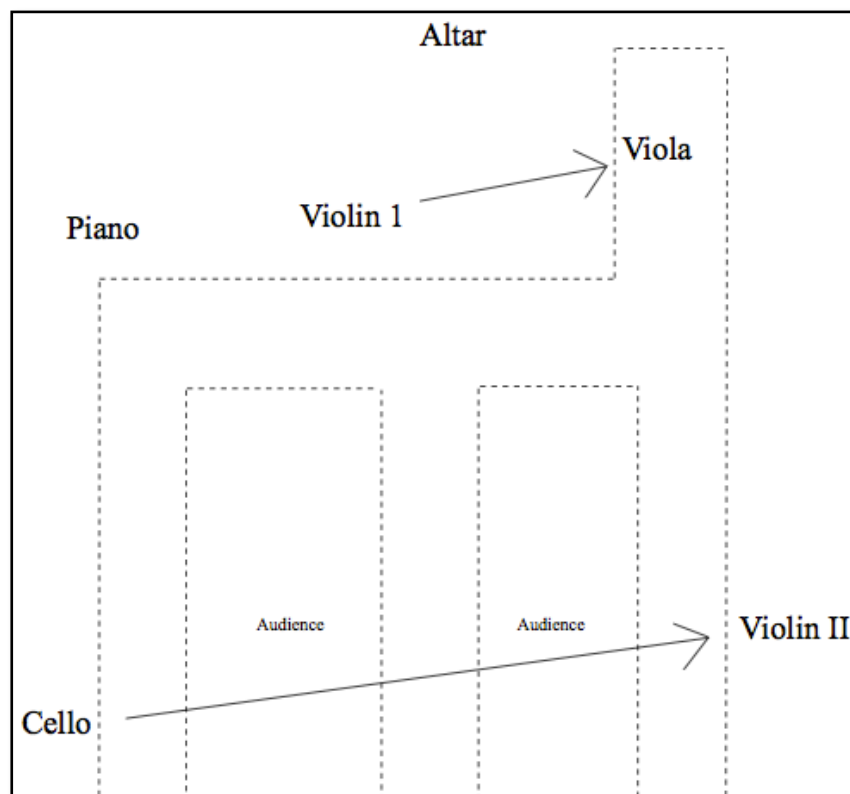
1/ Bars 288-292, Violin 1 and Cello, standing on the left hand side of the church, play in alternation with Second Violin and Viola, standing at the other end.

Figure 64: *Piano Quintet*, score extract (4)

The musical score extract shows four staves for Violin I, Violin II, Viola, and Cello. The key signature is B-flat major (two flats) and the time signature is 3/4. Violin I and Cello play a series of chords, while Violin II and Viola play a triplet of eighth notes. The dynamics are marked *pp* (pianissimo).

The resulting stereophonic effect is heard from an audience point of view.

Figure 65: *Piano Quintet*, stereophonic movement of the sound in the space



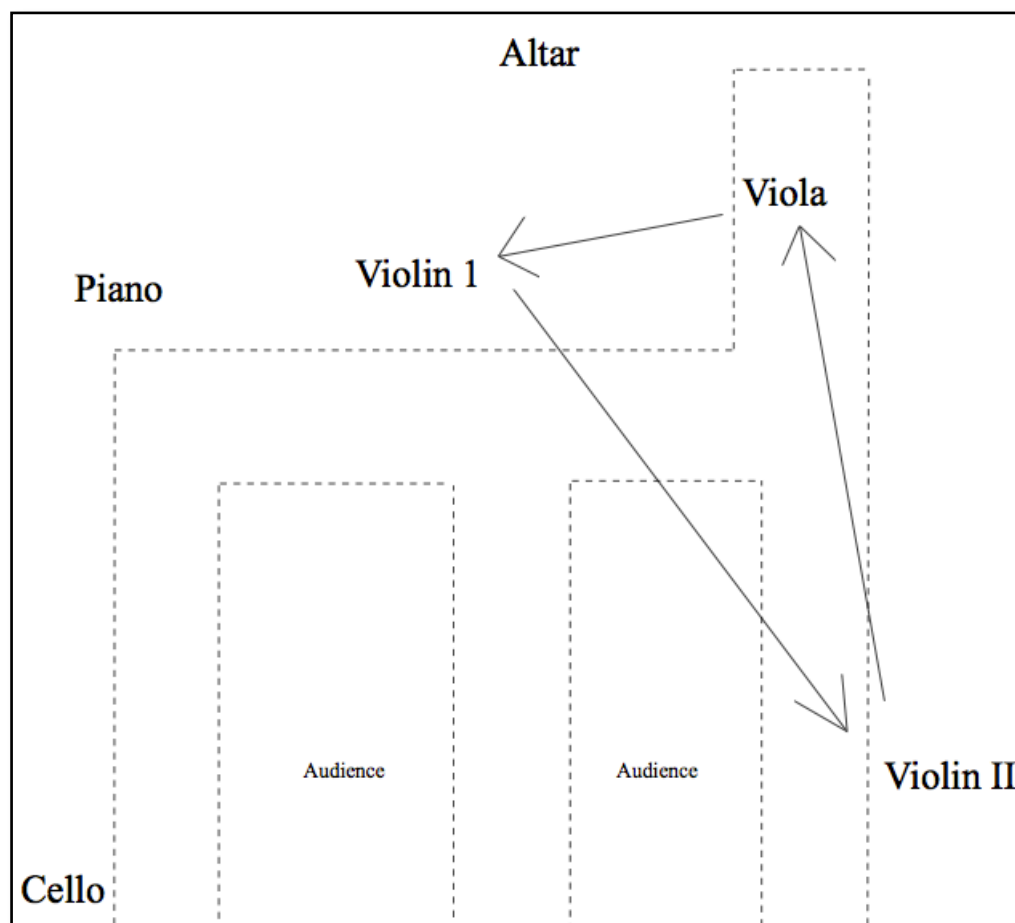
2/ Bars 294-297, First Violin, Second Violin and Viola play in alternation, with the Second Violin entrance slightly later each time (a triplet quaver approximately).

Figure 66: *Piano Quintet*, score extract (5)

The image shows a musical score extract for bars 294-297 of a Piano Quintet. It consists of five staves. The top three staves are for the First Violin, Second Violin, and Viola. The bottom two staves are for the Piano and Cello/Double Bass. The First Violin, Second Violin, and Viola parts are in alternation, with the Second Violin entrance slightly later each time (a triplet quaver approximately). The Piano part is marked 'mp' and the Cello/Double Bass part is marked 'mp'.

Again this is perceived as a movement in space, as the three performers circumscribe a specific location.

Figure 67: *Piano Quintet*, triangular movement of the sound in the space



3/ Bars 305-307, the four instrumentalists play in alternation, creating the effect of sound revolving in circles around the audience.

Figure 68: *Piano Quintet*, score extract (6)

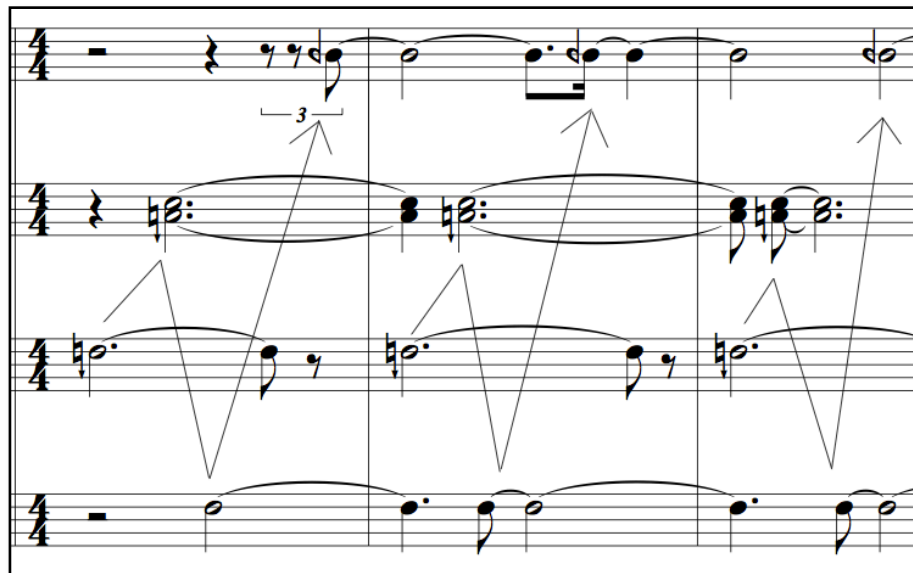
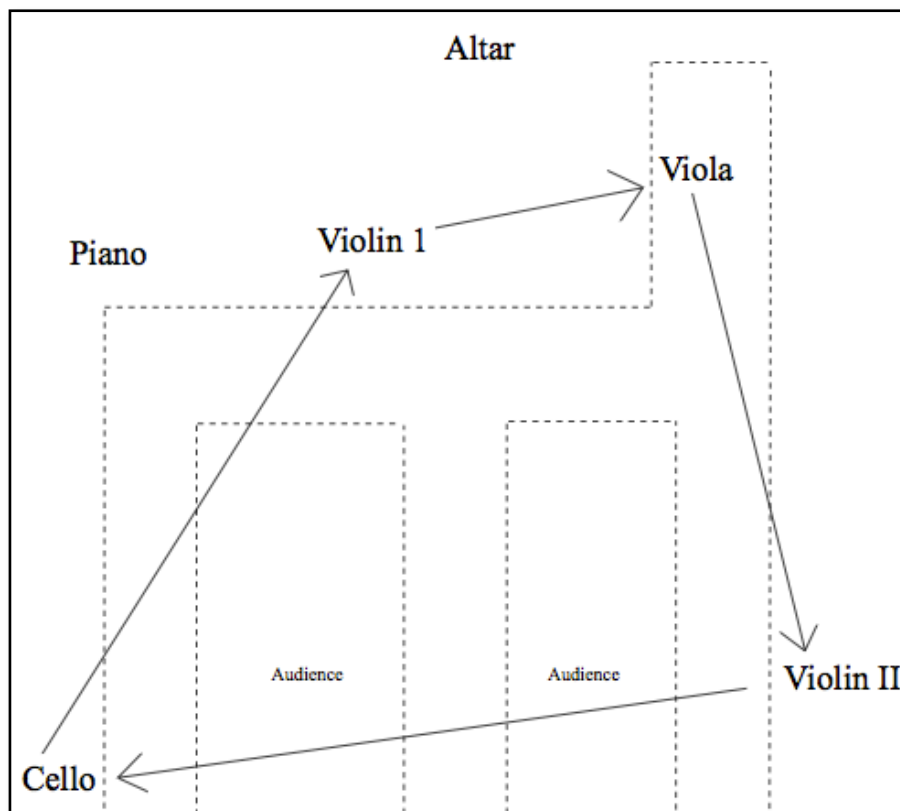


Figure 69: *Piano Quintet*, circular movement of the sound in the space



7.3.3 Rhythmic organisation and tempo modulations

The rhythmic structure of this piece often deals with slightly different periodicities, which is a material I have often worked with. In the opening of the piece for instance (figure 59), Violin I and Cello are slightly slower than Violin II and Viola. In these cases, an effort was made to find in each section the placement of bars and beats which corresponded best, so that the players could stay in phase with the general tempo as much as possible. The piece was first composed assembling sustained string samples on a sequencer,⁴⁰ assigning each sample to a certain pitch, and the rhythmic notation came afterwards, with the placement of bars and beats, using metronome marks between 33 and 75. I observed that in extremely slow tempi (33-40), the click track allowed for a great flexibility: I was able to move each impulse with a great amount of *rubato* without disturbing the sense of meter, allowing for great simplification of the rhythmic notation. The tempo changes were made intuitively, so there is no specific ratio between two consecutive tempi, as can be found in the Renaissance use of proportions or in Elliot Carter's 'metric modulation', for example. Most passages were written independently and then 'concatenated' in seven short movements. A tempo change within one movement often reflects a change in the musical material, thus revealing how different passages have been assembled.

7.4 Conclusion: Duration and differentiation; the relation between material and form

The duration of these pieces, and the absence of elements of differentiation would likely have not been so pronounced had I not encountered the late works of Morton Feldman (his *Piano and String Quartet* (1985) in particular). In an interview with Charles Amirkhanian⁴¹, the two composers discussed how important the performance of this piece had been for them. Charles Amirkhanian also mentioned his experience of hearing the long piece again on the radio, while driving, just after being present at the concert. These anecdotal remarks remained in my mind, suggesting that the late Feldman 'genre' was leading chamber music to new paths, suitable to an installation, or to the listening of a recording, and in this way not necessarily linked with the traditional concert hall 'ritual'.

⁴⁰ The samples used on this occasion came from the SOL database (Studio On-Line), recorded at IRCAM. The sequencer used was Logic.

⁴¹ (Amirkhanian, 1986, No.1, 39'00').

This encounter with Feldman was particularly striking in my development because I was already incorporating static elements in my own work for a long time, without being conscious of it. Most of the pieces I wrote during my studies at the Paris Conservatoire (2005-2010) rarely featured a development in the classical sense. In 2010, the French composer Gérard Pesson brought to my attention the fact that my pieces of that period often had parameters that remained unchanged throughout, in which he saw a similarity with installation works. The material in each piece could be radically different, but its relation to the general form often gave a sense of expansion or proliferation; thus, each piece feels more like a single proposal rather than a succession of different ideas.

While discovering some of Feldman's last pieces, such as *Piano and String quartet* (1985), or *Piano Violin Viola Cello* (1987), I thought I should experiment this formal aspect further. As observed earlier in Chapter 2.3.1, in such compositional situations, the notion of *scale* becomes of central importance. Repetition in these long pieces is not anymore a goal, but a point of departure, and as a result, duration, form, or proportions behave in a very different way than most pieces of the Western Art Music repertoire. It is in the first place this feeling of an unknown territory which pushed me to write these long pieces. Thinking of practice-based research, or how knowledge is informed by experience-based practice, I knew that experimenting with such extreme durations would be the best way for me to apprehend how the material and form interact at that scale.

8 THE WANDERER (2012-2014)

8.1 Introduction

This work represents a synthesis or a journey between different techniques explored in this folio. It recalls the microtonal piano sounds coming out of the tape in the *Percussion Quartet* discussed in Chapter 4. *The Wanderer* also recalls the game with references addressed in Chapter 5, or the paradox between the ‘authority’ of the act of composing, and the necessity to refer to tradition. The piece also uses the technique of ‘vocal synthesis’ discussed in Chapter 6, which transforms a recording of spoken words into singing voices (Chapter 6.2.1). Finally, it inherits the harmony of the Piano Quintet (it is also based on the harmonic spectrum of a low F), referred to in Chapter 7, as well as a wandering quality reflecting my absorption in the late music of Morton Feldman. The overall slow tempo, the quiet dynamics, the use of repetitions and the static quality of the pitches all contribute to the minimising of elements of differentiation in this piece (*‘Unto an untroubled surface of time’*, to borrow a verse by my father).

8.2 Pre-existing material: main text, passing references

The main text of this piece is the opening from *The Wanderer*, preserved in the Exeter Book, an anonymous manuscript dating from the late 10th century. The choice of an old English poem was for me an opportunity for me to explore my late father's heritage as he had studied Old and Middle English at Oxford with Christopher Tolkien (son of J.R.R.). This choice was both a chance to discover something of my personal heritage as well as a more universal understanding of the origins of English as *lingua franca*.

The piece *Dir - In Dir*, for vocal sextet and string sextet, by Stefano Gervasoni, my former teacher at the Paris Conservatoire, was performed and recorded by EXAUDI (Gervasoni, 2013). This work was a model and the initial source of inspiration for *The Wanderer*. My piece is not stylistically similar to *Dir - in Dir*, though its instrumentation is. A slow triad sequence appears several times in *Dir - In Dir*, and is quoted in my piece in bars 343-360 in the lower strings. This chord sequence, in bars (343-360), can be heard as an accompaniment of a violin solo, after a few seconds in the musical examples (CD, track 12) corresponding to bars 338-360.

This triad sequence is used as an accompaniment of a violin solo in *The Wanderer* (bars 324-360), which is also based on the transcription of borrowed material. It uses as a source a pre-existing recording of a piece by Tazul Tajuddin (2006), as a source, played by David Alberman. Tajuddin's piece uses a tablature-type notation, of which the outcome is unforeseeable pitch-wise because of its speed, its large intervals, and its scordatura. The resulting pitches are not notated.

Figure 70: Tazul Tajuddin, *Selindung Warna*, for solo violin, score extract
(With the kind permission of BabelScore, his publisher)

Selindung Warna (Hidden Colours)
(Gamelati VII) for Solo Violin

Play in POSITION I 1 ♩ = ca. 176 intense, aggressive, dramatically (average textural dynamic level is "f")

Scordatura:
I = C[♯]
II = G[♯]
III = C[♭]
IV = E[♯]

Solo Violin

harsh scrapy percussive sound arco pizz. bridge 5 6 bridge 1 pizz. arco s.p. snap pizz. arco 3 pizz. arco bridge

(Note: The score includes various dynamic markings such as sfz, f, ff, and sf, as well as performance instructions like pizz., arco, and bridge.)

The interpretation by David Alberman is exceptionally energetic and was my point of departure. I completely reassembled some of the most difficult samples of this recording, linking them one after another without a break, in order to create the impression of something almost unplayable by a human performer. I then transcribed the resulting sound file in standard notation (playing the recording in slow motion for more precision). This violin solo, since it is based on recording transcriptions, closely relates with my *Etude de Synchronisation*, and to the notion of found object. This external reference provokes a sudden contrast in energy as the piece unfolds, and then quickly disappears. This found object therefore evokes a sort a window, eliciting a brief glance at the outside world.

The form of the piece reveals itself through its use of the text. The dead language, often perceived as meaningless sound material, corresponds to the dominant monochrome 'surface' of the piece, fleetingly interrupted throughout by extracts in English, Italian, or French. Harmonically, the Old English corresponds to an F spectrum (or F sharp), while other languages adhere to completely different rules.

Two passages, bars 124-139 and 311-323, find their inspiration in the Ars Nova, for example in Machaut's isorhythmic motets, because they superimpose different speeds of elocution: the singing voices perform a very slow loop of four bars in each case, referring to the *talea* of the Tenor part in the medieval form. At the same time, the speaking voices dialogue as fast as possible, in a different language in the second example, which is reminiscent of the *Duplum* or *Triplum* parts of a medieval motet.

A very short quotation from *Meditation on Haydn's Name*, for piano, by George Benjamin appears in the tape, bars 428-429 and 434-435. The quotation is itself a reference, since the notes H, A and D, in German, refer to the name of the Viennese classical composer.

The French words '*Vienne la nuit (...)*', first used in bars 165-176, are extracted from *Sous le Pont Mirabeau* by Apollinaire. They are reminiscent of a song by Léo Ferré which uses the same poem, however the melodic material I used is completely different to Ferré's. The same words appear again towards the end of the piece, bars 456-477, this time paraphrasing the very famous opening melody from *The Lamb* by Sir John Tavener.

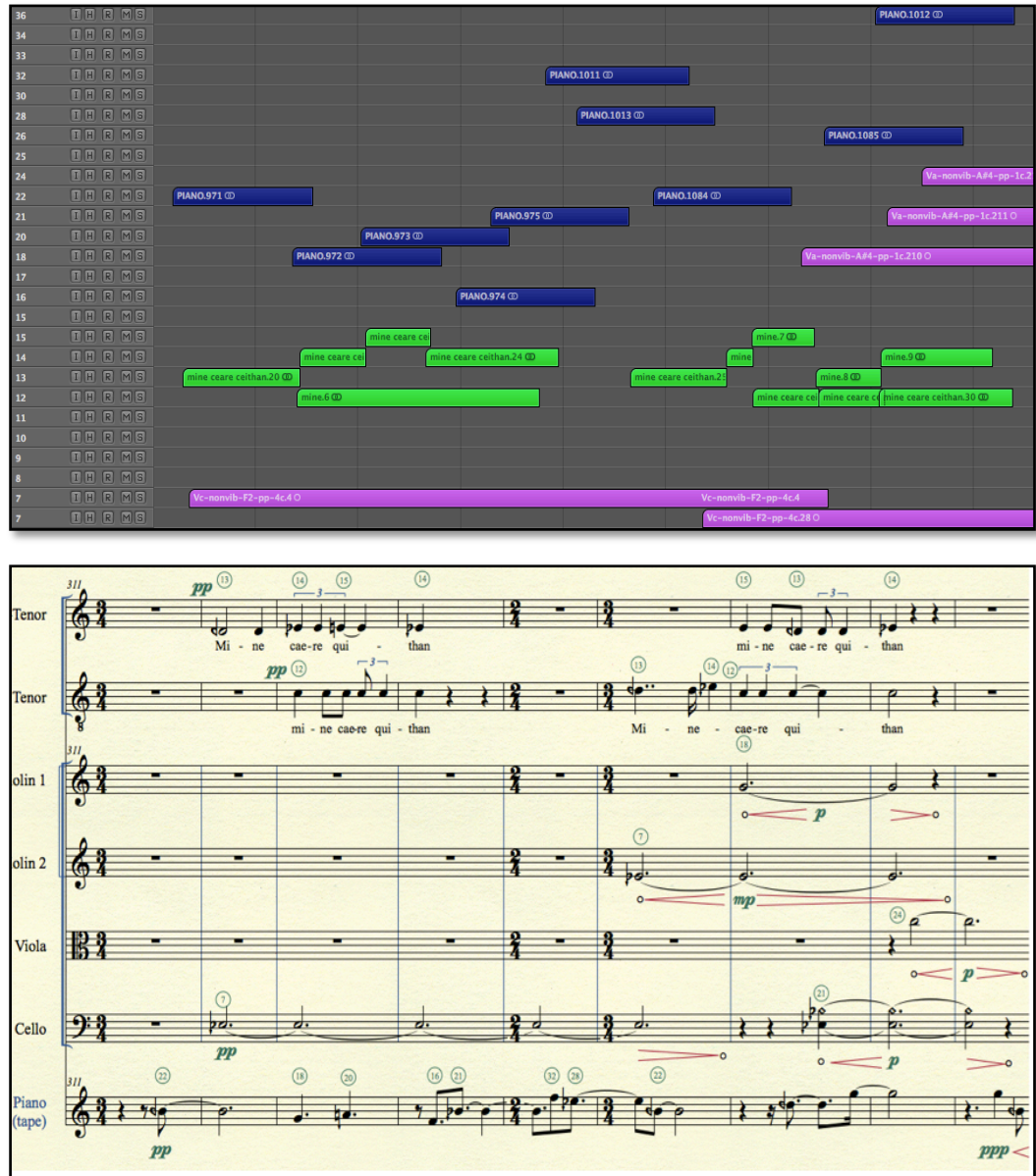
The last section of the piece, bars 436-490, owes its few *pizzicati* to the influence of two pieces by British composers: *Inscription* (2011), by James Weeks, and *Shadow Cast* (2001), by Christopher Fox. Both of these pieces contain slow sustained microtonal material played on strings, on the top of which one isolated pizzicato appears at irregular and long intervals of time, giving the impression of a clock marking every minute (particularly in the case of *Inscription*).

8.3 Representation

With *The Wanderer*, I was able for the first time to manipulate spectral chords with different simultaneous timbres (voices, strings and piano), assigning a specific pitch to each track. In the passage below, the representation on Logic displays the register of each instrumental group. The sequencer window displays the whole spectrum as one single big stave, covering the entire register. Each track is tuned to one partial of the harmonic series of a low F: from partial N° 7 at

the bottom (E flat low) to partial N⁰ 36 at the top (G). Each track automatically transposes the sample it plays to a single pitch, independent of the timbre used.

Figure 71-72: *The Wanderer*, visualisation in Logic, notation in Finale



Each instrumental group is assigned a specific colour (green for voices, purple for strings, blue for piano). For example, this representation shows clearly shows that the piano (displayed in blue) is situated in a higher register than the voices (in green). The same passage is represented both on Logic and Finale, in order to bring out the similarities and differences of the visualisations. It highlights that tracks of partial No.18 and No. 21 first play a piano sound, then a string sound,

which is why G and B flat low in bars 313-314 are then repeated in bars 317-318 in the strings.

8.4 Pitch material

A great majority of the chords used in this piece belong to the harmonic series of a low F. At the same time some of these chords were chosen primarily because of their resonance with elements of tradition; therefore, I will provide a harmonic analysis integrating, when possible, both 'scientific' (or spectral) and historical approaches.

The first section (entitled 'Harmony') deals with harmonies considered vertically, regardless of their directionality. The second section (entitled 'Counterpoint') regroups sequences of chords resulting of contrapuntal attractions, demonstrating a closer link with polyphony in earlier music.

8.4.1 Harmony

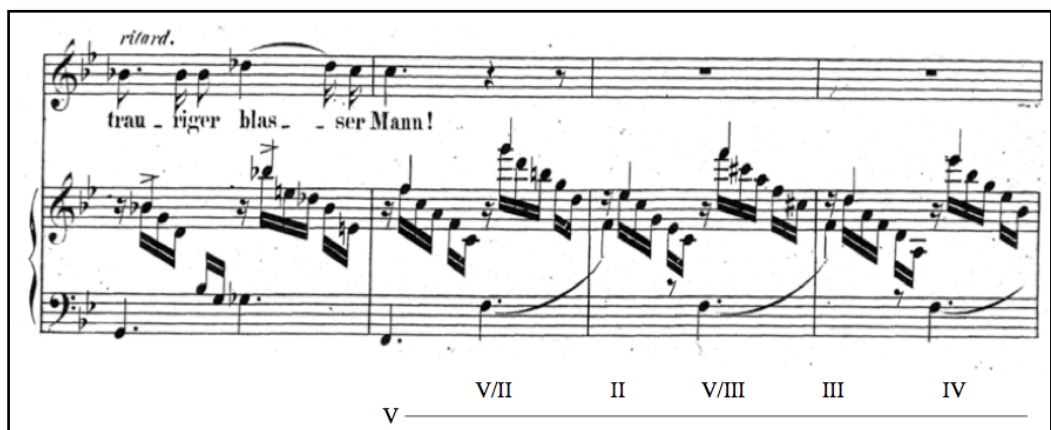
Figure 73: *The Wanderer*, score extract (1)

The image displays a musical score extract for 'The Wanderer', starting at measure 398. The tempo is marked 'Più mosso' with a quarter note equal to 80 beats (♩ = 80). The score is for six parts: Soprano (S), Mezzo (Mezzo), Contralto/Tenor (CTen.), Tenor (T), Baritone (Bar.), and Bass (Bs.). The key signature is one flat (B-flat), and the time signature is 4/4. The lyrics are in German: 'Ich to so the wa - t'. Above each vocal line, there are circled numbers representing harmonic analysis: S (15, 14, 11, 12, 12), Mezzo (12, 9, 17/2, 8, 17/2), CTen. (9, 8, 13/2, 6), T (6, 6, 5, 6, 6), Bar. (15/2, 9/2, 4, 9/2, 9/2), and Bs. (4, 7/2, 3, 3). The tempo changes to 'poco rit.' at the end of the extract.

Ich: The first bar of this extract (bar 398), would be (in the key of F major) a dominant chord (C Major triad) on a tonic pedal (F). This chord owes its particular consonance to the fractal nature of the harmonic spectrum: the four upper voices are respectively harmonics 6, 9, 12 and 15 of the low F, so each of these partials are themselves harmonics of C, partial number No. 3 (respectively 3x2, 3x3, 3x4, 3x5). In other words, the upper notes of this chord belong to both spectra of C and F. This first chord is also repeated at the end of the section, bars 407-409.

To: bar 399, in B flat major, would correspond to a modulation to C minor (II), on a dominant pedal (F), just as in the 3rd bar of the example below, an extract from Schumann's *Dichterliebe*.

Figure 74: Robert Schumann 'Am leuchtenden Sommermorgen' (12), *Dichterliebe*, Peters Edition



So: bar 400, does not recall any recognisable harmony (or 'accord classé'), because of the presence of partials N°11 and N°13, which are microtonal.

The: bar 401, is reminiscent of the suspended fourth typically found in Renaissance *clausulae* or Baroque cadences. This 'suspended fourth' chord is very consonant simply because it is made of two nested fifths F-C and C-G.

What: bar 402, keeps the same ambitus as the previous chord, but with two inner voices moving towards more inharmonic partials.

6th harmonic moves to 13/2, 13th harmonic an octave lower.

8th harmonic moves to 17/2, 17th harmonic an octave lower.

The following extracts by Gesualdo shows how the composer allows many different triads over a single sustained pedal, often towards the end of a piece.

Figure 75: Carlo Gesualdo *Languisce al fin*, and *Itene, O miei sospiri*, score extract (Extracts from 5th book of madrigals, VEB Deutscher Verlag).

The end of the second example in particular might have triggered the idea of searching for all the different triads contained in the same spectrum (F), as in the following passage (bars 31-34).

Figure 76: *The Wanderer*, score extract with harmonic analysis (2)

The first chord, although very microtonal, sounds surprisingly like a minor triad in second inversion (B-flat minor).

8.4.2 Counterpoint

The following extract, bars 179-183, with a low G flat as a fundamental, shows an example of preparation, suspension and resolution of a dissonance, inherited from traditional voice leading.

Figure 77: *The Wanderer*, score extract with harmonic analysis (3)

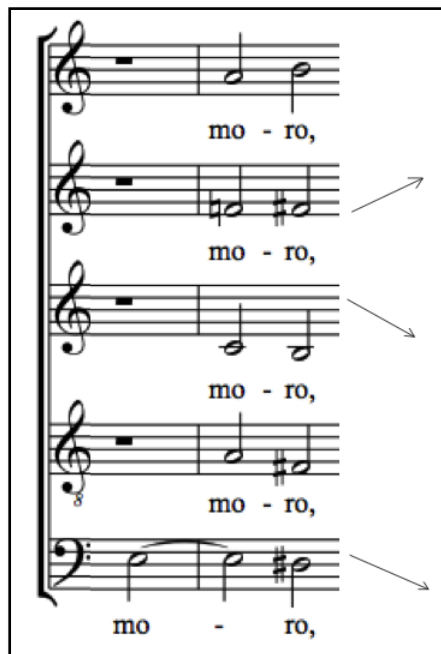
The image shows a musical score extract for 'The Wanderer' in 3/4 time. It consists of five staves: Mezzo, CTen., T, Bar., and Bs. The lyrics 'Wra - fra wael' are written below the staves. The CTen. and T staves have annotations: 'PREPARTION' and 'SUSPENSION' above the first two measures, and 'RESOLUTION' above the third measure. The T staff also has a circled number 8 below the first measure and a circled number 10 below the third measure. The Bar. staff has a circled number 6 below the third measure. The Bs. staff has a circled number 4 below the third measure. The Mezzo staff has a circled number 15 above the third measure. The CTen. staff has a circled number 13 above the first measure and a circled number 12 above the third measure.

Partials No. 11 and No. 13 resolve on to partials No. 10 and No. 12.

11 and 13 are prime numbers, so their corresponding partials are not as consonant as No. 10 and No. 12, which are respectively octave and double octave of partial No. 5 and No. 3, hence the feeling of resolution.

The examples below, extract from miscellaneous repertoires, intend to show how unusual chord sequences often find a contrapuntal justification.

Figure 78: Carlo Gesualdo, *Mille volte il di*, Extract from 6th book of madrigals VEB
Deutscher Verlag



The fundamentals of the two chords are F and B in this example, so they are distant of a tritone, which was very unusual throughout 16th century. This example is of particular interest because, although the chords are very distant in the cycle of fifths, most voices move only a semitone.

This simple idea of chromatic progression can obviously be found in many other contexts in later repertoire, as in Strauss for example, where distant triads like C minor and A-flat minor can follow each other for the same reasons of chromatic proximity.

Figure 79: Richard Strauss 'Frühling (I); Im Abendrot (IV)', *Four Last Songs*, (1948-49)
arr. John Gribben



In the following extracts from *The Wanderer*, I tried to reproduce the same effect of distant triads with the smallest movement in each voice. The type of chord progression displayed here is similar to the technique developed in the passage 'Ch'a pianger qui rimasi' from *Lasciato Hai Morte* (2012-Chapter 6.1.2). Here the words come from the poem *In my craft*, by Dylan Thomas.

Figure 80: *The Wanderer*, score extract (4)

Figure 80 shows a musical score extract for measures 385-387. It features three staves: Soprano (S), Mezzo, and Contralto/Tenor (CTen.). The lyrics are "When on-ly the moon ra-ges". Arrows indicate microtonal shifts between notes in each part.

In this passage, horizontally each note moves of a quartertone only, vertically between a low D minor triad in root position and a first inversion A Major triad.

Figure 81: *The Wanderer*, score extract (5)

Figure 81 shows a musical score extract for measures 380-382. It features three staves: Soprano (S), Mezzo, and Contralto/Tenor (CTen.). The lyrics are "when on-ly the moon ra-ges". Arrows indicate microtonal shifts between notes in each part. The dynamic marking "pp" is present.

In this passage similarly, each note moves a quartertone only, vertically are heard successively a minor triad in first inversion, a major triad in first inversion, and a minor triad in root position.

8.5 Conclusions and new perspectives

I have had only one workshop with EXAUDI on the vocal part of the piece. It was a relief to sense that the singers were enthusiastic about it. We began the rehearsal with the extracts using Dylan Thomas words, displayed above. The singers managed to sing these microtonal sequences straight away. This raised the question of the necessity of audio-scores in performance, but also in rehearsals involving singers with such an expertise in performing contemporary music. There are very few groups of singers in the world who would be able to perform this material so accurately. However, if such chords are realisable without the help of an earpiece, what are the implications regarding the approach developed in this commentary? I will return to this question in Chapter 8.5.2.

8.5.1 A renewal of interest in 'notation-centrism'

For this piece, the computer did not assist the performance, only the compositional process. This experience renewed my interest in what James Weeks called 'notation-centrism', (writing challenging material through the medium of a score only), simply because I had not realised it could be performed so precisely, and with such an ease.

The opportunity to work with experts, even for a short workshop, can have a great impact on the development of a composer. Without the limitations of practicalities, he can attempt to realise his musical ideas, and extend his compositional vocabulary based on what has been most successful in his experiments. In fact, experimenting with excellent performers is one of the only ways to make the subtle distinction between abstract composers' ideas detached from a musical reality, and genuine discoveries, which are sometimes a challenge to realise.

8.5.2 Audio-scores as a suitable medium for amateur practice

On the other hand, this workshop caused me to reflect on the different needs of young performers, non-specialist performers, and performers specialised in new music with respect to their uses of audio-scores. For musicians with no experience of microtonality (e.g. the Archos quartet in the *Piano Quintet*), the audio-guide can be very helpful as a means to understand the notation. This consideration later influenced my wish to investigate the development of audio-scores run by web applications at IRCAM (see Chapter 9.2.4.2), thus facilitating the exposure of this technique to diversified ranges of participants, including drama students, dancers, young performers or amateur choirs.

9 ONGOING RESEARCH

In spite of important efforts made in search of a middle-path, where machine and human could be mutually responsive, the possibility of developing audio-scores following performers or interacting with them in real-time remains today technically very challenging.⁴² In most performances of my music, the apparatus imposes an inflexible tempo (a click track) on the performer. However my music tolerates a significant amount of *rubato*. In slow music particularly, performers can ad-lib sing *behind* the audio-score if more convenient.

In his essay *Schoenberg and the New Music*, Carl Dahlhaus reminds us of the famously radical attitudes adopted by Schoenberg: “The middle path is, according to Schoenberg, the only one that does not lead to Rome” (Dahlhaus, Puffett, and Clayton, 1989, p. 6). These thoughts encouraged me to imagine projects not relying at all on the audio-score technique, in order to come back to it with a new insight.

I found the beginning of the IRCAM cursus an appropriate moment to experience again writing without any audio guides for a short period. This allowed me to re-discover, with the help of computer-assisted composition, the expressive potential of traditional notation (Chapter 9.1.1) and also to experiment with screen-scores, as will be presented in Chapter 9.1.2.

My second year project (2015/2016), on the other hand, focuses almost exclusively on audio-scores. Having recently discovered a way to adapt this apparatus to recent mobile devices (Chapter 9.2.2), the technical aspects of my research will primarily concern:

- Modes of synchronisation and communication between smartphones, tablets or computers through WIFI and/or Web networks (Chapter 9.2.3/9.2.4).
- Ways to implement forms of artificial intelligence or interactivity to audio-scores (Chapter 9.2.5).

⁴² However, such interaction could be envisaged with Antescofo (score follower), developed at IRCAM by Arshia Cont. This technology allows complex electronics to follow the performer with great accuracy.

9.1 New forms of notational practices

9.1.1 Computer-assisted composition (composition-centred practice)

Although it is primarily an electronic music course, the first year of composition *cursus* at IRCAM enabled me to discover new forms of notational practices through the process of learning computer-assisted composition. The previous chapters described the necessity, in my own practice, to begin a piece from electronically generated audio material and then transcribe it into notation, or to use audio-scores as a composition aid. *Open Music*, as well as the *Bach* and *Cage* libraries in Max/MSP, gave me the opportunity to manipulate pitch and rhythmic materials that were already notational. In other words, those softwares allowed me to manipulate symbolic (i.e. notational) material at the pre-compositional stage, thus reactivating an essential function of musical notation, which was arguably wanting in my former methods of workings.

9.1.1.1 *Open Music*

(DVD3 track 4, available at <http://jonathanbell.eu/open-music-study>)

What interested me about *Open Music* was the possibility to generate complex rhythmic microtonal notation, and the ability to hear it immediately.

Figure 82: *Etude*, visualisation in *Open Music*



The short extract displayed above shows how explicitly formalised processes triggered the generation of material, which is quite rare elsewhere in my compositions:

- The second and third staves are the exact rhythmic retrograde of the first. Consequently, the first staff starts with the ratio 4:5, while the second and third staves finish by this same ratio.
- In terms of pitches, the three voices are in (non-retrograde) canon. The second staff corresponds to the first, lowered an eighth of a tone; the third staff corresponds to the first, lowered a quartertone. Few pitches were then modified intuitively.
- Rhythmic notation is very flexible in *Open Music*. In this example, each staff is in a different tempo. For each bar, any denominator is possible (here 4, 8, 16 but also 5 or 7...). Within such unusual time signatures, almost any rhythmic ratio is allowed.
- The background chords in the middle-low register are not displayed in the score, but are prominent in the recording. They were generated with the help of a ring-modulation model. Each four-note chord obeys the following rules:
 - Two frequencies f_1 and f_2 are chosen intuitively.
 - The third frequency is the sum: $f_3 = f_1 + f_2$.
 - The fourth frequency is the difference: $f_4 = f_1 - f_2$.

9.1.1.2 *Bach and Cage libraries in Max/MSP*

Music notation symbols have long been missing in the Max/MSP environment. Composers Andrea Agostini and Daniele Ghisi have developed the Bach Library (2011), which precisely fills this gap. Bach is programmed in a language called lisp-like linked lists (LLL), and translates to the Max real-time environment most of the 'lisp thinking' which computer-assisted composition inherited from Open Music and Patchwork. The project evolved in 2014 with the Cage⁴³ Library, allowing for more complex transformations, such as melodic profiles, and processes inspired by electronic music (e.g. register filtering, frequency modulation, harmonic interpolations...). The extract below (fig. 83) comes from a

⁴³ The acronym stands for *Composition Assistée Genève*.

composition of mine for twelve voices,⁴⁴ and was composed using these tools. In the last bars, the twelve voices are divided in groups of four:

- Group 1: the three basses and Tenor 3 are based on a unison proportion canon (i.e. with different speeds). The prosody is treated freely and does not follow the rules of the canon.
- Group 2: Alto 2, Alto 3, Tenor 1 and Tenor 2 are also in canon, an octave higher.
- Group 3: the three sopranos and Alto 1 are based on the same principle, a fifth higher.

The encounter with computer-assisted composition opened new horizons for me, particularly considering how formalisation allowed for the generation and precise control of a dense material. The ability to hear immediately what is generated, edit, graphically time-stretch, or quantify (in bars and beats) within the Max/MSP environment gives computer-assisted composition an ergonomic workspace, which hopefully, will carry on developing in the future.

Conclusion: Learning the software *Open Music* and more importantly Max/MSP's *Bach* Library gave me the opportunity to rediscover the strength of working exclusively with notational material at the pre-compositional stage, as opposed to working with electronically generated sounds (as exemplified in most pieces submitted in this folio). The positive result obtained in the piece *Pecure* had a strong impact on my perception of the function of notation for a composer, and how formal constrains (multiple canons in this case) permitted a precise and intuitive control over harmony, registers and density.

⁴⁴ *Pecure* (2015), for twelve voices, was commissioned by the French vocal ensemble *Solli Tutti*.

Figure 83: *Pecure*, score extract

poco rit e diminuendo al fine 25

ppp

81

S 1
la'l - di - la di u ma - re

S 2
la di u ma - re

S 3
di - la ma - re

A 1
la u ma - re

A 2
l'al di - la di u ma - re

A 3
l'al di - la di u ma - re

T 1
di u ma - re

T 2
l'al di - la di u ma - re

T 3
la di u ma - re

B 1
la u ma - re

B 2
la di u ma - re

B 3
la u ma - re

The image shows a musical score extract for a piece titled 'Pecure'. The score is for a vocal ensemble with parts for Soprano 1 (S1), Soprano 2 (S2), Soprano 3 (S3), Alto 1 (A1), Alto 2 (A2), Alto 3 (A3), Tenor 1 (T1), Tenor 2 (T2), Tenor 3 (T3), Bass 1 (B1), Bass 2 (B2), and Bass 3 (B3). The music is written in a key with one flat (B-flat) and a common time signature. The tempo and dynamics markings at the top right indicate 'poco rit e diminuendo al fine' leading to measure 25. The dynamic 'ppp' (pianissimo) is marked at the beginning of each vocal line. The lyrics are 'la'l - di - la di u ma - re' and 'l'al di - la di u ma - re'. The score includes various musical notations such as notes, rests, and slurs, with some parts featuring triplets.

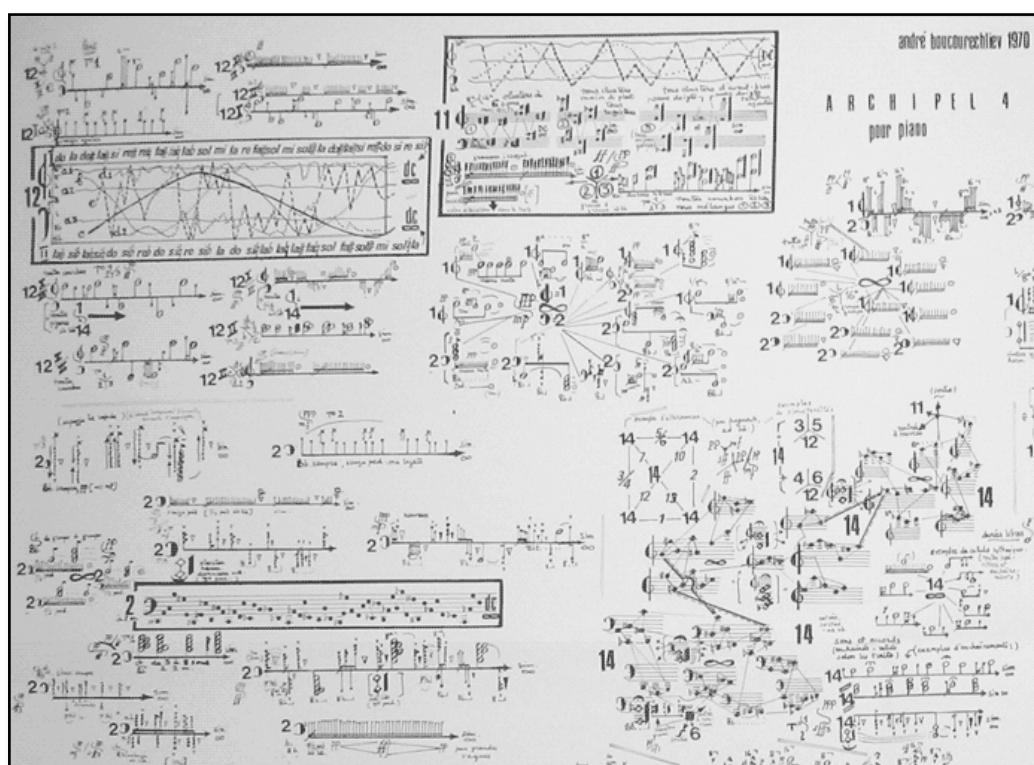
9.1.2 Screen-scores (performance-centred practice)

9.1.2.1 The Emergence of Screen-scores

The desire to further develop my notation recently guided me towards the notion of *screen-score*. What I find most interesting about this tool is its ability to provide the performer with different possibilities of realisation each time. The exploration of most unconventional notational practises is, in my own experience, closely linked with the *open works* of the fifties. During my piano studies as a teenager I became interested in the music of André Boucourechliev, playing his piece *Archipel IV* (1970), which comes from this *open work* tradition. *Archipel IV* displays an archipelago on a very large piece of paper with different musical structures or modules, in which the player freely finds his path. The free journey that was allowed between the different modules was particularly stimulating to me, playing them in a different order, with a different duration each time.

Figure 84: André Boucourechliev, *Archipel IV*, score extract

(© 1971 by Alphonse Leduc Éditions musicales, reproduced by kind permission of the editor)



This experience, together with the concept of ‘real-time’ (very influential at IRCAM), inspired for my *cursus* piece the idea of an interactive score that could display on a screen the pages of an open work in a different order in each

performance, thus adding an element of surprise, and proposing an original approach to form.

Most successful *open works* of the 1950s were often solo pieces.⁴⁵ Xenakis nevertheless intended to realise mobile forms with larger forces in *Duel* (Xenakis, 1959) and *Stratégie* (Xenakis, 1962), for 56 and 82 musicians respectively, but the performance of these works is still problematic today, since in both pieces, the two conductors have to choose in real-time which section of the piece to play, and then convey this information to the players. Mikhaïl Malt and Benny Sluchin proposed a form of computer-aided performance in which a screen-score for each musician would make the performance of these works more realisable (Sluchin & Malt, 2014a). An interesting property of screen-scores therefore lies in their potential ability to co-ordinate a large group of players performing an *open work*: I will consequently investigate further this formal aspect in my IRCAM *post-cursus* project in 2016, where the sections of the piece should be presented to a vocal ensemble in a slightly different order each time.

Considering how paper is progressively replaced by screens, it is, in my view, almost a necessity for a composer today to investigate the realm of screen-scores or animated notation. These new tools present a radical turn in the way music is conveyed to the performer, moving towards different forms of representation, with of course various advantages and drawbacks. This shift from paper music sheet towards animated or interactive screen-based notation has only been particularly noticeable in the last few years.⁴⁶ Several symposiums and reviews can attest of this very recent tendency. To name a few:

- In 2013, a symposium entitled 'Notation in Contemporary Music: Composition, Performance, Improvisation' (Goldsmiths, University of London) presented a great variety of approaches available through technology in the field of musical notation.
- The review *Organised Sound* (Wyse and Whaley, 2014) dedicated a special issue on 'mediation: notation and communication in electro-

⁴⁵ Stockhausen's *Klavierstücke XI* (Stockhausen [1956], 2002) and Boulez's *Third Sonata* (1957) are for instance the major musical references in Umberto Eco's *Opera Aperta* (Eco, [1962] 1989).

⁴⁶ However, *Prima Vista* (1962-64), by Mauricio Kagel, can be considered as a pioneering experiment in that field. In this piece, the Argentinean composer, in this piece, provided his players with musical notation on slides projected on a screen, which the audience could visualise as well.

acoustic music', showing again in great details different forms of animated screen-based notation.

- The event 'Tenor 2015', held in Paris, entitled 'First International Conference on Technologies for Music Notation and Representation', addressed similar issues. The second edition will take place in Cambridge in May 2016.

9.1.2.2 *Archipel* (2015)⁴⁷

This effervescence in the realm of new notational practices has strongly influenced my wish to experiment with screen-scores. *Archipel*, the harp piece I composed for my first year *cursus* at IRCAM, is an open work where the computer decides in real-time the order in which the ten sections of the piece are to be played. The screen-score is necessary in this piece for two reasons: a) it displays to the performer which section has been chosen by the machine, b) it helps the performer synchronise precisely with the tape and live-electronics.⁴⁸ The material is identical in each performance, but the order in which the sections are presented, and the transitions between them are different each time; thus, the dress rehearsal and the concert did not start or finish in the same way.

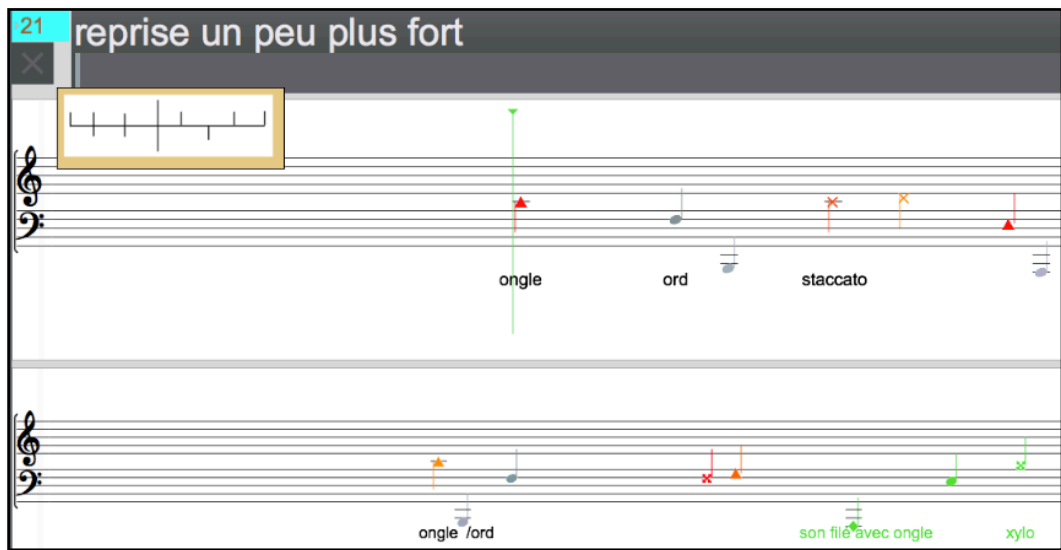
Most of the score was edited inside *Bach.score* objects within Max/MSP⁴⁹, in proportional notation, without bars and beats. A visual cursor moving across the stave (displayed in green in the example below) indicated to the harpist at which speed and when to play each fragment. This visual cue allowed great temporal precision without requiring a click track or a MIDI pedal, as is normally the case in pieces involving live electronics.

⁴⁷ A recording of the piece is available on DVD 3 track 3.

⁴⁸ The link '<http://jonathanbell.eu/archipel>' provides a film of the performance, as well as the screen-scores of the dress rehearsal and concert.

⁴⁹ The object used, called *bach.roll*, is an equivalent of *chord-seq* in Open Music.

Figure 85: *Archipel* (2015), score extract.



The principal difficulties encountered with this approach lie in the fact that the performer cannot annotate the score as he/she would normally do with paper; in addition, page turns on a screen need to be meticulously prepared, in order to allow enough preview.

In spite of the few above-mentioned limitations, many advantages strongly encourage me to further investigate new forms of screen-based notation. These include:

- The possibility to send any kind of visual information to the player during the performance, and the particular type of stimulus provoked by dynamic visual elements.
- The temporal precision that screen-scores allow: this kind of representation is more suitable to durations than rhythm, and is therefore well suited to non-pulsed music, when the performer needs to keep in time with the electronics.
- The possibility to present the sections of the piece in a different order each time. This changes the traditional relationship between material and form in a piece of music. It adds an interesting element of surprise, and gives a striking impression of a work behaving like a living organism.

Conclusion: It is beyond the scope of the present submission to fully explore the complex issues raised by animated or screen-based notation. Nevertheless the

use of a screen-score was a very important discovery for me, and provided interesting answers regarding the notation of time in my compositional research:

- This method unveiled an original form of precise rhythmic notation, which does not rely on traditional concepts of bars, beats, or prolation.
- Each version of the form of the piece was different but equally valid in my view. This observation confirms the idea that the relationship between material and form in my music can be understood as *non-teleological*.

9.2 Ongoing research on audio-scores

9.2.1 Immersive Theatre: an underlying motivation

In 2014 I attended a performance in London of *The Drowned Man*, a show by the company *Punchdrunk*. This was my first encounter with ‘Immersive Theatre’. It seemed to me to be a performance without a stage, or rather, where the whole venue is part of the show. The performers wandered around making the spectators feel as though they are immersed in a movie. In such a setup, the performers are particularly exposed due to the fact that the stage/audience barrier does not exist any more. Distanced from one another and surrounded by members of the audience, these performers have to sing, act, and move in the space, which presents different challenges than more conventional stage situations. After witnessing this ‘immersive’ experience, it occurred to me that wireless screen-scores and/or audio-scores could facilitate the singer’s task in performances of this kind.

This concept of *Immersive Theatre* is primarily what motivated my search for a technical improvement of audio-scores. Consequently, after some fastidious research on the internet, I finally discovered in April 2015 *iVideoShow*,⁵⁰ a recent iOS⁵¹ application making it possible for me to synchronise audio-scores (or screen-scores) within a WIFI network.⁵² This wireless set-up finally allowed singers to move freely in the space of the performance, which was something I had long been aiming for.

⁵⁰ *iVideoShow* (2013) is developed by *os-cillation* GmbH, Siegen, Germany. It is primarily used for presentations and shows on multiple iPads.

⁵¹ iOS is the operating system for iPhones, iPads, iPods(5th generation), and iWatch.

⁵² The devices are connected together through a local network (WLAN or WIFI) without necessarily being connected to the Internet.

9.2.2 First attempts with *iVideoShow*

The showcase 'Focus Musique Contemporaine', held in Paris on the 10th June 2015, was an occasion for me to experiment for the first time with a substantial technical improvement in the realm of audio-scores. The *De Caelis* Ensemble premiered my piece *De Joye Interdict*⁵³ in October 2014. For the premiere we used the usual setup (a computer sending independently five audio-guides via a soundcard). For the 'Focus' version, each singer had an iPad playing her audio-score through an earpiece, displaying a video with her individual part⁵⁴. The synchronisation between parts was made possible thanks to *iVideoShow*, which allows for simultaneous triggering of different video files copied beforehand on each iOS devices (iPhone, iPod, or iPad). The devices are connected to the same WIFI network (or WLAN), and communicate between themselves through OSC⁵⁵ messages. This method presents undeniable advantages over the computer/soundcard apparatus:

- The wireless setup allows performers to move, and/or to be distanced from one another without the limitations and potential fallibility of using long wires. This technical improvement is in my view very promising in the case of staged works and site specific or immersive performances.⁵⁶
- Screen-scores, combined with audio-scores, aim to help singers perform and watch their audience. The screen only displays the systems that are being sung. Supposing the singer has learned the piece beforehand, this method will allow him/her watching the screen only when his/her memory needs recall: he/she does not need to follow every system or turn pages.

⁵³ DVD 3 Track 1, available at: <http://jonathanbell.eu/de-joye-interdict>. The piece was commissioned by Festival d'Île de France.

⁵⁴ The screen-score of Soprano 2 is also available at: jonathanbell.eu/de-joye-interdict

⁵⁵ OSC (Open Sound Control) is a protocol developed at CNMAT (Berkeley), by Adrian Freed and Matt Wright. It is an alternative to MIDI, and has the advantage to be very suitable to Internet connectivity.

⁵⁶ My piece *Déserts* (2007) was performed on 19th July 2015 for the *European Church Music Festival* (Schwäbisch Gmünd, Germany). The performance took advantage of the properties of the wireless technology, allowing the performers to move in the space. The singers began on the altar, close together for the first piece which was homorhythmic (and therefore required cohesion), then they placed themselves around the audience, for the following pieces which were more contrapuntal (and where the spatial separation made the polyphony clearer).

- The outputs of a soundcard are not usually amplified; therefore connecting headphones directly to the output of a soundcard only allows for a very quiet sound unless each headphone is provided with its own amplifier. Playing audio-scores from an iOS device allows for much wider dynamic range, and each performer can adjust his/her volume independently during the performance.

9.2.3 A central computer replaced by multiple communicating devices

Over the last eight years, I have experimented with sending audio-scores from a central computer through a multichannel soundcard to performers via cables, Bluetooth, infrared and radio frequency headphones (HF). Until only very recently, in concert situations, headphones connected to wires were always more reliable; however, considering the successful results obtained with *iVideoShow*, the rapidly evolving technologies encourage me to investigate other technical set-ups.

Smartphones (and tablets) are becoming today widespread and ordinary. Their integration into the realm of performance would allow audio-scores to be sent to players, but would also be naturally disposed to other types of interactions including recording, amplification or transformation of their sound (via the internal microphone), sending visual information (e.g. a score displayed on the screen), receiving a kinetic information (e.g. track their movement with the camera, or their acceleration with sensors), communicating with tactile devices (via touch screen), etc... Most importantly for the present study, the simple idea of triggering different media players simultaneously⁵⁷ (between several computers, tablets, telephones or lighting devices) is today a very simple way to synchronise with precision audio-scores (i.e. performers), sounds (a multichannel tape), lightings, or videos in different locations of the same venue.

The main technical difference between my former computer setups and the iPad/*iVideoShow* setup can be illustrated, in Deleuzian terms, as a shift from an *arborescent* model (where a central computer sends an audio signal to different earpieces) towards a *rhizomatic* one (where each device plays its own files and therefore may act relatively autonomously).⁵⁸

⁵⁷ Via applications like *iVideoShow* or *MultiScreener*, discussed below.

⁵⁸ The synchronisation between the different modules nevertheless requires the establishment of a master/slave, or server/client architecture between one device (the conductor) and the others.

Conclusion: The simultaneous triggering of multiple files on electronic devices (aided by a router through a WLAN) enables the synchronisation of performers positioned at a distance (led by audio scores), loudspeakers, screens and lighting in a variety of performative settings. The avoidance of having to use numerous cables is a great practical advantage of this method of synchronisation. My current research on the subject of audio-scores, therefore, focuses on this multimedia aspect.

9.2.4 OS X, iOS, or Web applications?

The solution found with *iVideoShow* and iPads unanimously convinced the singers of the *De Caelis* ensemble. This same *rhizomatic* model could equally be applied to computers (Mac OS X), or to Web applications instead of iPads (or other iOS devices). These different setups give rise to various advantages and inconveniences as outlined below:

9.2.4.1 Audio-scores on OS X (Macintosh computers)

Multiscreeener,⁵⁹ an open-source application running on Macintosh computers, is an OS X equivalent of *iVideoShow* (running on iOS exclusively), and allows for a perfect synchronisation between video or sound files running on multiple computers, through WIFI and the udp protocol. The synchronisation is more accurate than with *iVideoShow*, and is precise enough to allow the diffusion of multichannel electronics which will only tolerate a few milliseconds of time difference. It is, therefore, suitable for pieces involving audio-scores and electronics (such as *Percussion Quartet*, *Flute Violin and Piano*, or *Etude de Synchronisation*, submitted in this folio). On the other hand, *Multiscreeener* and computers potentially compromise the mobility of performers allowed by *iVideoShow* and iOS devices.

9.2.4.2 Web applications

Hosting audio-scores within a web application reveals interesting properties, including a simplified set up for the user, and the potential for dissemination of the works over the Internet. Consequently, research into the realm of web application occupies a central importance during my second year at IRCAM. A Web application, as opposed to *iVideoShow* (running on iOS only), facilitates

⁵⁹ *Multiscreeener* (2008), is an open source, standalone application developed by Zach Poff on Max/MSP 5.

cross-platform set-ups (Android, iOS, Mac OS, Windows...), and spontaneous forms of collaborative music making (such as workshops with an amateur group of singers). Without the requirements of any preliminary installation (unlike with *iVideoShow*), each participant can join the performance by simply logging in to the same webpage⁶⁰ and connecting to the same WIFI network. This setup allows any type of device (phones, tablets, or computers) to communicate in real-time, regardless of their respective operating systems, since the program is executed directly in the browser (such as Chrome, Firefox or Safari).

Recent research has proven that today's technology allows loading reasonably heavy files (around 50MB) from a local server to a large amount of participants' smartphones. The synchronisation of the playback of these files can be extremely accurate, thanks to recent developments of the Web Audio API and its Web Audio Clock: the latency between the client's devices mainly depends on the vector size of the devices used, which situates between 10 and 100 ms approximately. These recent features give me great hope that the setup of immersive performances with audio/screen scores, multichannel electronics/video/lightings will soon be considerably simplified.

This idea of using web technologies as an aid for professional but also amateur practice was influenced by the COSIMA⁶¹ project from the ISMM⁶² research team at IRCAM. These researchers are specialised in the development of collaborative web-hosted smartphone music applications, mainly used in participative installations. Taking as a model *iVideoShow*, which is essentially a multitrack media player, we are currently developing a web-hosted equivalent of it within *Soundworks*, the JavaScript framework developed by COSIMA. Norbert Schnell, who is in charge of Web Audio and the COSIMA project at IRCAM, describes *Soundworks* as 'A playground for artists and developers to create collaborative mobile web performances' (Robaszkiewicz & Schnell, 2015). The COSIMA team outlines an approach to technology which interestingly converges with the thesis developed in the present commentary:

These new forms of musical expression strongly shift the focus of design from human-computer interactions towards the emergence of

⁶⁰ The html page is delivered by a computer running a local server with Node.js, the performers (or participants) can access its URL by scanning a QR code.

⁶¹ COSIMA stands for Collaborative Situated Media.

⁶² ISMM stands for *Interaction Son Musique Mouvement* (Sound Music Movement Interaction).

computer-mediated interactions between players based on sonic and social affordances of ubiquitous technologies (Schnell, 2015a).

Experimenting with wireless audio-scores on a large group of performers would have been technically very demanding ten years ago, since HF headphones were (and are still today) an expensive technology. The recent development of ‘ubiquitous technologies’ makes such scenarios perfectly realisable, not only with auditory information (audio-scores), but also with visual information (screen-scores). The reliance on a local server as a mediator for new forms of musical (or, more generally, performative) interaction between participants holds great promise in terms of potential for dissemination: first, because each participant can use a different device (Window, OSX, android, iOS...), secondly because of the absence of installation allowed by this system. Again, in order to join the performance, the only thing the participant is required to do is to select a WIFI network and type in a URL in their browser (or else scan a QR code).

Although the participant’s task is made very easy, the realisation of a web application of this sort requires significant knowledge in programming. The COSIMA team’s *Soundworks* framework aims to facilitate the realisation of such a ‘scenario’ within this challenging technological environment:

The *Soundworks* template allows anyone to bootstrap a scenario based on *Soundworks* and focus on its audiovisual and interaction design instead of the infrastructure (Schnell, 2015b).

The *Soundworks* framework is written in JavaScript, a programming language which, inserted into to an html page, allows for a web page to be become dynamic (or interactive). More specifically, it is based on a client/server architecture supported by Node.js⁶³ and WebSockets.⁶⁴ Such infrastructure implies interaction between different devices, which is made possible thanks to a real-time communication between the server-side and client-side of the application through WebSockets. The timeliness required by a musical performance makes this type of interaction across multiple devices very

⁶³ Node.js permits *server side* JavaScript programming. It is suitable to real-time web applications that run across distributed devices.

⁶⁴ WebSocket is a communication protocol which allows for point to point communication in both directions (full-duplex). This protocol make more interaction possible between a browser (client-side) and a website (server-side), the server being able to *push* unsolicited (asynchronous) information to the client in real time, without refreshing the html page.

challenging. Fortunately, some tools developed within the *Soundworks* environment deal specifically with this synchronisation problem⁶⁵. Norbert Schnell and researchers of the COSIMA team at IRCAM have agreed to help me develop a framework specifically designed for the diffusion and display of audio-scores and screen-scores.

Realising audio-scores using this recent technology should help giving my research/composition accessibility and exposure. In order to diversify experiences, my goal is to make this system (as well as my music) as suitable to collaborative amateur or professional practices as to new music ensembles, so that the essential nature of what is at stake in the present investigation – performance aid – may carry on evolving. This corroborates an observation made by Chaya Czernowin, in a lecture at IRCAM in 2015. In reference to experimentalism and aesthetics, the composer remarked how an artistic movement could only either ‘grow or die’, confirming the idea that transformation is crucial to the development of artistic research.

9.2.5 Audio-scores and generative processes/artificial intelligence

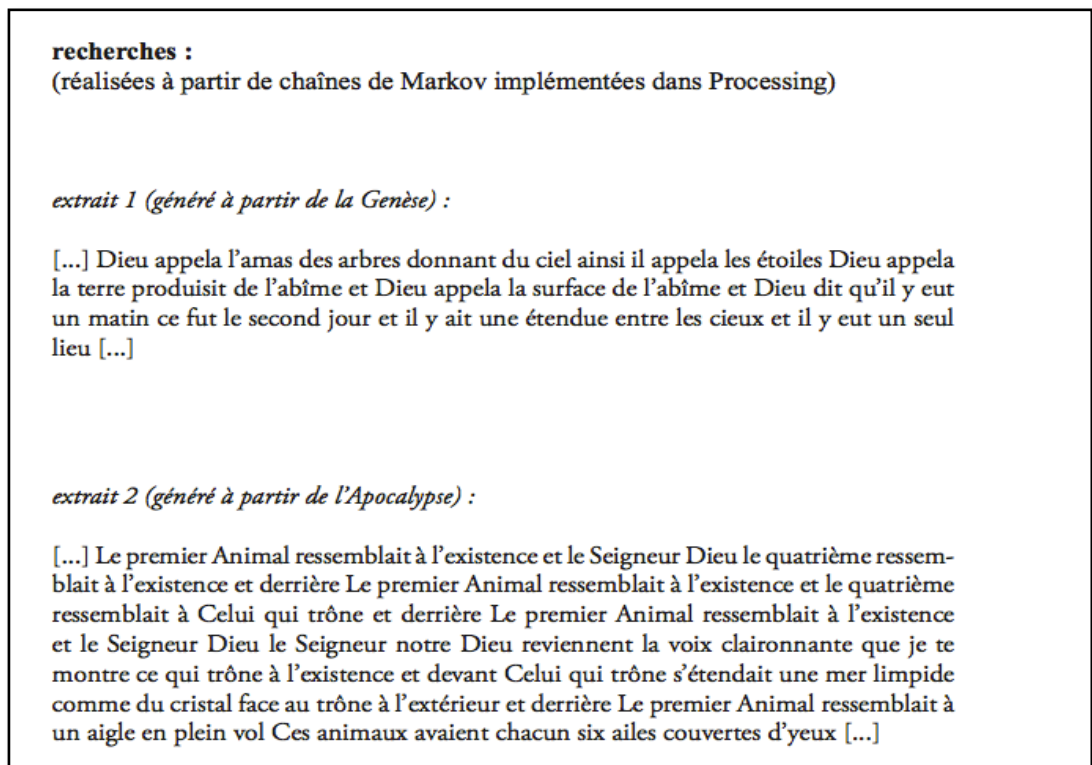
In 2011, the first example of audio-scores which James Weeks advised me to investigate was ‘*I, purples, spat blood, laugh of beautiful lips*’ by Aaron Cassidy (presented in Chapter 3.4.7, fig. 11). In this work the earpiece presents an interesting challenge to the performer. As explained in Chapter 3.4.7, a Max patch generates in real-time a sine-tone glissando. The audio input being generated live, its function is to prompt original responses, rather than just to help the performer realise a fixed material. What interests the composer here is the challenging situation which the performer faces as he is asked to match the unexpected evolution of the glissando while interpreting the written text. As a result, the glissando curve – the pitch material of the audio-score – is different each time and, more importantly, the effect of this stimulus on the performer should help him/her finding a new response in each performance.

This live generation of material constitutes an important aspect of my on-going composition/research project.

⁶⁵ The code for the ‘sync module’ is available here: <https://github.com/collective-soundworks/sync> [Accessed: 30 December 2015].

During the performance, in order to generate real-time responses from the computer, one of the strategies which I am currently considering involves implementing forms of artificial intelligence to audio-scores. Fabien Zocco, my collaborator on this project, is a net-artist, studying at *Le Fresnoy-Studio National des Arts Contemporains*. He is currently developing an application that will be able to send a generative text to multiple smartphones (he is aiming for twenty to forty devices), in which a vocal synthesiser will pronounce the words received. An important aspect of Fabien's artistic research involves making computers 'speak', through generative processes, artificial intelligence models and text-to-speech applications. As a result our collaboration will intend to make human performers say, or embody the text generated live by a computer. To give an example, the two extracts below (fig. 86) can be considered as a computer generated improvisation in the style of biblical texts: Fabien implemented Markov Chains in *Processing*,⁶⁶ using passages from Genesis and Apocalypse as source material.

Figure 86: Text generation by Fabien Zocco



⁶⁶ *Processing* is an open source programming language dedicated to electronic arts, new media arts and visual design.

My role will be to use this set-up in a performative context, with performers interpreting this text synthesised in real-time as a theatre script. Such use of smartphones and earpieces as cueing devices will be far more interactive than what I have realised thus far, shifting from a fixed audio-score (fixed media) towards the interpretation of live computer-generated performance instructions or speech material, hence reminiscent of the prompting role of the earpiece in Aaron Cassidy's piece.

Conclusion: The recent discovery of the iOS application *iVideoShow* offers greater flexibility to the audio-scores system. The wireless system is more comfortable for the singers, and allows them to move during the performance. Further technical improvements of audio-scores are currently being investigated during my second year of residency (cursus II) at IRCAM, in the realms of web application and computer-generated performance instructions.

10 CONCLUSIONS

10.1 Research and risk-taking

Practice-based research, when applied to the realm of music composition, might be understood as collecting and interpreting information from the analysis of a folio of compositions. As well, it may also consist of assimilating certain principles and drawing conclusions from the experience acquired through composing. However, in the present submission, the audio-score axiom (or postulate) highly conditions the pieces it produces, and influences my own perception of these works. I am most interested in analysing and discussing these pieces through the angle of this specific protocol. Numerous sections of this practice-based research commentary focus on the way the music is transmitted rather than the music itself, thus emphasising its research/scientific component. The intention is to present a model in which the research postulates *precede* the artistic outcome: they are a set of initial conditions out of which the artistic works have emerged.

This emphasis on research most significantly highlights the originality of the present thesis, and reveals the risks taken in orienting my compositional practice in this manner. The long and unpredictable nature of the research process meant I could not predict where audio-scores would lead me when I began this investigation eight years ago. I was unaware at that time how significantly this specific working method would transform my approach to composition, notation, and determine the performers I would work with. After promising experiments with audio-scores in 2006/7, I was advised during my studies at the Paris Conservatoire to discard them, in order to write for larger ensembles, with traditional means of notation. Two pieces, *Chroma* (2008, Figure 88) and *Trauma* (2009, figure 89), displayed below, were written at that time. In spite of important efforts made during the compositional process, and generous rehearsal time with skilled performers, I was not entirely satisfied with the result of these works. I thought I could obtain more interesting and unique results with audio-scores. Consequently, after this experience, I concluded that audio-scores and computer-aided performance deserved further investigation, hence the specialisation of my compositional research in this area.

Figure 87: *Chroma* (2008), for ensemble and electronics

CHROMA $\text{♩} = 56$

accél. $\text{♩} = 48$ $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

Jonathan Bell

Flute $\text{♩} = 48$ $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

Oboe $\text{♩} = 48$ $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

Clarinet in Bb $\text{♩} = 48$ $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

Percussion 1 $\text{♩} = 48$ $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

Percussion 2 $\text{♩} = 48$ $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

Percussion 3 $\text{♩} = 48$ $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

Violin I $\text{♩} = 48$ $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

Violin II $\text{♩} = 48$ $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

Viola $\text{♩} = 48$ $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

Cello $\text{♩} = 48$ $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

CROTALE baguette dure

GROSSE CAISSE baguettes feutrées

CYMBALE SUR TIMBALE baguettes feutrées, jouez sur la cymbale

Echantillon 1 : $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

Echantillon 2 : $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

TAM-TAM mailloche douillette progressivement

Violoncelle $\text{♩} = 48$ $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

Violon $\text{♩} = 48$ $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

Viola $\text{♩} = 48$ $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

Cello $\text{♩} = 48$ $\text{♩} = 80$ nt. sans attaque melo vib. timbre sur le crescendo

[illegible]

10.2 Notation

Whilst the present research on audio-scores proposes *a priori* a kind of alternative to written notation, I never thought the latter could be replaced completely. Instead, I am aiming for integration of the two media. I will now discuss a few domains where notation and music reading present undeniable advantages over the aural approach.

10.2.1 Notation is more creative than representational

In my view, written language and the score share many similarities; therefore, I propose that music behaves like language when it is notated, in the sense that 'Language constructs reality rather than merely reflecting it' (Cook, 2000). It might then be an error to consider the score just as an attempt to reflect an initial musical idea. In the process of notation or transcription, what is put to paper is not merely reflecting the initial object transcribed, but it embodies the notational symbols so as to create a new object, composed. Doing so, it moves away from what it was initially representing, to reach what this association of symbols means to the performer. No matter how precise a score can be, it will always be somehow unforeseeable, and therefore will always stimulate the creativity of the performer.

10.2.2 The act of reading and the performer

It would be perilous not to take advantage of the expertise acquired in music reading by classically trained performers. In my compositional practice, I realised that one of the main differences between audio cues and notated scores is that the aural input delivers information in the time of the performance, while the score (the separate part) allows the performer to obtain a preview.

The earpiece puts the singer in the position of a listener, and in a state of perpetual expectation. Without the visual input, the performer feels as though he/she is required to react in real-time to what is heard, whereas the presence of a written score offers knowledge of what comes next. Also, as seen in previous examples, such as in Chapter 6.1.4, the score allows the performer to distinguish when he should come in and when he is just given a cue. Similarly, the visual storage allowed by music reading would be absolutely irreplaceable by audio cues only in instrumental practice, when for example a pianist plays complex chords, or when a clarinetist has to play fast atonal figurations. In rehearsals, the annotations made by the performers in their parts allow assimilation,

appropriation and interpretation. Finally, the score helps the performer considerably in the construction of a mental representation of the sequence of events (of the form), as opposed to an audio-score, which can only unfold in time.

For a performer, what is most irreplaceable with music reading relates to his/her background and experience as a classically trained musician. This observation leads to the following conclusion: generally speaking, the visual input (the score) engages with prior knowledge of the performer, and allows him/her to understand and reconstruct what is written on the page. The auditory stimulus, on the other hand, is looking for a mimetic or spontaneous response.

10.3 Audio-scores as a medium between notation and the performer

I believe that it is problematic to consider audio-scores as merely an aid in the realisation of the score, and yet these tools were initially conceived as entirely subordinate to notation.

I started engaging with audio-scores with the intention of realising complex material with standard groups of performers. The idea emerged during my first year in composition with Emmanuel Nuñez at the Paris Conservatoire. In this environment I met several students who wrote complex music and complained about the execution of their work, which they found too approximate. Audio-scores were therefore initially conceived in my work as guides that could both accommodate composers' notated intentions and performers' requirements, thus implicitly adhering to the assumption of a mismatch between the score and its realisation in performance of contemporary music. Frank Cox eloquently explained this mismatch in an article analysing performance practice of complex music:

Such extreme developments [the ones of 'complex music'], which have rendered inadequate those training methods and means developed over the last two centuries in order to achieve a higher degree of performative accuracy and reliability, have widened the rift between contemporary composed demands and performative capabilities to a degree rarely seen in the history of Western art music. (Cox, 2002, p. 70)

Audio-scores have proven to be very accessible to performers inexperienced with microtonality. The aid therefore minimises the potential misunderstandings that may arise between composer and players through demanding microtonal notation. However, further research has led me to the conclusion that the most interesting properties of these guides are not actually primarily concerned with the assistance they provide in the realisation of a text. The accuracy which audio-scores allow should therefore not be understood as a goal per se: first because the notions of *text* and *accuracy* do not convey enough flexibility to the performer; secondly, since ever-improving new music ensembles are today very familiar with complex notation, composers – myself included – should have little concern regarding accuracy in the realisation of their score. Audio-scores, rather, enable in the first place *original performative situations*, in terms of placement of musicians (or scenography), dynamics, and general musical character. They may be considered as cues helping the realisation of notational information, but their principal function is, in my view, of different nature.

While audio scores are not to be understood as entirely subordinate to notation, the inverse idea is also problematic. When notation is nothing more than the transcription of an audio-score, or when notation is entirely subordinate to audio-scores, it is deprived of a certain freedom.

10.4 Audio-scores as a mirror of the notation?

Audio-scores and notation serve different functions. Their impact on interpretation is different, and yet an exact note-for-note correspondence tightly links them together in most of the works presented in this folio. Since the slightest difference between the two can be disturbing for the performer, I always endeavour to achieve as much transparency as possible. The resulting ‘mirror effect’ between the two media provides a mixture which is often sight-readable and reassuring for the performer, particularly when he/she can only read this music few times before performing it in public.

This transparency between auditory and visual information often implies, to a certain extent, simplicity in the notation, to the detriment of a conception where both media (score and audio-score) would coexist more freely. Although this

clarity or simplicity is assumed compositionally in some of my pieces,⁶⁷ it may in some cases be limiting when trying to convey more ambiguous or suggestive stimuli. More differentiation between the notation and the audio-score would provide more complex information to the performer, but it would also perhaps allow a wider range of choice in their interpretation. My *Etude de Synchronisation*, because it is based on transcriptions, has revealed to me the potential which lies in the exploration of a greater distance between the two media. In this particular work, the auditory information cannot always be exactly equivalent to the notation; although still very close, the audio-score and the notation do not perfectly reflect each other, but, instead, work in synergy: they both inform the performer in different ways.

My approach to the relationship between notation and audio-scores will certainly evolve in the future. The major challenge, which remains to be solved in this research, will be to find forms of flexibility in my notation, without losing the clarity, coherence and efficiency that this method allows. Following the experience acquired with *Archipel* (2015, Chapter 9.1.2.2), where a screen-score presents the material in a different order in each performance, I now envisage engaging with open forms more systematically in the future. Mobile structures, (or open forms) offer in my view a promising way to counterbalance the predictability or lack of responsiveness that may occur with fixed audio-scores.

10.5 Audio-scores as a composition aid

Building a piece out of audio technologies may appear restrictive in comparison to the potentially infinite scope which notation might allow. Nevertheless, as stated earlier, relying on audio-scores gives a precise control over the material or the local level. These tools constitute a *compositional aid* – a sort of *instrument* without which I cannot compose. My *écriture* training, use of computers, and experience as a pianist have all influenced me towards very simple forms of expression, and great simplicity in the notation, which I find necessary in order to relate to musical practice in an immediate and concrete way. Although some of the greatest works in new music since approximately 1970 involve very complex

⁶⁷ As remarked Belgium composer Thierry De Mey, some of my work, such as my piece *Flute Guitar and Piano*, which does not use microtones or extended instrumental technique, may be perceived as a manifestation of 'Simplicity' in that regard.

notation, in my personal experience as a composer, an abundance of information in the score can hinder or blur the delivery of the few sounds I am certain I want to hear, which is why notation in my scores stays most of the time very simple, in comparison to the standards of today's new music. In this simplicity and concrete relation to musical practice I feel close affinities with Morton Feldman. Christopher Fox describes how Feldman's way of working, specifically his close relation to the instrument, would never let his relation toward material 'slip into abstraction'.

What Feldman took from his painter friends was a sense of the vital importance of direct contact with the material on which one is working. In painting, this is obvious - the material is paint on surface and a painting is no more than the traces of the artist's exploration of that material. In composed music, the process is more complicated - sounds are transcribed into notation and that notation is interpreted by performing musicians - and it's a process in which the composer can lose contact with the sense of sounds as living, vibrating entities. For Feldman, it was crucial that this encounter with musical material should never slip into abstraction. He composed at the piano, testing each combination of sounds over and over again before writing it down (...) (Fox, 2006).

Taking as a model Morton Feldman composing at the piano, the use of audio-scores at the early stages of the elaboration of a piece raises questions about the instrument as a *composition aid*. Notwithstanding that listening in the mind's ear has always remained the composers' most essential attribute, instrumental practice has nevertheless supported and influenced their choices throughout history. For instance, between the late Middle Ages and early Renaissance, composers were principally trained as singers (such as Dufay or Josquin), while from the 17th century onwards, most of them were renowned keyboard players (Bach, Beethoven, Brahms...). This shift undoubtedly reflects aspects of how music was understood in those eras. Composers' ideas were shaped or filtered by this practice, and the representation of music through singing or a keyboard created natural boundaries that channelled experimentation.

I see audio-scores and the use of a computer while composing as a natural historical continuation of the above-cited composer's practices. Audio-scores are understood in this case as a composition aid (rather than a performance aid).

Like traditional instruments, new technologies offer possibilities and limitations. A balance must be found between practicality and imagination, or between such instrumental aids and the mind's ear.

10.6 Audio-scores as a performance aid

This notion of *instrument* is equally important for conceiving audio-scores as a *performance aid*. In this sense, a parallel can be drawn between the function of audio-scores when used by singers to help microtonal intonation and the role of instruments in the Middle Ages. The very small amount of surviving medieval instrumental music allows us to imagine a primitive function for instruments at that time. Instruments were not highly regarded as they were a human invention while the voice was the creation of God; we may therefore infer that the role of the instrument was merely to help sustain the voice.

The use of technology as a compositional aid is very common practice today amongst composers. The originality of the present thesis, therefore, is essentially concerned with its performance-centric aspect, rather than computer-assisted composition (or the composition-centric angle). In this sense, the function of audio-scores in my music shares an affinity with the Austrian composer Pia Palme: 'I use audio scores mostly because of the performative aspect rather than the compositional aspect. I use them because they bring in another completely different way of immersing the performers into a score/music.'⁶⁸

The primary goal is to develop a form of computer-assisted interpretation, or computer-aided performance. **Computer-aided performance** remains today the best term to describe the realm in which I aim to acquire expertise. However, three problems with this term should be stated:

- Regarding the word 'computer', as discussed in Chapter 9.2.4.2 (web applications), my research on audio-scores is now primarily concerned with networks between today's ubiquitous technologies (smartphones and tablets), in such a way that the computer only runs a web server, and most of the processing is now executed on the client-side, on smart-

⁶⁸ Quoted from a private e-mail conversation with the composer.

devices. Smart phones and tablets should therefore be included in the present definition of computers.

- In some circumstances, audio-scores may be used in rehearsal, as a learning aid, but left aside during the performance. In this particular case 'computer-aided learning' (instead of performance) might be more appropriate.
- Audio-scores were initially thought of as a tool for assistance in the realisation of a fixed text. However recent experiments have revealed promising forms of screen-scores involving notational and audio material generated live, such as in *Archipel* (Chapter 9.1.2.2), and the project discussed in Chapter 9.2.5 (Artificial Intelligence), where the notion of *assistance* is not quite appropriate. In such situations, the work becomes different in each performance, and gives a striking impression that it functions as a living entity. The score (audio-score or screen-score) presents the material differently in each performance and surprises the performer in a positive way. Recent experiments (see web application, Chapter 9.2.4.2) also allowed me for instance changing one performer's screen-score by clicking on the screen of another performer. The role of the score in such situations is not only to assist, but also to provoke, stimulate or prompt original responses from the performer.

10.7 Composer/performer/audience and their respective views

After my experience using a combination of the two, it would be futile at this stage of my development as a composer to identify an absolute answer, which would lead me to abandon either audio-scores or notation. Instead, just like the pieces in this folio, the works I will compose in the future will continue to interrogate and assess their results according to the two following angles:

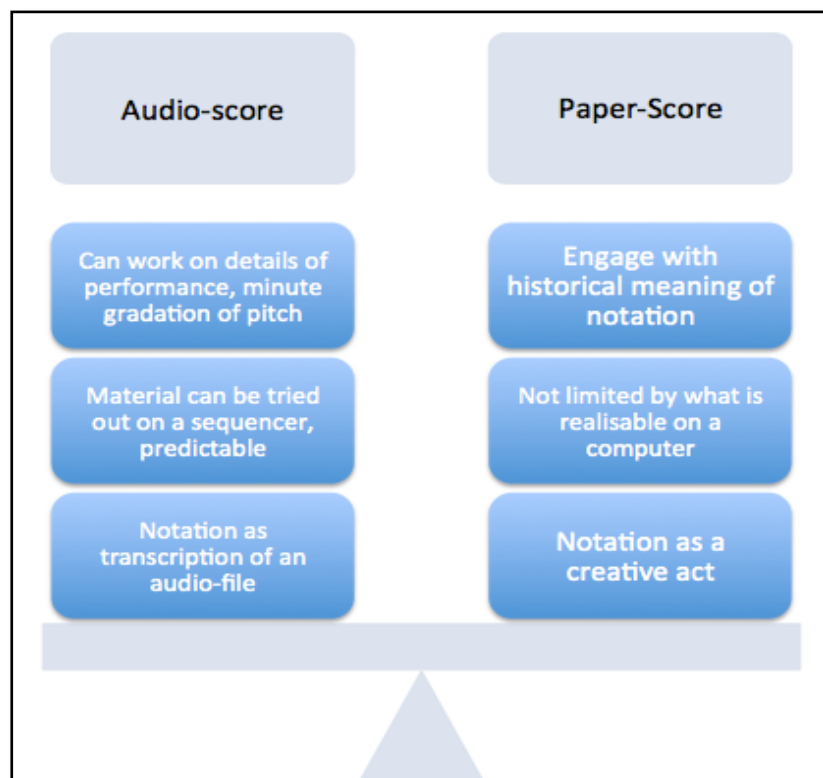
- The dialectical relationship between notation and audio-score.
- The conception/performance/reception of the work, or the composer, performer, listener and their respective views.

10.7.1 For the composer

When I begin writing a new piece, I am often primarily interested in the investigation of new materials (such as words, rhythms, harmony, microtones or movements in space). This pre-compositional investigation often occupies a long period of time before the narrative or any sense of general form appears. This way of working has likely guided me towards audio-scores, which in my view incline to focus on the tiniest details of material.

The audio file sent to the performer is, most of the time, one of the voices of the mock-up of the real piece. In that sense, the possibility to test material and to hear in advance what will become the final piece provides the composer with an important control or preview of the end result. However, this control over the material should impinge as little as possible on the performer's freedom, which is why notation is always equally important in my work, as it stimulates the performer in a different way. The use of notation engages with its long history. It makes a dialogue possible between the composer's intentions and the expertise acquired by classically trained performers in music reading. These musical symbols can suggest to the performer, through their specific meaning or their degree of abstraction (depending on the case), a very detailed, or on the contrary a very ambiguous response.

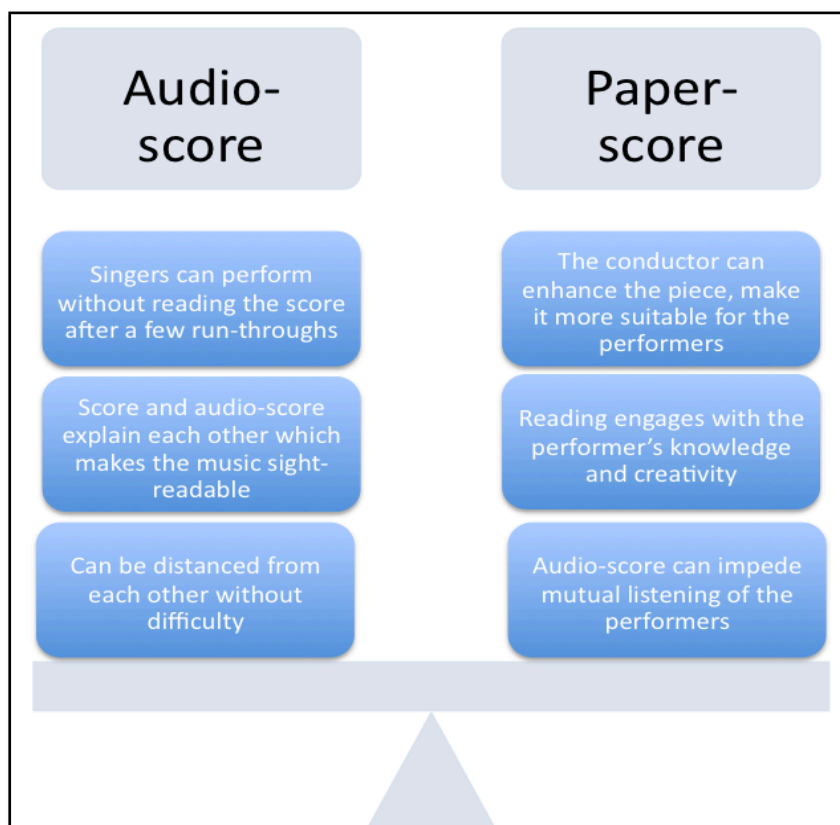
Figure 89: A balance between audio-score and notation, for the composer



10.7.2 For the performer

I explained earlier in this commentary how audio-scores accelerate the rehearsal process and how they facilitate performances where the players are placed far away from one another. However, when musicians wear an earpiece, some difficulties sometimes arising in performance need to be stated: the main obstacle concerns mutual listening. In consort music, a good performance often exists when there is a synergy between performers. The ability to connect with the other musicians in terms of adding one's sound into the sound of the ensemble, responding to what the other musicians are doing in a very immediate way, making subtle adjustments in response to other players on the day of the concert – all these factors are of crucial importance for a genuine live performance. With earpieces, singers (or instrumentalists) sometimes experience difficulty in adjusting their dynamics, which suggests that their abilities to listen to each other may be hindered. Audio-scores can, on rare occasions, interfere with a performer's capacity to listen to his/her own voice, if we consider that a singer is constantly listening back to what he/she hears him or herself doing. Finally, we saw earlier that notation is not a mere representation of a sound, but instead opens fields of interpretation, reactivating the performer's (or conductor's) knowledge, and stimulating their creativity.

Figure 90: A balance between audio-score and notation, for the performer



These are the reasons why, in some future projects, I will perhaps consider using audio-scores only as a learning aid, instead of wearing them during the performance (for instance in concert pieces taking place on stage and not around the audience).

For non-specialists or amateurs, however, wearing earpieces until the performance offers possibilities which I find hardly replaceable. Non-specialists often find contemporary repertoire very challenging. One of the most interesting aspects of the coupling score-earpiece is that both media can explain each other; as a result, the information is considerably simplified. Performers never get lost, singers can adjust with little effort to intervals which would otherwise be very difficult to pitch (in the case of voices *a cappella*). Thus, they can focus entirely on their performance, more than on the technical realisation of the text. Finally the score becomes much easier to learn from memory, and watching the audience is made easier.

10.7.3 For the listener

Although audio-scores offer new possibilities, the theatrical aspect of a musician with an earpiece on stage must be considered. In an article called *Technology and Music Performance in the Age of Mechanical Reproduction*, Jon Frederickson reminds us: 'This process [the introduction of technology into musical performance] transforms traditional aesthetic definitions of what constitutes live musical experience' (Frederickson, 1989). Today, headphones enjoy an ubiquitous status. Listeners increasingly access online recordings through their telephone or personal computers. Consequently live music (but also the collective experience of a recording played through speakers) is quickly shifting towards a more individualistic listening experience. We must be aware that when audio cues are used simultaneously with a score, they may prevent musicians from being really connected with their audience, or fully present on stage, because they are not hearing the same thing as the audience, or as the other performers. In spite of these states of isolation which I will come back to in the general conclusion, I believe it is part of the actor's skills to make the audience forget about these technicalities. As discussed earlier, musicians surrounding the audience, or site-specific concert-installation give an immersive feeling which undoubtedly enhances the experience of the listener, and audio-scores greatly facilitate the performance of such works.

While some singers find earpieces very useful, the audience may be intrigued or even disturbed by their presence. The listener will often be seduced by the immersive feeling of performance happening all around him, but at the same time he might be disappointed or intrigued if the performer is merely reproducing what is heard through his ear, as he might perceive it as a threat to the genuine engagement of the performer on stage (or *in situ*). The technical⁶⁹ aspect or the protocol is an essential part of the creation of these works. The potential controversy it may suggest to its audience reminds one of the paradox that a work of art is both 'art'-ificial and authentic at the same time. Auditory signals may augment performer's capacities, but, from the audience's point of view, watching them wearing earpieces during the performance can be disconcerting.

⁶⁹ Τέχνη (*Teckhnê*) means 'art' or 'craftsmanship' in ancient Greek. It is often associated with and compared to ἐπιστήμη (*epistêmê*), meaning 'knowledge' or 'science'. These two words offer an interesting comparison with our modern conceptions of theory (pure knowledge) and experience-based practice.

10.8 General conclusions

The contribution to knowledge of the present submission falls within the realm of computer-aided performance. It postulates that new forms of musical works and performances can emerge from auditory assistance through today's ubiquitous technologies.

The study of classical harmony and counterpoint taught me that working between piano and paper was the only way to obtain satisfying results whilst writing within a given style. I see my compositional craft today as a natural continuation of this process, with the piano replaced by a computer. Confronting systematically computer-generated materials with their notation has refined my understanding and knowledge of microtonality. The process of transcribing electronic material generated intuitively allows for the representation and understanding of their harmonic/intervallic structures. In return, notational representation and spectral-harmony theory inform and influence the choice of the harmonic material generated.

This investigation has made it possible for me to find a real synergy between what is most inherent in my compositional language, my notation, and what audio-scores allow in performance. In the last pieces submitted in this folio, the sense of isolation and composure inherently conveyed by audio-scores fits organically with the relatively neutral expression and economical use of material in the music. The peculiar musical character that emerged in those works is empowered by its expansion within extended durations. This exploration of large-scale forms is influenced by the late music of Morton Feldman. The reliance on audio-scores limited the scope of my composition, in terms of dynamics, registers and musical time; this also shaped its personal character. These works often seek a form of minimalism, avoiding a clear sense of direction, ruptures and contrasts; as well, the placement of performers at a distance from one another plays a crucial role.

I managed to work on a regular basis with several vocal groups since I started undertaking the present research. With two of those groups, I could rehearse with audio-scores exclusively (with *De Caelis* since 2007, and with *Mangâta*⁷⁰ since 2015). A large majority of the singers who experienced this process

⁷⁰ *De Caelis* is directed by Laurence Brisset, *Mangâta* by Hernàn Alcalà.

recognised that audio-scores help clarify the notation, accelerate the rehearsal process, and give great assurance in performance. For some of them, the simplification of the technical realisation leads to greater freedom, allowing them to be fully involved in the music rather than concerned with technical difficulties. However, the principal problem encountered with audio-scores is the sense of isolation inherent to the system. Many composers working with audio-scores, including Rytis Mazulis,⁷¹ Pia Palme (cf. p. 65), or Martin Iddon, would agree that earpieces tend to isolate singers from each other – a situation which, nevertheless, is not without a certain expressivity. Martin Iddon observes the following: ‘I must confess I think there's something really interesting about those states of isolation within an ensemble’.⁷² One of the achievements of the present research is accounting for the potential expressivity inherent in this paradox, placing performers at a considerable distance from one another, so that those states of isolation become part of the aesthetical idea.

My investigation into audio-scores is ongoing. I am convinced that the development of new forms of notational practices (such as screen-scores), further research into the realm of web applications, and the implementation of generative processes should altogether be a source of inspiration in finding ways to develop and renew the techniques developed in this commentary. I have analysed how audio-scores constitute a *compositional aid*, without which the pieces submitted could not have been composed. However, the originality of this thesis resides primarily in its *performance-centric* aspect. In order to explore this area further, I hope to work with non-specialist or even amateur performers, for whom an audio-guide may be particularly helpful. Considering amateur practice gave me the idea to investigate recent developments in the realm of real-time web applications. Such applications would allow any group of performers to use audio-scores and screen-scores simultaneously by simply logging in their smartphone or tablet to the same web page, without any specialised equipment or prior installation. The simplicity of my music and its notation suggest that audio-scores could be suitable to such forms of spontaneous collaborative music-making, where non-specialists performers of contemporary music, semi-

⁷¹ Rytis Mazulis wrote many pieces with audio-guides: *Cum essem parvulus* (2001), *Form is Emptiness* (2006), *Canon Fluxus* (2008), *Puja* (2009), *Schisma* (2009), *Non in Commotione* (2010), *Telescope* (2011).

⁷² Quoted from a private e-mail conversation with the composer.

professional groups of performers, or amateur choirs could use ubiquitous technologies, turning their own smartphone into a performance aid.

Recent technologies (smart devices) make the use of audio-scores and screen-scores considerably more practical than when I first started using them in 2006/7. Today I am very optimistic about the possibility of realising original types of multimedia performances thanks to this setup. Although the basic principle has not changed much through the years, I have received considerable feedback from performers, composers, and teachers, throughout the development of this research, and this has helped me find ways of developing this technique with greater precision. The improvements in the music, in its notation, and in the audio-scores have been enthusiastically received by musicians (such as the *De Caelis* Ensemble), as well as researchers (at IRCAM), allowing me the opportunity to further investigate experimental research in this particular domain.

The emergence of this music and compositional resource would have never been possible without the great support of the *De Caelis* Ensemble. They commissioned five pieces⁷³ and frequently performed my music over more than eight years. The ensemble has given me precious feedback at every stage of my research, regarding their impressions of audio-scores, how they can be improved, and how audiences perceive them. This medieval vocal ensemble devotes a great deal of rehearsal time towards improving their pitch. Perfect fifths and octaves help to define the beauty in the motets and masses of this repertoire, but these intervals are unforgiving of the slightest approximation. This great focus on intonation might be one of the reasons why the members of this ensemble always find earpieces useful during the performance of my music.

The aesthetic of the medieval a cappella vocal group has also been very influential for my development, since the notion of ritual plays an important role in my music. Forasmuch as a large proportion of their repertoire is religious, my own compositions for this ensemble have certainly inherited from aspects of this penchant. The peculiar character of their concerts is evocative of the 'parasitical dependence on ritual' which Walter Benjamin attributed to works of art preceding mechanical reproduction (Benjamin, 1936, IV). Such ancient sacred repertoires are appreciated today as aesthetic objects, but a significant part of their

⁷³ The pieces commissioned by *De Caelis* are: *Déserts* (2007), *Lasciato Hai Morte* (2011), *Five Pieces for Voices and Electronics* (2012), *De Joye Interdict* (2014), and a new piece for 2016.

expressiveness remains inherited from their archaic subordination to ritual. In this sense, in my own experience as a listener, I find a connection between early polyphony, the music of Morton Feldman, and some of my music, in which the unfolding of time is not goal-oriented, or driven by teleology.

Finally, working with *De Caelis* has triggered questions in my compositional practice surrounding confrontation between the old and the new. This experience has offered me an original perspective on the tension between the earliest manifestations of Western Art Music and our contemporary interest in new technologies.

Bibliography

1 Books and articles:

Adorno, T. W. and Hullo-Kentor, R. (1947/2006) *Philosophy of new music*. Minneapolis: University of Minnesota press.

Anderson, Julian (1993) In Harmony: Julian Anderson Introduces the Music and Ideas of Tristan Murail, *Musical Times* 134, No. 1804 (June 1993): 321-323.

Anderson, V. (2013) *Sound and score: Essays on sound, score and notation*. Edited by Paulo de Assis, William Brooks, and Kathleen Coessens. Leuven: Leuven University Press.

Bell, R. (1988) *Corniche*, French translation Catherine Despax. Available at: <https://jonathanbell.eu/my-fathers-poetry/> [Accessed 19 May 2016]

Bell, R. (1989) *Please do not laugh Mr. Breughel*. French translation Catherine Despax. Available at: <https://jonathanbell.eu/my-fathers-poetry/> [Accessed 19 May 2016]

Benjamin, W. (1936) Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit, (The Work of Art in the Age of Mechanical Reproduction) originally published in *Zeitschrift für Sozialforschung*, in *Illuminations*, ed. and tr. Hannah Arendt, Fontana, London.

Berlioz, H. (1843) Le Chef d'Orchestre, extract of the *Grand Traité d'Instrumentation et d'Orchestration Modernes*. Henry Lemoine Edition, Paris.

Bonnet, A. (1987) Ecriture and perception: on Messagesquise by Pierre Boulez, *Contemporary Music Review*, 2(1), pp. 173–209. doi: 10.1080/07494468708567058.

Boulez, P. and Jameux, D. (2010) Pierre Boulez – Écriture musicale et accident, *Genesis*, (30), pp. 219–228. doi: 10.4000/genesis.85

Bosseur, J.-Y. (2005) *Du son au signe: Histoire de la notation musicale*. Paris: Editions Alternatives.

Cage, J. (1961/2011) *Silence: Lectures and Writings*, 50th Anniversary Edition. Middletown, CT: Wesleyan University Press.

- Clarke, E., Cook, N., Harrison, B. & Thomas, P. (2005) Interpretation and performance in Bryn Harrison's *être-temps*, *Musicae Scientiae*, 9(1), pp. 31–74. doi: 10.1177/102986490500900102.
- Clarke, E., Cook, N., Leech-Wilkinson, D., Rink, J. (2008) *The Cambridge Companion to Recorded Music* (Cambridge Companions to Music). United Kingdom: Cambridge University Press.
- Conquergood, D. (1989) Poetics, play, process, and power: The performative turn in anthropology, *Text and Performance Quarterly*, 9(1), pp. 82–88. doi: 10.1080/10462938909365914.
- Cook, N. (1989) *Musical analysis and the listener*. New York: Garland Publishing.
- _____ (1992) *Music, imagination, and culture*. New York: Oxford University Press.
- _____ (2000) *Music: A Very Short Introduction* (Very Short Introductions). Oxford: Oxford University Press, USA.
- _____ (2001) Between process and product: Music and/as performance, *Music Theory Online* 7.2 : 1-31. Available at: <http://www.mtosmt.org/issues/mto.01.7.2/mto.01.7.2.cook.html> [Accessed: 15 July 2015]
- _____ (2005) Prompting Performance, *Music Theory online* Available at: <http://www.mtosmt.org/issues/mto.05.11.1/mto.05.11.1.cook.html> [Accessed: 13 December 2015]
- _____ (2007) *Music, Performance, Meaning: Selected essays* (Ashgate Contemporary Thinkers on Critical Musicology Series). Aldershot, Hampshire, England: Ashgate Publishing.
- _____ (2014) *Beyond the score: Music as performance*. United States: Oxford University Press.
- Coolidge, C. (1988) Regarding Morton Feldman's music and wherever it all now goes, *Sulfur* No. 22 (Spring 1988). Available at: http://www.webdelsol.com/Sulfur/Sulfur%2022_contents.htm <http://www.cnvill.net/mfcooldg.htm> [Accessed: 25 September 2015]
- Cowell, H. and Nicholls, D. (1930/1996) *New Musical Resources*. 3rd edn. Cambridge, UK: Cambridge University Press.

- Cowell, H. and Cowell, S. (1955) *Charles Ives and his music*. United Kingdom: Oxford University Press.
- Cox, F. (2002) Notes Toward a Performance Practice For Complex Music, in Mahnkopf, in C.-S., Cox, F. and Schurig, W. (2002) *Polyphony and complexity*. New Music and Aesthetics in the 21st Century, Volume 1 United States: Wolke Verlag.
- Cross, Lucy E. (2000) *Ars Subtilior, A Performer's guide to medieval music* Ross W.Duffin (Chapter III, article 16, 228), Indiana University Press.
- Dahlhaus, C., Puffett, D. and Clayton, A. (1989) *Schoenberg and the new music: Essays by Carl Dahlhaus*. United Kingdom: Cambridge University Press.
- Dascal, M. (2005) The balance of reason, in Vanderveken, D. and Belnap, N. D. in *Logical, Thought and Action*. United States: Springer-Verlag New York.
- De Assis, P. (2013) Experimentation versus Interpretation: Exploring New Paths in Music Performance in the 21st Century, in *Share, Handbook for Artistic Research Education*, Mick Wilson and Shelte van Ruiten. Available at: <http://www.elia-artschools.org/images/products/120/share-handbook-for-artistic-research-education-high-definition.pdf> [accessed: 21 December 2015]
- Deazley, R. (2006) *Rethinking Copyright: History, Theory, Language*. Cheltenham, UK: Edward Elgar Publishing, ISBN 978-1845422820
- Deleuze, G. , Guattari, F. (1980/1998) *Mille Plateaux*, Collection Critique. Editions de Minuit, France.
- Deliège, C. and Deliège-Smismans, I. (2012) *Cinquante ans de modernité Musicale : de Darmstadt à l'IRCAM: contribution historiographique à une musicologie critique*. Liège: Mardaga.
- DeLio, T. (2000) *The Music of Morton Feldman*, The Excelsior Profile Series of American Composers, New York: Excelsior Music Publ. Co. (first edn.), Routledge (new edition).
- Dench, C. (2002) Complexity and Polyphony, in Mahnkopf, C.-S., Cox, F. and Schurig, W. (2002) *Polyphony and complexity*. United States: Wolke Verlag.
- Dimpker, C. (2013) *Extended Notation: The Depiction of the Unconventional*. Germany: Lit Verlag.
- Eco, U. (1984) *The role of the reader: Explorations in the Semiotics of texts* (Advances in Semiotics Ser.). United States: Indiana University Press.

Eco, U., Cancogni, A. and Robey, D. (1989) *The Open Work*. Cambridge, MA: Harvard University Press.

Einstein, A. (1921) *Geometry and experience*, Lecture before the Prussian Academy of Sciences, January 27, 1921.
Available at: <http://pascal.iseg.utl.pt/~ncrato/Math/Einstein.htm>
[Accessed 22 May 2016]

Feisst, S. (2011) *Schoenberg's New World: The American Years*. United States: Oxford University Press.

Feldman, M. (1981) Crippled Symmetry, RES: Anthropology and Aesthetics, No. 2 (Autumn, 1981), pp. 91-103. Published by *The President and Fellows of Harvard College*, available at:
<http://www.jstor.org/stable/20166669>
accessed: [23 May 2016]

Feldman, M. (1983) The Johannesburg Master classes (July 1983, session 1)
In *Morton Feldman Says: Selected Interviews and Lectures 1964-1987* (New Series) Edited by Chris Villars. London: Hyphen Press.
Also available at: <http://www.cnvill.net/mfmasterclasses01.pdf>
[Accessed: 4 July 2015]

_____ (1984) *Darmstadt lecture 1984*, in *Morton Feldman Says: Selected Interviews and Lectures 1964-1987 (New Series)*. Edited by Chris Villars. London: Hyphen Press.
Also available at: <http://www.cnvill.net/mfdarmstadt1984.pdf>
[Accessed: 8 July 2015]

_____ (1985) *Morton Feldman essays*, Edited by W. Zimmerman. Hanover: Frog Peak.

_____ (1988) Between Categories, in Benitez, J. M. *Listening 2 (Contemporary Music Review)*. Edited by J.M. Benitez, J. Kondo, and S. Shono. New York: Harwood Academic (Performing Arts). Available at:
https://books.google.fr/books?id=URAIFLfjszAC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
[Accessed: 29 December 2015]

_____ (1994) Universal Edition brochure, in Griffiths, P. (2010) *Modern music and after*. 3rd edn. United States: Oxford University Press.
Available at: <http://www.cnvill.net/mfgriff.htm>
[Accessed: 5 July 2015]

_____ (2006) *Morton Feldman Says: Selected Interviews and Lectures 1964-1987 (New Series)*. Edited by Chris Villars. London: Hyphen Press.

- Feldman, M. & O'Hara, F. (2000) *Give My Regards to Eighth Street: Collected Writings of Morton Feldman*, Cambridge, MA: Exact Change.
- Ferneyhough, B., Boros, J., Toop, R. foreword Harvey, J. (1995) *Brian Ferneyhough: Collected Writings* (Contemporary Music Studies). 2nd edition. Amsterdam: Harwood Academic Publishers.
- Fisher, J. H., Allen, M. and Chaucer, G. (2011) *The complete poetry and prose of Geoffrey Chaucer*. 3rd edn. Boston: Heinle & Heinle Publishers Inc., U.S.
- Fitch, L. (2013) *Brian Ferneyhough*, Critical Guides to Contemporary Composers. Bristol: Intellect Books.
- Frederickson, J. (Dec. 1989) Technology and Music Performance in the Age of Mechanical Reproduction, *International Review of Aesthetics and Sociology of Music*, Vol.20, No. 2.
- Fox, C. (2006) Lost in music, *The Guardian*, 18 November 2006. Available at: <http://www.theguardian.com/books/2006/nov/18/classicalmusicandopera.music> [Accessed: 13 December 2015]
- Gann, K. (1995/2006) *The Music of Conlon Nancarrow* (Music in the Twentieth Century). Cambridge, UK: Cambridge University Press
- Ghent, E. (1967) Programmed Signals to Performers: A new Compositional Resource, *Perspectives of New Music*, Vol. 6, No. 1.
- Giovannelli, A. (2005) *Goodman's aesthetics*. Available at: <http://plato.stanford.edu/entries/goodman-aesthetics/> [Accessed: 1 January 2016]
- Goehr, L. (1994) *The Imaginary Museum of Musical Works: An Essay in the Philosophy of Music*. Oxford: Oxford University Press, USA.
- Goodman, N. (1976) *Languages of Art: An Approach to a Theory of Symbols*. 2nd edn. Indianapolis: Hackett Publishing Company.
- Gould, E. (2015) *Behind Bars: the Definitive Guide to Music Notation*. UK, Faber Music.
- Grant, I. H. (2008) *On an Artificial Earth: Philosophies of Nature After Schelling*. London: Continuum International Publishing Group.
- Hanninen D. A. (1999) Feldman, Analysis, Experience, *twentieth century music*, 1, pp. 225–251. doi: 10.1017/S1478572205000137
- Harnoncourt, N. (1988) *Baroque Music Today: Music as Speech, Ways to a New*

Understanding of Music - Portland, OR: Amadeus Press.

Harley, J. (2010) *Xenakis: His life in music*. New York: Routledge.

Harris, M. and Harris, R. (1987) *Reading Saussure*. United States: Open Court Publishing Co, U.S.

Heidegger, M. and Hertz, P. D. (1982) *On the way to language (Unterwegs zur Sprache)*, Vol. 1, 1st edn., San Francisco: HarperCollins Publishers.

Hirs, R. (2009) *Contemporary compositional techniques and Openmusic*, Rozalie Hirs, Bob Gilmore, editors, Musique/Science Series, IRCAM/Delatour, France and Amsterdam School of the Arts, Amsterdam, Netherlands.

Johnson, S. and Johns, J. (2001) *New York Schools of Music and the Visual Arts* (Studies in Contemporary Music and Culture). New York: Routledge.

Kanach, S. (2010) *Performing Xenakis*. United States: Pendragon Press.

Kanno, M. (2007) Prescriptive notation: Limits and challenges, *Contemporary Music Review*, 26(2), p. 231-234.

Kerman, J. (1986) *Contemplating Music: Challenges to Musicology*. Reprint edition. Harvard University Press.

Knockaert, Y. (2004) Systemlessness in Music, in Dunsby, J., Straus, J. N. and Knockaert, Y. (2004) *Order and disorder: music-theoretical strategies in 20th-century music*, Proceedings of the 'International Orpheus Academy for Music Theory 2003', Leuven: Leuven University Press.

Kogan, G. (2010) *Busoni as Pianist* (Eastman Studies in Music). Rochester, NY: University of Rochester Press.

Kostelanetz, R. (2002) *Conversing with Cage*. Routledge. London.
Available at: <http://m.friendfeed-media.com/a22cb5a001c77158dc061b8626ea3b7b1b24abf7>
[Accessed: 21 December 2015]

Kramer, J. (1996) *Postmodern concepts of musical time*, Indiana Theory Review, 17: 2, pp. 21–61. Available at:
<https://scholarworks.iu.edu/dspace/bitstream/handle/2022/3754/KramerPostmodernConceptsV17.pdf?sequence=1>
[Accessed: 31 July 2015]

Lacan, J. and Fink, B. (2007) *Ecrits: The First complete edition in English*. New York: Norton, W. W. & Company.

- Lachenmann, H. (2008) *Musique Concrète Instrumentale*, a conversation and concert with Helmut Lachenmann, Available at: https://slought.org/resources/musique_concrete_instrumentale [Accessed: 3 July 2015]
- Leonhardt, G. (1952) *The Art of Fugue, Bach's Last Harpsichord Work: An Argument*, Martinus Nijhoff, The Hague.
- Lyotard, J.-F. (1979) *La Condition Postmoderne. Rapport sur le savoir (Collection Critique)*. Paris: Editions de Minuit, France.
- MacDonald, H. (2007) *Berlioz's Orchestration Treatise, a Translation and Commentary*, Cambridge University Press, originally: *Le Chef d'Orchestre, Théorie de son Art*, extrait du *Grand Traité d'instrumentation et d'orchestration Modernes* (1855).
- Mahnkopf, C.-S., Cox, F., Schurig, W. & Dovern, W. (2002) *Polyphony and Complexity*. United States: Wolke Verlag.
-
- _____ (2008) *Facets of the second modernity*. 1st edition. Hofheim: Wolke Verlag.
- Malt, M. (2000) Brian Ferneyhough et l'aide informatique à l'écriture, in Szendy, P. (2000) *Brian Ferneyhough*. L'Harmattan.
- Malt, M. & Sluchin, B. (2011) L'interprétation assistée par ordinateur, *Le journal de l'association des anciens de Sciences et Musicologie*, Hors Série No. 1, April 2011.
- Mason, B. (2004) *felt | ebb | brink | here | array | telling* (CD booklet) Donaueschinger Musiktage 2004, col legno.
- McLuhan, M. (1964/1994) *Understanding media: The extensions of man*, 1st edn. Cambridge, MA: MIT Press.
- McLuhan, M. and Powers, B. R. (1989) *The Global Village: Transformations in World Life and Media in the 21st Century* (Communication and Society). New York: Oxford University Press, USA.
- Meïmoun, F. (2010) *Entretien avec Pierre Boulez: La naissance d'un compositeur*, Château-Gontier: Aedam Musicae.
- Meyer, F. (1998) *Settling new scores: Music manuscripts from the Paul Sacher foundation*. London: Schott.
- Nicholls, D. (1990) *American Experimental Music (1890-1940)*, Cambridge University Press.

- Noble, A. (2013) *Composing ambiguity: the early music of Morton Feldman*, Burlington. Ashgate Pub Co.
- Nyman, M. (1999) *Experimental Music, Cage and Beyond*, Music in the Twentieth Century, Cambridge University Press.
- Pace, I. (2009) Notation, Time and the Performer's Relationship to the Score in Contemporary Music, in *Unfolding Time: Studies in Temporality in Twentieth-Century Music*, Collected Writings of the Orpheus Institute, edn. Darla Crispin (Leuven: Leuven University Press, 2009), pp. 151-192.
- Patel, S. K. (2013) "Time After Time" a short teaser of an installation by Canan Tolon, Available at: <http://vimeo.com/49699726>
Accessed: 23 May 2016
- Paynter, J. (1993) *Companion to Contemporary Musical Thought*, Vol. 1, London: Routledge.
- Pearl, J. (2014) *Art in America, 1945-1970: Writings From the Age of Abstract Expressionism, Pop Art, and Minimalism*, The library of America.
- Randel, D. M. (edn.) (2003) *The Harvard Dictionary of Music*, Harvard University Press Reference Library, 4th edn. Cambridge, MA: Belknap Press of Harvard University Press.
- _____ (1996) *The Harvard Biographical Dictionary of Music*. Cambridge, MA: Belknap Press of Harvard University Press.
- Reich, S. (1968) Music as a gradual process, in *Writings on Music 1965-2000*, Edited by Paul Hillier. Oxford: Oxford University Press, USA.
- Reynolds, R. (2005) *Mind Models: New Forms of Musical Experience*. 2nd edn. New York, NY: Routledge.
- Robaszkiewick, S. and Schnell, N. (2015) Soundworks – A playground for artists and developers to create collaborative mobile web performances, Available at: <http://architexte.ircam.fr/textes/Robaszkiewicz15a/index.pdf> [Accessed: 22 August 2015]
- Rosen, C. (1998) Freedom of interpretation in 20th-century music, in Thomas, W. *Composition - Performance – Reception: Studies in the Creative Process in Music*. Aldershot, Hants, England: Ashgate Publishing.
- Russell, B. (1919) The Study of Mathematics, in *Mysticism and Logic: And Other Essays*. Longman. Retrieved 2008-08-22.

- _____ (1919) *Introduction to Mathematical Philosophy*, George Allen & Unwin, London, UK. Reprinted, John G. Slater (intro.), Routledge, London, UK, 1993.
- _____ (1903/1996) *The Principles of Mathematics (Reissue)*. 2nd edn. New York: W. W. Norton & Company.
- Schaeffer, P. (1977) *Traité des objets musicaux: Essai interdisciplines*. Paris: Edition du Seuil.
- Schnell, N. (2015a) Cosima@Tangible and Embedded Interfaces 2015, conference held at Stanford University in January 2015. Available at: <http://ismm.ircam.fr/cosima-tei15/#more-1009> [Accessed: 7 August 2015].
- Schnell, N. (2015b) *Soundworks*, Available at: <https://github.com/collective-soundworks/soundworks> [Accessed: 20 August 2015].
- Schoenberg, A. (1922/2010) *Theory of Harmony*, 2nd edn. Berkeley, CA: University of California Press.
- Schoenberg, A. (1950/2010) *Style and Idea: Selected Writings*. Edited by Leonard Stein. 2nd edn. United States: University of California Press.
- Seeger, C. (1958) Prescriptive and descriptive music-writing, *The Music Quarterly*, Vol. 44, No. 2 (April 1958), page 184-195.
- Shakespeare, W., Mowat, B. A. and Westervelt, P. (2004) *As you like it (Folger Shakespeare library)*, New York: Washington Square Press.
- Sloboda, J. (2005) The Psychology of Music Reading, *Exploring the Musical Mind: Cognition, Emotion, Ability, Function*. 1st edition. Oxford: Oxford University Press.
- Sluchin, B. & Malt, M. (2010a) Interpretation and Computer Assistance in John Cage's Concert for Piano and Orchestra (1957-1958), 7th Sound and Music Computing Conference Proceedings, Barcelona.
- _____ (2010b) A computer Aided Interpretation Interface for John Cage's Number Piece Two⁵, Actes des Journées d'Informatique Musicale (JIM 2012, 9-11 mai 2011, Mons Belgium).
- _____ (2014a) Théorie des jeux et structure formelle dans *Duel* (1959) et *Stratégie*(1962), A Computer Aided Performance for the realisation of Xenakis orchestral works, Centre de Documentation de Musique Contemporaine, Nov. 2014.

-
- _____ (2014b) John Cage Solo for sliding trombone, a Computer-Assisted Performance Approach, NIME 2014 (New Interfaces for Musical Expression) Interactive Music Notation and Representation, Goldsmiths, University of London, June 2014.
- Steadman, P. (2002) *Vermeer's Camera: Uncovering the Truth Behind the Masterpieces*. United Kingdom: Oxford University Press.
- Stravinsky & Craft, R. (1967) *Conversations with Igor Stravinsky*, Garden City, N. Y., 1959. See also David Hamilton, "Stravinsky and the microphone," in *High Fidelity*, XVII/9 (June 1967), p. 59-60.
- Szendy, P. (1998) *Emmanuel Nuñez, textes réunis par Peter Szendy*, IRCAM-L'Harmattan, Paris.
- _____ (1999) *Brian Ferneyhough, textes réunis par Peter Szendy*, IRCAM-L'Harmattan, Paris.
- Thompson, O. (1975) *The International Cyclopedia of Music and Musicians*, 10th edn. Dodd, Mead.
- Ulman, E. (1994) Some Thoughts on the New Complexity, in *Perspectives of New Music*, Vol. 32 No. 1, pp. 202-206, (Winter 1994)
doi: 10.2307/833163.
Available at: <http://hutchies.host-ed.me/ferneyhough/ulman.pdf>
[Accessed: 25 August 2015]
- Valéry, P. (1928) La conquête de l'ubiquité, in *Oeuvres, tome II, Pièces sur l'art*, Nrf, Gallimard, Bibl. de la Pléiade, 1960, p. 1283-1287. Paru dans *De la musique avant toute chose*, Editions du tambourinaire, 1928.
- Vicentino, N. (1555) *L'antica Musica Ridotta Alla Moderna Prattica, Terzo Libro, Della Pratica*, (page 48, page 66 in the *fac-simile*), available at: http://petrucci.mus.auth.gr/imglnks/usimg/9/94/IMSLP114662-PMLP210243-lantica_musica.pdf [Accessed: 5 July 2015]
- Weeks, J. (2012) Exaudi 2012/The residency – days 3 and 4, Available at: <http://exaudi2012.wordpress.com/2012/05/04/the-residency-days-3-and-4/> [Accessed 29-12-2015]
- Whittall, A. (1999) *Musical Composition in the Twentieth Century*. New York: Oxford University Press, USA.
- Windsor, L. (1996) Autonomy, Mimesis and Mechanical Reproduction in Contemporary Music, in *A Poetry of Reality: Composing with Recorded Sound, Contemporary Music Review*, Vol. 15, Parts 1-2. Taylor and Francis (formerly published by Gordon and Breach/Harwood) issue editor Katherine Norman.

- Wishart, T. (1985) Beyond Notation, *British Journal of Music Education*, 2(03), p. 311. doi: 10.1017/s0265051700000668.
- _____ (1996) *On Sonic Art*. Editor: Simon Emmerson. 2nd edn. New York: Routledge.
- _____ (1996) *The Aesthetics of composition in a digital age*, Editor: Simon Emmerson, Publisher: Psychology Press.
- Wyse, L. and Whalley, I. (2014) Editorial, in *Organised Sound*, 19(03), pp. 213–214. doi: 10.1017/S1355771814000193
- Xenakis, I. and Kanach, S. (2001) *Formalized music: Thought and mathematics in composition* (Harmonologia series, no 6). United States: Pendragon Press.
- Zimmermann, M. (2001) *Auctor et auctoritas: Invention et conformisme dans l'écriture médiévale: Actes du colloque tenu à l'Université de Versailles-Saint-Quentin-en-Yvelines, 14-16 juin 1999*. Paris: École des chartes.
- Zimmermann, W. (1976) Conversation Between Morton Feldman and Walter Zimmermann, in *Desert plants: Conversations with 23 American musicians*. Vancouver, B.C.: Zimmermann, Aesthetic Research Centre of Canada Publications.
Available at: <http://www.cnvill.net/mfzimmr.htm>
[Accessed: 1 January 2016]

2 Scores and recordings

Adès, T. (2008) *In Seven Days*, for piano and orchestra, commissioned by the Southbank Centre and the Los Angeles Philharmonic, Fabermusic. Available at: <http://www.fabermusic.com/repertoire/in-seven-days-148> [Accessed: 26 August 2015]

Amirkhanian, C. (1986) Morton Feldman interviewed at the Exploratorium Speaking of Music in San Francisco, January 30, Other Minds audio archive. Available at: <https://archive.org/details/MFeldmanSOM> [accessed: 4 January 2016]

Bailie, J. (2011-12) *Harmonizing (Artificial Environment No.7)*, for voices and tape. 2 sop, 2 alt, ten, bass, written for EXAUDI. Available at: http://joannabailie.com/files/9614/1901/0118/Harmonizing_revised_complete.pdf [Accessed: 6 July 2015]

Berio, L. (1966/2005) *Sequenza III: per voce femminile*. Vienna: Universal Edition. Available at: <http://www.universaledition.com/Luciano-Berio/composers-and-works/composer/54/work/4597> [Accessed: 13 August 2015]

_____ (1968/2011) *Sinfonia for eight voices and orchestra*, Wien: Universal Edition. Available at: <http://www.universaledition.com/Luciano-Berio/composers-and-works/composer/54/work/4672> [Accessed: 13 August 2015]

Boucourechliev, A. (1970) *Archipel IV*, Alphonse Leduc, Paris.

Boulez, P. (1957) *Troisième Sonate, Formant 3, Constellation-Miroir*, for piano, edited by Robert Piencikowski (2003), Vienna, Universal Edition.

Cage, J. (1958) *Concert for Piano and Orchestra*, Edition Peters, Available at: [http://www.edition-peters.com/product/modern/concert-for-piano-and-orchestra-\(conductor\)/ep6705n?TRE00000/](http://www.edition-peters.com/product/modern/concert-for-piano-and-orchestra-(conductor)/ep6705n?TRE00000/) [Accessed: 11 August 2015]

_____ (1966) *John Cage and Morton Feldman In Conversation*, Radio Happenings, recorded at WBAI, New York City, July 1966 – January 1967. Available at: <https://archive.org/details/CageFeldman5> [accessed: 4 January 2016]

_____ (1974-75) *Etudes Australes I – IV*, for piano, Edition Peters, available at: [http://www.edition-peters.com/product/modern/etudes-australes-\(books-i-and-ii\)/st10681?TRE00000/](http://www.edition-peters.com/product/modern/etudes-australes-(books-i-and-ii)/st10681?TRE00000/)

[Accessed: 11 August 2015]

_____ (1978) *Etudes Boreales I – IV*, for cello and/or piano, Edition Peters. Available at: https://www.edition-peters.de/cms/deutsch/general/produkt.html?product_id=EP66327
[Accessed: 11 August 2015]

_____ (1989-90) *Freeman Etudes*, for solo violin, Edition Peters. Available at: <http://www.edition-peters.com/product/modern/freeman-etudes/st15162?TRE00000/>
[Accessed: 11 August 2015]

Carter, E. (1959-1961) *Double Concerto*, for Harpsichord, Piano and two Chamber Orchestras, G. Schirmer & Associated Music Publishers Inc, N.Y.C.

_____ (1971) *String Quartet No. 3*, G. Schirmer & Associated Music Publishers Inc. N.Y.C.

_____ (1986a) *8 Pieces for 4 Timpani* (1966), G. Schirmer & Associated Music Publishers Inc., N.Y.C.

_____ (1986b) *Variations for Orchestra (1954-1955)*. G. Schirmer & Associated Music Publishers Inc., N.Y.C.

Carver, A. F. (1988) *Cori Spezzati: An Anthology of sacred polychoral Music, No. 2*, Cambridge University Press, 1988.

Cassidy, A. (2004) *The Crutch of Memory*, score extract available at: <http://aaroncassidy.com/music/crutchofmemory.htm>
[Accessed: 5 May 2015]

_____ (2007) *I, purples, spat blood, laugh of beautiful lips*. For solo voice, with live computer-generated pitch material, score extract available at: <http://aaroncassidy.com/music/purples.htm>
[Accessed: 5 May 2015]

Collins, D. (edn.) (2012) *The act of musical composition: Studies in the creative process*. United Kingdom: Ashgate Publishing.

Cowell, H. (1915-1917) *Quartet Romantic*, for 2 flutes, violin and viola, Rhythm-Harmony Quartets, Peters Editions.

Feldman, M. (1977) *Piano*, Vienna: Universal Ed. Available at: <http://www.universaledition.com/Piano-Morton-Feldman/composers-and-works/composer/220/work/4165>
[Accessed: 31 July 2015]

-
- (1981) *Triadic Memories*, for piano solo. London: Universal Ed. Available at: <http://www.universaledition.com/Morton-Feldman/composers-and-works/composer/220/work/5426>.
-
- (1985) *Piano and String Quartet*, Dedicated to Aki Takahashi and the Kronos Quartet, Vienna. Universal Edition. Available at: <http://www.universaledition.com/Piano-String-Quartet-Morton-Feldman/composers-and-works/composer/220/work/4167> [Accessed: 31 July 2015]
-
- (1986) *Coptic Light*, for orchestra. Vienna: Universal Edition Available at: <http://www.universaledition.com/Coptic-Light-Morton-Feldman/composers-and-works/composer/220/work/1739> [Accessed: 31 July 2015]
-
- (1987) *Piano, Violin, Viola, Cello*. Universal Edition. Vienna. Available at: <http://www.universaledition.com/Morton-Feldman/composers-and-works/composer/220/work/4187> [Accessed: 13 August 2015]
- Ferneyhough, B. (1973-76) *Time and Motion Study II*, for solo cello and delay tapes. Peters Editions, London. Available at: <http://www.edition-peters.com/product/modern/time-and-motion-study-ii/ep7223?TRE00000/> [Accessed: 15 August 2015]
-
- (1975-6) *Unity Capsule*, for solo flute. Peters Editions, London. Available at: <http://www.edition-peters.com/product/modern/unity-capsule/ep7144?TRE00000/> [Accessed: 15 August 2015]
-
- (1979) *La Terre est un Homme*, for orchestra, Edition Peters, London. Available at: <http://www.edition-peters.com/product/modern/la-terre-est-un-homme/ep7225?TRE00000/> [Accessed: 5 July 2015]
-
- (1982) *Carceri d'Invenzione (I)*, for Fl (Picc), Ob (Ca, Tgl II), Cl (ClEb), B-cl, Bsn (C.) Peters Editions, London. Available at: <http://www.edition-peters.com/product/modern/carceri-dinvenzione-i/ep7291?TRE00000/> [Accessed: 15 August 2015]
-
- (1985) *Carceri d'Invenzione (II)*, for Fl Solo, 02(EH), 2(Eb,Bcl)1 0200 Str(8-2-2-1) Peters Editions, London. Available at: <http://www.edition-peters.com/product/modern/carceri-dinvenzione-ii/ep7292?TRE00000/> [Accessed: 15 August 2015]

-
- _____ (1985) *Carceri d'Invenzione (III)*, for 2Fl (I=Picc, II=Picc, A-fl), 2Ob (II=Ca), 2Cl (II=C Peters Editions, London. Available at: <http://www.edition-peters.com/product/modern/carceri-dinvenzione-iii/ep7293?TRE00000/> [Accessed: 15 August 2015]
-
- _____ (1990) *Mort Subite*, for Piccolo, Clarinet, Vibraphone and Piano. Peters Editions, London. Available at: <http://www.edition-peters.com/product/modern/mort-subite/ep7425?TRE00000/> [Accessed: 15 August 2015]
- Fox, C. (2001) *Shadow Cast*, for 6 violins, 2 violas, 2 celli and double bass. Commissioned by the Goldberg Ensemble, premiered at Royal Northern College of Music, Manchester, February 2002.
- Gervasoni, S. (2013) *Dir – In dir*, for vocal sextet and string sextet, Recorded by EXAUDI and L'Instant Donné, Winter and Winter (Label).
- Gesualdo, C. (1594-1611) *Fifth Book of Madrigals*, Publisher: VEB Deutscher Verlag. Available at: http://petrucci.mus.auth.gr/imglnks/usimg/8/8f/IMSLP18136-Gesualdo_-_Madrigals_book_5__edition_weissmann_.pdf [Accessed: 22 September 2015]
-
- _____ (1594-1611) *Sixth Book of Madrigals*, Publisher: Hans-Jörg Rechtsteiner. Available at: http://petrucci.mus.auth.gr/imglnks/usimg/e/e8/IMSLP356504-PMLP164752-Gesualdo__Carlo._Madrigals__Book_6.pdf [Accessed: 4 January 2016]
- Ghent, E. (1985) *Dithyrambos*, for brass quintet, (1967) Edition Peters. Available at: [http://www.edition-peters.com/product/OUP/dithyrambos-\[quintet-version\]/9780193371507?TRE00000/](http://www.edition-peters.com/product/OUP/dithyrambos-[quintet-version]/9780193371507?TRE00000/) [Accessed: 31 July 2015]
- Grisey, G. (1975) *Partiels*, for 18 musicians, part of 'Les espaces acoustiques', Ricordi. Available at: <http://www.ricordi.it/catalogue/products/partiels-2/> [Accessed: 31 July 2015]
- Hanson, M. M. (1981) *O Bonne Douce Franse, En Ablion de Fluns* (both anonymous), in French Secular Music of the Fourteenth Century, Codex Chantilly. Editions de L'oiseau-Lyre, Les Remparts, Monaco. Nowadays available at Lyrebird Press, University of Melbourne.
- Iddon, M. (2010) *Ἀμαδρυάδες (hamadryads)*, For five voices and glass harmonica, Composers Edition, Leeds. Available at:

<http://composersedition.com/composers/martiniddon/ce-mi1h1>
[Accessed: 31 July 2015]

Kagel, M. (1962/64) *Prima Vista*, for dispositive and sound sources,
Universal Edition, Vienna.
<http://www.universaledition.com/Prima-Vista-Mauricio-Kagel/composers-and-works/composer/349/work/4273>
[Accessed: 31 July 2015]

Kondo, J. (1984) *Hunisucle*, for orchestra, University of York Music Press
Available at: <http://www.uymp.co.uk/works/jo-kondo-hunisucle-194>
[Accessed: 29 June 2015]

Mason, Benedict (1992) *Animals and the Origins of the Dance*, for 21 players,
Commissioned by the Westdeutscher Rundfunk, Köln, Chester Music
Ltd. Available at:
<http://www.musicsalesclassical.com/composer/work/1008/8133>

_____ (2004) *felt|ebb|thus|brink|here|array|telling*, for 48 performers,
Ensemble Modern, Junge Deutsche Philharmonie, Franck Ollu
(conductor), Donaueschinger, Musiktage 2004, SACD Col Legno, 2005.

Mazulis, R. (2001) *Cum essem parvulum*, for 8 voices (2S-2T-2A-2B).
Available at: <http://www.mic.lt/en/database/classical/composers/mazulis/>
[Accessed: 15 January 2016]

_____ (2002) *Ajapajapam* for 12 voices and string quartet, premiered by
Latvian Radio Chamber Singers.
Available at: <http://mic.lt/en/database/classical/library/16818/>
[Accessed: 28 June 2015]

_____ (2006) *Form is Emptiness*, for 12 voices, cello and tape.
Available at: <http://www.mic.lt/en/database/classical/composers/mazulis/>
[Accessed: 15 January 2016]

_____ (2008) *Canon Fluxus*, for flute, clarinet, 2 violins, viola, cello and
piano. Available at:
<http://www.mic.lt/en/database/classical/composers/mazulis/>
[Accessed: 15 January 2016]

_____ (2009) *Puja*, for 2 pianos, vibraphone and marimba. Available at:
<http://www.mic.lt/en/database/classical/composers/mazulis/>
[Accessed: 15 January 2016]

_____ (2009) *Schisma*, for 14 flutes. Available at:
<http://www.mic.lt/en/database/classical/composers/mazulis/>
[Accessed: 15 January 2016]

- _____ (2010) *Non in Commotione*, for flute, clarinet, oboe, horn, bassoon.
Available at:
<http://www.mic.lt/en/database/classical/composers/mazulis/>
[Accessed: 15 January 2016]
- _____ (2011) *Telescope*, for 12 voices (3S-3A-3T-3B).
Available at:
<http://www.mic.lt/en/database/classical/composers/mazulis/>
[Accessed: 15 January 2016]
- Nancarrow, C. (1969) *Study No. 37*, for player piano, Vol. 3, ED 7685,
ISMN: 979-0-001-08002-6 Schott Music, Mainz, Germany.
Available at: <http://www.schott-music.com/shop/1/show,38200.html>
[Accessed: 28 June 2015]
- _____ (1998) *Piano Studies Nos. 6 and 7*, arr. for two pianos,
Thomas Adès, Schott, Mainz, Germany.
<http://www.schott-music.com/shop/1/show,223338.html>
[Accessed: 31 July 2015]
- Nuñez, E. (1988-1991) *Lichtung I*, for 9 instrumentalists and live
electronics. Premiered by Ensemble Intercontemporain, Réalisateur en
informatique musicale: Eric Daubresse. Commissioned by IRCAM Centre
Pompidou, Publisher: Ricordi, Munich.
Available at: <http://www.ricordi.de/de-DE/Composers/N/Nunes-Emmanuel.aspx>
[Accessed: 31 July 2015]
- Palme, P. (2012) *Cantu Foliato*, performed by EXAUDI, direction James
Weeks, Huddersfield.
Available at: <http://piapalme.at/works/cantu-foliato-2012/>
[Accessed: 5 July 2015]
- Schumann, R. (1840) *Dichterliebe*, Edition Peters, London. Available at:
<http://www.edition-peters.com/product/dichterliebe-op-48/q9537?TRE00000/>
[Accessed: 5 July 2015]
- Shere, C. (1967) Interview with Morton Feldman, (July 1, 1967), KPFA,
Berkeley, Other Minds Audio Archives.
Available at: <https://archive.org/details/MortonFeldmanInterview1967>
[Accessed: 5 July 2015]
- Stockhausen, K. (1956/2002) *Klavierstücke XI*, for piano, 9th edition (2002),
London: Universal Edition. Available at:
<http://www.universaledition.com/Klavierstueck-11-Nr-7-for-piano-Karlheinz-Stockhausen/composers-and-works/composer/698/work/3084>
[Accessed: 31 July 2015]

- _____ (1958-60) *Kontakte*, for Piano, Percussion and electronic sounds, Stockhausen-Verlag: Work N°12. Available at:
http://www.stockhausen-verlag.com/Verlag_Edition_Scores_Publications.htm
[Accessed: 31 July 2015]
- _____ (1955-57) *Gruppen*, for 3 orchestras
London: Universal Edition. Available at:
<http://www.universaledition.com/Karlheinz-Stockhausen/composers-and-works/composer/698/work/2695>
[Accessed: 18 August 2015]
- _____ (1959-60) *Carré*, for 4 orchestras and 4 choirs, 9th edn. (2002), London: Universal Edition. Available at:
<http://www.universaledition.com/Carre-Nr-10-for-4-orchestras-4-choirs-4-conductors-Karlheinz-Stockhausen/composers-and-works/composer/698/work/1521>
[Accessed: 18 August 2015]
- _____ (1962-69) *Momente*, for 4 choir groups and 13 instrumentalists. Original Score. Available at: http://www.stockhausen-verlag.com/Verlag_Edition_Scores_Publications.htm
[Accessed: 11 January 2016]
- Strauss, R. (1948-49) *Vier letzte Lieder (Four Last Songs)*, Arranger/Publisher: John Gribben, Creative Commons Attribution (IMSLP). Available at:
[http://imslp.org/wiki/4_Letzte_Lieder,_TrV_296_\(Strauss,_Richard\)](http://imslp.org/wiki/4_Letzte_Lieder,_TrV_296_(Strauss,_Richard))
[Accessed: 31 July 2015]
- Tallis, T. (1966) *Spem in alium nunquam habui: motet in forty parts*. Edited by Philip Brett. London: Oxford University Press, USA
Available at:
http://conquest.imslp.info/files/imglnks/usimg/a/af/IMSLP30201-PMLP66937-Tallis_Spem_in_alium_full_score_PML.pdf
[Accessed: 31 July 2015]
- Tajuddin, T. (2006) *Selindung Warna*, for solo Violin, premiered by David Alberman. Publisher: Babelscore, Paris.
Available at: <http://www.babelscores.com/en/catalog/instrumental-music/solo-instrument/selindung-warna-2>
[Accessed: 31 July 2015]
- Wandelweiser und so weiter (2012) 6-disc box set featuring music by composers in or around the Wandelweiser collective, including Sam Sfirri, Jurg Frey, Antoine Beuger, Taylan Susam, Michael Pisaro, Radu Malfatti, Eva-Maria Houben, John Cage, James Saunders, realised on the label *Another*

Timbre, Sheffield. Available at:
<http://www.anothertimbre.com/page145.html>
[Accessed: 21 August 2015]

Webern, A. (1929) *Symphonie opus 21*, Universal Edition, Wien: Philharmonia
Available at: <http://www.universaledition.com/Anton-Webern/composers-and-works/composer/762/work/5131>
[Accessed: 31 July 2015]

Weeks, J. (2011) *Inscription*, for vocal quartet and string quartet. Text:
Fernando Pessoa, performed by EXAUDI and Endymion at Sound
Festival, St Marchar's Cathedral, Aberdeen, Scotland,
12th November 2011. Text available at: <http://jamesweeks.org/inscription>
[Accessed: 31 July 2015]

Werder, M. (2008) *Found Sentences*, Available at:
<http://foundsentences.blogspot.fr> [Accessed: 31 July 2015]

Xenakis, I. (1959) *Duel*, for 59 musicians, Durand-Salabert-Eschig, MC 554
Available at: http://www.durand-salabert-eschig.com/formcat/catalogues/xenakis_iannis.pdf
[Accessed: 25 September 2015]

_____ (1962) *Stratégie*, for 82 musicians, Boosey & Hawkes,
Available at:
<http://www.boosey.com/cr/music/lannis-Xenakis-Strategie/3260>
[Accessed: 25 September 2015]

_____ (1968) *Nuits*, for twelve voices, EAS 17045,
Editions Salabert, France. Available at:
<http://www.boosey.com/shop/prod/Xenakis-lannis-Nuits/2094010>
[Accessed: 31 July 2015]

_____ (1969) *Persephassa* for six percussionists, MC539, Edition
Salabert, Paris. SLB 4469 Available at:
[http://www.durandsalaberteschig.com/english/search.php?formsubmit=go
&search_string=xenakis&search_where=3&detail_cat=cat](http://www.durandsalaberteschig.com/english/search.php?formsubmit=go&search_string=xenakis&search_where=3&detail_cat=cat)
[Accessed: 31 July 2015]

_____ (1973) *Evryali*, for piano, Editions Salabert, France.
SLB1823, EAS 17492 Available at:
[http://www.durandsalaberteschig.com/english/search.php?formsubmit=go
&search_string=xenakis&search_where=3&detail_cat=cat](http://www.durandsalaberteschig.com/english/search.php?formsubmit=go&search_string=xenakis&search_where=3&detail_cat=cat)
[Accessed: 31 July 2015]

3 References of borrowed audio material:

I. *Etude de Synchronisation* (2011)

Baker, Richard *Aria Infuriata* for English Horn, Harp, Viola and Tenor (1998)
0:02-0:12 is used bars 108-124, bars 139-140, 209-227

Bell, Jonathan *Quatre Secondes*, for Piano and Tape (2004)
Performer: Jonathan Bell
Several extracts of this piece are used in the piano solo, bars 200-209

Berio, Luciano *Sequenza II* for Solo Harp (1963)
Performer: Yinuo Mu (2002)
2:39 is used bar 8, bars 47-50, bar 84, bar 88 (slower) and bar 92.
2:43 is used bar 12, bar 22, bar 40 (slower), bar 86, bar 91.
http://www.youtube.com/watch?v=YK7Dt_gkWhg
[Accessed: 25 July 2012]

Berio, Luciano *Sequenza IV* for Solo Piano (1963)
Performer: Jocy de Corvalho(1966)
0:31-0:32 is used bar 10,13, 25-26
0:34-0:35 is used bar 14 and bars 27-28
<http://www.youtube.com/watch?v=uJqRvP6SU9c>
[Accessed: 25 July 2012]

Berio, Luciano *Sequenza IXb* for Alto Saxophone (1981)
Performer: Doug O'Connor (2009)
1:30 is used bars 16-18 and bars 30-32
1:45 is used bars 22-24
<http://www.youtube.com/watch?v=3G3nzwKmE6w&feature=relmfu>
[Accessed: 25 July 2012]

Ferneyhough, Brian *Time and Motion Study I* for solo bass clarinet (1977)
Performer: Carl Rosman
3:06-3:08 is used bar 32
6:21 is used bar 37-39
6:33-6:40 is used
6:40-6:45 is used bars 146-150
6:48 is used bar 30
6:51-6:55 is used bars 75-78
7:00-7:03 is used bar 30-31
<http://www.youtube.com/watch?v=ATV8-i21HBs>
[Accessed: 25 July 2012]

Ferneyhough, Brian *Unity Capsule* (1975-1976)
Performer: Kolbeinn Bjarnson
5:45-5:51 was used bar 179-182
5:51-5:56 was used bar 169-170
6:37 was used bar 246, 250 and 254
6:43-44 was used bar 176 (at the end of the bar)
7:39-7:42 was used bars 177-178
7:42-7:44 was used bars 173-174
7:49-7:50 was used bars 182-183

<http://www.youtube.com/watch?v=Y71cx8Vj15Q>
[Accessed: 28 July 2012]

Giuliano, Giuseppe (1987) *Tempi Della Mente* for saxophone.
Performer: Daniel Kientzy
0:32-0:46 is used bars 1-24 (repeated 4 times) in violin, cello, clarinet, double bass.
http://www.youtube.com/watch?v=CO_94Ejax88
[Accessed: 29 July 2012]

Harrison, Bryn (2008) *Quietly Rising* for Piano.
Performer: not specified (2011)
0:00-0:05 is used bars 101-107
0:00-0:02 is used bar 197 (slower)
http://www.youtube.com/watch?v=xzDQGh9m_Xk
[Accessed: 25 July 2012]

Kurtag, Gyorgy (1960) *8 Pieces op. 3* for Piano.
Performer: I-Ting Wen
3:15-3:20 is used bars 30, 32 and 38
<http://www.youtube.com/watch?v=wSfbD3izkdE>
[Accessed: 25 July 2012]

Scelsi, Giacinto (1953) *Quattro Illustrazioni*, IV Krishna-Avatara for Piano.
Performer: not specified (uploaded in 2009)
0:00-0:15 is used bars 237-241
<http://www.youtube.com/watch?v=SsD9rG9BOGs&feature=fwrel>
[Accessed: 25 July 2012]

Muldowney, Dominic (1983) *Piano Concerto*.
The opening (0:00-0:29) of the piano Cadenza was used bars 84-96.
<http://open.spotify.com/local/Dominic+Muldowney+-+Piano+Concerto/Saxophone+Concerto/Cadenza/205>
[Accessed: 11 August 2015]

Sciarrino, Salvatore (1974-75) *Tre Notturmi Brillanti*
Performer: Garth Knox
1:44-1:49 was used bar 49
5:55-6:00 was used bar 259 (processed with reverb)
<http://www.youtube.com/watch?v=2W08KeQAwYE>
[Accessed: 25 July 2012]

Schoenberg, Arnold (1909) *Klavier Stucke op. 11 n^o3*.
Performer: Maurizio Pollini
0:18-0:22 is used bars 78-80
0:27-0:29 is used bars 81-82
1:33-1:35 is used bar 28, bars 77-78, 83-84
<http://www.youtube.com/watch?v=8vHNcNrojDM>
[Accessed: 25 July 2012]

Schoenberg, Arnold (1912) *Pierrot Lunaire, op. 21*
Performer: Pierre Boulez
0:02-0:04 is used bars 184-188
<http://www.youtube.com/watch?v=veUJxETj7-c>
[Accessed: 25 July 2012]

Suarez Cifuentes, Marco Antonio (2007) *Máquina Mística*, for Double Bass and Live Electronics. Performer: Nicolas Crosse
Extracts of this piece are mainly used when saxophone and double bass play in duo. (bars 40-41, 58-60, 83, 89, 168-169, 200-201)
<http://www.babelscores.com/catalog/musica-mixta/solista-instrumental-o-vocal-medios-electroacusticos-en-tiempo-real/maquina-mistica>
[Accessed: 29 July 2012]

II. *Body Factory* (2012)

Artaud, Antonin (1946) *Aliénation et magie noire*
4:57-5:05 is used in the tape at 2:28 and 2:35
<http://www.youtube.com/watch?v=fOXDRBofKN0>
[Accessed: 29 July 2012]

Baker, Richard (2004) *Angelus, Three Strange Angels*
Performers: Benjafeld/Brannick
0:00 was used at 4:26
<http://www.soundandmusic.org/thecollection/node/124642>
[Accessed: 29 July 2012]

Beckett, Samuel (1972) *Not I*
2:10 is used at 5:35
5:28-5:35 is used 3:36-3:43
<http://www.youtube.com/watch?v=l8C4HL2LyWU>
[Accessed: 29 July 2012]

Beckett, Samuel (1962) *Play*
1:39-1:43 is sampled in the tape at 2:08
<http://www.youtube.com/watch?v=NiEtsVPpjyM&feature=related>
[Accessed: 29 July 2012]

Beckett, Samuel (1981) *Quad I + II*
fragments of drumming are used at 2:40-2:46
<http://www.youtube.com/watch?v=xBxrtI2qeVk>
[Accessed: 29 July 2012]

Berberian, Cathy (1966) *Stripsody*
Performer: Cathy Berberian
Although it is not properly quoted, this piece was, with *Sequenza III* by Berio, a major source of material during the rehearsal process with the singer.
<http://www.youtube.com/watch?v=XHUQFGhXHCw&feature=related>
[Accessed: 29 July 2012]

Berio, Luciano (1965) *Sequenza III* for voice, Performer Cathy Berberian
6:44-6:48 was processed and imitated by the singer for the ending (from 5:20 onwards)
<http://www.youtube.com/watch?v=DGOvCafPQAE>
[Accessed: 29 July 2012]

Duparc, Henri (1870) *L'invitation au voyage*, for voice and piano.
Poem by Charles Baudelaire, *Les Fleurs du Mal* (1857)

The singer uses this melody from 13:36 (July 2012 performances only)

Rihm, Wolfgang (1990) *Quo Me Rapis*, for two choirs or eight singers

Performer: EXAUDI (direction James Weeks)

1:31-1:35 is used in the tape at 2:11, 2:20 and 2:29.

Schütz, Heinrich (1639) *O Jesu Nomen Dulce*

Performer: Andreas Scholl

The beginning of the recording is used at 1:45 (December 2011 performances only)

<http://www.youtube.com/watch?v=0TkRXQH5np8>

[Accessed: 29 July 2012]

Victoria, Tomas Luis (1572) *O Magnum Mysterium*

0:00-0:19 is used in the beginning until 1:45

0:36 is used at 3:51

<http://www.youtube.com/watch?v=zeKvNxYMDxE&feature=related>

[Accessed: 29 July 2012]

III. *The Wanderer* (2013)

Tajuddin, Tazul (2006) *Selindung Warna*, for solo violin, performed by David Alberman

The recording was used as material for Bars 11, 13, and 323-357.

<http://www.babelscores.com/en/catalog/instrumental-music/solo-instrument/selindung-warna>

[Accessed: 19 June 2014-06-28]

Benjamin, George (1982) *Meditation on Haydn's Name*, for piano

The opening from *Meditations* the piece is quoted in *The Wanderer*, 426-7 429-430

<https://www.youtube.com/watch?v=L3-bkBA2CYc>

[Accessed: 19 June 2014-06-28]

Feldman, Morton (1986) *Palai de Mari*, for piano.

Bars 18-22 are quoted in *The Wanderer*, bar 426 and 429-432.

<https://www.youtube.com/watch?v=RfKLia5CEDY>

[Accessed: 19 June 2014-06-28]

Appendix 1: List of submitted works

1. *Three Painted Walls and a Marble Ground* (DVD 1 Track 1)

Available at <http://jonathanbell.eu/three-painted-walls-and-a-marbled-ground>

Performers: Benjamin Graves, Max Mausen, William Newell, Yoanna Prodanova

Creation: March 2014, Parasol Unit art gallery, London

2. *Percussion Quartet* (DVD1 Track 2)

Available at: <https://dl.dropbox.com/u/40502174/ScansA3.pdf>

Recording: <http://soundcloud.com/jonathanbell-3/percussion-quartet>

Performers: Ellie Duris, Felicity Hindle, Taichi Imanishi, Katrina Pett.

Creation: May 2011, Guildhall School of Music and Drama, London

3. *Etude de Synchronisation* (CD1 Track 1)

Available at: <http://jonathanbell.eu/etude-de-synchronisation>

Performers: Zafraan Ensemble, direction Emile Jouette

Creation: 4 October 2011, Konzerthaus Berlin

4. *Body Factory* (DVD1 Track 3)

Available at: <http://jonathanbell.eu/body-factory>

Musicians: Alexia Pingaud, Jonathan Bell

Choreographer: Mansoor Ali

Dancers: Elliot Smith, Bridget Lappin, Julie Schmidt Andreassen, Rickard

Fredborg, Ellen Nous, Emily Crouch

Creation: 15 November 2011, The Place, Robin Howard Theatre, London

5. *Lasciato Hai Morte* (CD 1 Track 2)

Available at: <http://jonathanbell.eu/lasciato-hai-morte>

Performers: *De Caelis* Ensemble

Creation: September 2011, Musée de Cluny, Paris

6. *Fives Pieces for Voices and Electronics* (CD1 Track 3-7)

Available at: <http://jonathanbell.eu/five-pieces>

Performers: *De Caelis* Ensemble

Creation: April 2012, *Maison de la Radio* (Radio France), Paris.

7. *Flute Guitar and Piano* (DVD 1, track 4)

Available at: <http://jonathanbell.eu/flute-guitar-and-piano>

Instrumentalists: Chiawen Kiew, Simone Mead, Lambros Zannettos

Dancers: Tim Clark, Victoria Guy, Robyn Ann Holder, Julie Schmidt Andreasen

Creation: 7th February 2014, St Mary of the Angels, Notting Hill, London.

8. *Piano Quintet* (CD 1, Track 8)

Available at: <http://jonathanbell.eu/piano-and-string-quartet>

Instrumentalists: Filip Jeska, Maria Laskowska, Igor Michalski, Marta Lagoda, Simone Mead.

Dancers: Tim Clark, Victoria Guy, Robyn Ann Holder, Julie Schmidt Andreasen

Creation: 7th February 2014, St Mary of the Angels, Notting Hill, London.

9. *The Wanderer*

Score: <https://dl.dropboxusercontent.com/u/40502174/The%20wanderer.pdf>

Appendix 2: Audio examples (CD No 2)

Track 1: *Percussion quartet*, extract without the electronics

Corresponding to the score extract page 64 in the commentary.

Track 2: *Percussion quartet*, the same extract, with the electronics

Corresponding to the score extract page 64 in the commentary.

Track 3: *Percussion quartet*, a canon of ratio: 123 / 134^{1/3} / 145^{1/2}

Corresponding to the score extract page 65 in the commentary.

Track 4: *Percussion quartet*, audio cue of P1

Corresponding to the score extract page 67 in the commentary.

Track 5: *Etude de Synchronisation*

Corresponding to the score extract page 71 in the commentary.

Track 6: *Lasciato Hai Morte*, opening chords

Corresponding to the score extract page 79 in the commentary.

Track 7: *Lasciato Hai Morte*, 'Cha pianger qui rimasi'

Corresponding to the score extract page 79 in the commentary.

Track 8: *Lasciato Hai Morte*, Audio cue for Soprano 1

Corresponding to the score extract page 83 in the commentary.

Track 9: *Menbimeieno*, technical elaboration of the material

Corresponding to the score extract page 85 in the commentary.

Track 10: *Leaves, Dead Leaves*

Corresponding to the score extract page 88 in the commentary.

Track 11: *Percussion quartet*, a recording of the performance

Considering this piece as a study, instead of listening to the whole recording of the performance, it might be more relevant to choose a short fragment anywhere in the piece, and compare, with the help of the score, the live recording and the MIDI version.

Track 12: *The Wanderer*

Corresponding to bars 338-360 in the score, page 188 in the commentary.

Appendix 3: Subsequent work (DVD 3)

Track 1: *De Joye Interdict* (2014)

Available at: <http://jonathanbell.eu/de-joye-interdict>

For five female voices a cappella

Performers: *De Caelis* ensemble

Commissioned by Festival d'Île-de-France

Track 2: *Polyphonies* (2014)

Available at: <http://jonathanbell.eu/polyphonies-herve-robbe/>

Choreographer: Hervé Robbe (France)

Dance company: *Pantera* (Russia)

Music: Piano quintet (*Archos* quartet), Five Piece (*De Caelis*)

Track 3: *Archipel* (2015)

Available at: <http://jonathanbell.eu/archipel>

Realised at IRCAM during the first year composition *cursus*.

Performer: Éloïse Labaume

Track 4: *Open Music Etude* (2014)

Available at: <http://jonathanbell.eu/open-music-study>

Realised at IRCAM during my first year composition *cursus*.